GITAM
(DEEMED TO BE UNIVERSITY)
(Estd. u/s 3 of the UGC Act, 1956)
BENGALURU * HYDERABAD * VISAKHAPATNAM
NAAC Accredited with A+ Grade

REGULATIONS AND SYLLABUS of

Bachelor of Technology

in Mechanical Engineering

(w.e.f 2019-20 admitted batch)

www.gitam.edu

A University Committed to Excellence

B. Tech. in Mechanical Engineering

REGULATIONS

(w.e.f. 2019-20 admitted batches)

1. ADMISSION

1.1 Admission into B. Tech. in Mechanical Engineering program of GITAM (Deemed to be University) is governed by GITAM admission regulations.

2. ELIGIBILITY CRITERIA

2.1 A first class in 10+2 or equivalent examination approved by GITAM (Deemed to be University) with subjects Physics, Chemistry and Mathematics.

2.2 Admission into B.Tech. will be based on an All India Entrance Test (GITAM Admission Test - GAT) conducted by GITAM/Specified rank holders of JEE mains/EAMCET(AP & TS) and the rules of reservation of statutory bodies, wherever applicable, will be followed.

3. CHOICE BASED CREDIT SYSTEM

3.1 Choice Based Credit System (CBCS) was introduced with effect from the academic year of 2015-16 admitted batch and revised in 2019-2020 academic year, based on guidelines of the statutory bodies in order to promote: o Activity based learning

- o Student centered learning o Cafeteria approach
- o Students to choose courses of their choice
- o Learning at their own pace
- o Interdisciplinary learning

3.2 Course Objectives, Learning Outcomes and Course Outcomes are specified, focusing on what a student should be able to do at the end of the course and program.

4. STRUCTURE OF THE PROGRAM

4.1 The Program consists of humanities and social sciences, basic sciences, basic engineering, program core, program electives, open electives, interdisciplinary electives, industry internship, laboratory, mandatory courses and project work.

Core Courses	Branch specific	Compulsory
Elective courses	Program Electives	Supportive to the discipline courses with expanded scope in a chosen track of specialization or cross track courses
	Interdisciplinary Electives	Interdisciplinary exposure & nurture the student interests in other department courses.
	Open Electives	Common to all disciplines that helps general interest of a student

4.2 Each course is assigned a certain number of credits depending upon the number of contact hours (lectures/tutorials/practical) per week.

4.3 In general, credits are assigned to the courses based on the following contact hours per week per semester.

- One credit for each Lecture/Tutorial hour per week.
- One credit for two hours of Practicals per week.

4.4 The curriculum of the eight semesters B.Tech. program is designed to have a total of 160 credits for the award of B.Tech. degree.

5. MEDIUM OF INSTRUCTION

The medium of instruction (including examinations and project reports) shall be English.

6. REGISTRATION

Every student has to register himself/herself for the courses in each semester individually at the time as specified in academic calendar.

7. ATTENDANCE REQUIREMENTS

7.1 A student whose attendance is less than 75% in all the courses put together in any semester will not be permitted to attend the end - semester examination and he/she will not be allowed to register for subsequent semester of study. He/she has to repeat the semester along with his/her juniors.

7.2 However, the Vice-Chancellor on the recommendation of the Principal / Director of the Institute/School may condone the shortage of attendance of the students whose attendance is between 65% and 74% on genuine medical grounds and on payment of prescribed fee.

8. EVALUATION

8.1 The assessment of the candidates's performance in a theory course shall be based on two components: Continuous Evaluation (40 marks) and Semester-end Examination (60 marks).

8.2 A candidate has to secure an aggregate of 40% in the course in the two components put together to be declared to have passed the course, subject to the condition that the candidate must have secured a minimum of 24 marks out of 60 marks (i.e. 40%) in the theory component at the semester-end examination.

8.3 Practical courses are assessed under Continuous Evaluation for a maximum of 100 marks, and a candidate has to obtain a minimum of 40% to secure pass grade.

8.4 The courses having theory and practical combined, 70% of the weightage will be given for theory component and 30% weightage for practical component. The candidate has to acquire 40% in the semester end theory examination. However, candidate must have secured overall 40% (Theory + Practical) to secure pass grade.

8.5 Project Work/ Industrial internship courses are assessed under continuous evaluation for a maximum of 100 marks, and a candidate has to obtain a minimum of 40% to secure pass grade.

8.6 Mandatory Courses are assessed for PASS or FAIL only. No grade will be assigned to these courses. If a candidate secures more than 40 out of 100 marks, he / she will be declared PASS, else FAIL

8.7 Mandatory courses NSS/NCC/NSO/YOGA are assessed for satisfactory or not satisfactory only. No grade will be assigned. A candidate has to undergo two hours training per week in any one of the above in both 1st and 2nd semesters.

Details of Assessment Procedure are furnished in Table 1.

Table 1: Assessment Procedure

S.No	Component of Assessment	Types of Assessment	Marks Allotted	Scheme of Evaluation
1	Theory courses	Continuous Evaluation	40	(i) Thirty (30) marks for mid semester examinations. Three mid examinations shall be conducted for 15 marks each; performance in best two shall be taken into consideration. ii) Ten (10) marks for Quizzes, Assignments and Presentations.
		Semester End Examinations	60	Sixty (60) marks for semester-end Examinations.
		Total	100	
2	Practical courses	Continuous Evaluation	100	(i) Fifty (50) Marks for regularity and performance, records and oral presentations in the laboratory. Weightage for each component shall be announced at the beginning of the semester. ii) Ten (10) marks for case studies. iii) Forty (40) marks for two tests of 20 marks each (one at the mid term and the other towards the end of the semester) conducted by the concerned lab teacher.

3	Theory and Practical combined courses	(a) Theory component: continuous evaluation and semester end examination. (b)Practical component: continuous evaluation Total	100 100 200	70% of the weightage will be given for theory component. Evaluation for theory component will be same as S. No 1 as above. 30% weightage for practical components. Evaluation for practical component will be same as S. No 2 as above
4	Project work (VII & VIII Semesters)	Continuous Evaluation	100	i) Forty (40) marks for periodic evaluation on originality, innovation, sincerity and progress of the work assessed by the project supervisor. ii) Thirty (30) marks for mid-term evaluation for defending the project before a panel of examiners. iii) Thirty (30) marks for final Report presentation and Viva-voce by a panel of examiners.
5	Industrial Internship (VII Semester)	Continuous Evaluation	100	i) Thirty (30) marks for Project performance, assessed by the Supervisor of the host Industry/ Organization. Submission of Project Completion Certificate from host organization is mandatory. ii) Forty (40) marks for Report and Seminar presentation on the training, assessed by the Teacher/Coordinator.

				iii) Thirty (30) marks for presentation on the training, before a panel of examiners.
6	Mandatory Courses	Continuous Evaluation	100	(i) Sixty (60) marks for mid semester Examinations. Three mid examinations shall be conductedfor30 marks each; performance in best two shall be taken into consideration (ii) Forty (40) marks for Quizzes, Assignments and Presentations

9. RETOTALING & REVALUATION

9.1 Retotalling of the theory answer script of the semester-end examination is permitted on request by the candidate by paying the prescribed fee within one week after the announcement of the results.

9.2 Revaluation of the theory answer scripts of the semester-end examination is permitted on request by the student by paying the prescribed fee within one week after the announcement of the result.

9.3 A candidate who has secured ‘F’ grade in a theory course shall have to reappear at the subsequent examination held in that course. A candidate who has secured ‘F’ grade can improve continuous evaluation marks upto a maximum of 50% by attending special instruction classes held during summer.

9.4 A candidate who has secured ‘F’ grade in a practical course shall have to attend Special Instruction classes held during summer.

9.5 A candidate who has secured ‘F’ grade in a combined (theory and practical) course shall have to reappear for theory component at the subsequent examination held in that course. A candidate who has secured ‘F’ grade can improve continuous evaluation marks upto a maximum of 50% by attending special instruction classes held during summer.

9.6 A candidate who has secured ‘F’ Grade in project work / Industrial Training shall be permitted to submit the report only after satisfactory completion of the work and vivavoce examination.

10. PROVISION FOR ANSWER BOOK VERIFICATION AND CHALLENGE EVALUATION

10.1 If a candidate is not satisfied with his/her grade after revaluation, the candidate can apply for, answer book verification on payment of prescribed fee for each course within one week after announcement of revaluation results.

10.2 After verification, if a candidate is not satisfied with revaluation marks/grade awarded, he/she can apply for challenge valuation within one week after announcement of answer book verification result/ two weeks after the announcement of revaluation results, which will be valued by the two examiners i.e., one Internal and one External examiner in the presence of the candidate on payment of prescribed fee. The challenge valuation fee will be returned, if the candidate is succeeded in the appeal with a change for a better grade.

11. SUPPLEMENTARYEXAMINATIONS AND SPECIAL EXAMINATIONS.

11.1 The odd semester supplementary examinations will be conducted on daily basis after conducting regular even semester examinations during April/May.

11.2 The even semester supplementary examinations will be conducted on daily basis after conducting regular odd semester examinations during October/November.

11.3 A candidate who has completed his/her period of study and still has “F” grade in final semester courses is eligible to appear for Special Examination normally held during summer vacation.

12. PROMOTION TO THE NEXT YEAR OF STUDY

12.1 A student shall be promoted to the next academic year only if he/she completes the academic requirements of 60% of the credits till the previous academic year.

12.2 Whenever there is a change in syllabus or curriculum he/she has to continue the course with new regulations after detention as per the equivalency established by the BoS to continue his/her further studies.

13. MASSIVE OPEN ONLINE COURSES

Greater flexibility to choose variety of courses is provided through Massive Open Online Courses (MOOCs) during the period of study. Students without any backlog courses upto fourth semester are permitted to register for MOOCs from fifth semester onwards up to a maximum of 15 credits from program elective/ interdisciplinary elective/ open elective courses. However the Departmental Committee (DC) of the respective campuses has to approve the courses under MOOCs. The grade equivalency will be decided by the respective Board of Studies (BoS).

14. BETTERMENT OF GRADES

14.1 A student who has secured only a pass or second class and desires to improve his/her class can appear for betterment examinations only in eight theory courses of any semester of his/her choice, conducted in summer vacation along with the Special Examinations.

14.2 Betterment of Grades is permitted ‘only once’, immediately after completion of the program of study.

15. HONORS

A student who secured 8 CGPA or above up to IV semester is eligible to register for B. Tech (Honors) degree. The student has to complete additional 20 credits (six theory courses + seminar) as approved by the respective Departmental Committee (DC) to secure B. Tech (Honors). The courses will be approved by DC of respective campuses.

16 GRADING SYSTEM

16.1 Based on the student performance during a given semester, a final letter grade will be awarded at the end of the semester in each course. The letter grades and the corresponding grade points are as given in Table 2.

Table 2: Grades and Grade Points

S.No.	Grade	Grade Points	Absolute Marks
1	O (Outstanding)	10	90 and above
2	A+ (Excellent)	9	80 to 89
3	A (Very Good)	8	70 to 79
4	B+ (Good)	7	60 to 69
5	B (Above Average)	6	50 to 59
6	C (Average)	5	45 to 49
7	P (Pass)	4	40 to 44
8	F (Fail)	0	Less than 40
9	Ab. (Absent)	0	-

16.2 A student who earns a minimum of 4 grade points (P grade) in a course is declared to have successfully completed the course, subject to securing an average GPA of 5.0 (average of all GPAs in all semesters) at the end of the program to declare pass in the program.

17. GRADE POINT AVERAGE

17.1 A Grade Point Average (GPA) for the semester will be calculated according to the formula:

$$GPA = \frac{\Sigma[C^* G]}{\Sigma C}$$

where, C = number of credits for the course.

G =grade points obtained by the student in the course.

17.2 To arrive at Cumulative Grade Point Average (CGPA), a similar formula is used considering the student’s performance in all the courses taken, in all the semesters up to that particular semester.

17.3 CGPA required for classification of class after the successful completion of the program is shown in Table 3.

Table 3: CGPA required for award of Class

Class	CGPA Required
First Class with Distinction	>8.0*
First Class	> 6.5
Second Class	> 5.5
Pass Class	> 5.0

* In addition to the required CGPA of 8.0 or more, the student must have necessarily passed all the courses of every semester in first attempt.

18. ELIGIBILITY FOR AWARD OF THE B. Tech. DEGREE

18.1 Duration of the program: A student is ordinarily expected to complete the B.Tech. program in eight semesters of four years. However, a student may complete the program in not more than eight years including study period.

18.2 However, the above regulation may be relaxed by the Vice-Chancellor in individual cases for cogent and sufficient reasons.

18.3 A student shall be eligible for award of the B.Tech. Degree if he / she fulfills all the following conditions:

i) Registered and successfully completed all the courses and projects.

ii) Successfully acquired the minimum required credits as specified in the curriculum in the branch of his/her study within the stipulated time.

iii) Has no dues to the Institute, hostels, Libraries, NCC/NSS etc, and no disciplinary action is pending against him/ her.

19. DISCRETIONARY POWER

Notwithstanding anything contained in the above sections, the Vice-Chancellor may review all exceptional cases, and give his decision, which will be final and binding.

Program Educational Objectives (PEO)

The program educational objectives of the Department of Mechanical Engineering Program are to produce engineers whose attributes several years after graduation are marked by their ability to

PEO 1	Thrive as professional engineers in core mechanical engineering and other allied fields.
PEO 2	learn new knowledge and skills through professional development prospects or pursue advanced education
PEO 3	Pursue lifelong learning opportunities to enhance and develop their technical and professional skills
PEO 4	Follow to the highest level of professional code of ethics

Program Outcomes (PO) & Program specific outcomes

Program outcomes

PO 1	Apply basic knowledge of mathematics and science to design and analyze mechanical engineering systems.
PO 2	Apply recent advances in mechanical engineering to solve industrial problems.
PO 3	Establish the procedures for experimentation using core mechanical engineering knowledge for data collection, simulation and analysis.
PO 4	Implement computer solution methods for design and synthesis of mechanical engineering systems.
PO 5	Assess the influence of global changes on organization for effective decision making.
PO 6	Acquire knowledge of fast changing technologies for solving engineering problems.
PO 7	Exhibit leadership capabilities
PO 8	Perform multi-disciplinary goals as a team member.
PO 9	Communicate effectively in peer and diverse groups.
PO 10	Acquire skills to become an entrepreneur.
PO 11	Engage in life-long learning environment.
PO 12	Imbibe professional and ethical responsibility towards the society.

Programme Specific Outcomes (PSO)

After the culmination of the course students will be able to acquire:

PSO1	Competency to diagnose, interpret and unravel engineering problems in the fields of mechanical design, thermal engineering, and manufacturing technology along with allied multi-disciplinary streams.
PSO2	Ability to develop state-of-the-art technologies in futuristic areas of engineering through ground-breaking research.
PSO3	Aptitude for nation-building by accomplishing technological and managerial skills and becoming Technocrats and Entrepreneurs.

Department of Mechanical Engineering

(Effective from the academic year 2019-20 admitted batch)

Semester I

S. No	Course Code	Course Name	Category	L	T	P	C	Remarks
1.	19EMA101	Engineering Mathematics I (Calculus and Algebra)	BS	3	0	0	3	Common to all except BT
2.	GEL131	Communicative English	HS	2	0	2	3	Common to all
3.	19ECY133/ 19EPH133	Chemistry of materials/ Applied Physics	BS	3	0	3	4.5	Common with CIVIL
4.	19EID131/ 19EEE131	Problem Solving and Programming / Basic Electrical and Electronics Engineering	ES	3	1	3	5.5	Common to all
5.	19EME121/ 19EME131	Basic Workshop / Engineering Graphics	ES	0/1	0	3	1.5/2.5	Common to all
6.	19EMC181A/ 19EMC181B/ 19EMC181C/ 19EMC181D	National Service Scheme/National Service Scheme/ National Sports Organization/ Yoga	MC	0	0	2	0	Common to all
Total							**17.5/18.5**	

Semester II

S. No	Course Code	Course Name	Category	L	T	P	A	C	Remarks
1.	19EMA102	Engineering Mathematics II (ODE,PDE and Multivariable Calculus)	BS	3	0	0		3	Common with ECE, EEE & CIVIL
2.	19EID132/19EID134/19EID234/19EID232	Design Thinking/ AI tools/ Life Sciences for Engineers /internet of things	ES	2	0	2		3	Common to all
3.	19EPH133/ 19ECY133	Applied Physics/ Chemistry of materials	BS	3	0	3		4.5	Common with CIVIL
4.	19EME131/ 19EME121	Engineering Graphics/ Basic Workshop	ES	1/ 0	0	3		2.5/ 1.5	Common to all
5.	19EEE131/ 19EID131	Basic Electrical and Electronics Engineering/ Problem Solving and Programming	ES	3	1	3		5.5	Common to all
6.	19EME122	Mechanical Engineering Workshop	PC	0	0	3		1.5	Branch Specific
7.	19EMC181A/ 19EMC181B/ 19EMC181C/ 19EMC181D	National Service Scheme/National Service Scheme/ National Sports Organization/ Yoga	MC	0	0	2		0	Common to all
8	19EHS122	Comprehensive Skill Development I	HS	0	0	0	6	1	COMMON TO ALL
9.	VDC111	Venture Discovery	PW	0	0	4		2	Common to all
Total								**23/22**	

Semester III

S.No	Course Code	Course Name	Category	L	T	P	A	C	Remarks
1.	19EMA201	Engineering Mathematics III(PDE, Complex Variables and Transform Techniques)	BS	3	0	0		3	Common with CIVIL
2.	19EID132/19EID134/ 19EID234/19EID232	Design Thinking/ AI tools/ Life Sciences for Engineers /internet of things	ES	2	0	2		3	Common to all
4.	19EME201	Engineering Mechanics	PC	2	1	0		3	Common with CIVIL
5.	19EME203	Thermodynamics	PC	2	1	0		3	Branch Specific
6.	19EME205	Material Science and Engineering	PC	3	0	0		3	Branch Specific
7	19EME231	Computer Aided Machine Drawing	PC	1	0	3		2.5	Branch Specific
8	19EMC281/ 19EMC282	Constitution of India/Environmental Sciences	MC	3	0	0		0	Mandatory Course
9	19EHS221	Comprehensive Skill Development II	HS				6	1	Common to all
		Total				**18.5**			

Semester IV

S.No	Course Code	Course Name	Category	L	T	P	A	C	Remarks
1.	19EMA202	Engineering Mathematics IV(Numerical Methods, Probability and Statistics)	BS	3	0	0		3	Common with EEE &CIVIL
2.	19EID132/19EID134 / 19EID234/19EID232	Design Thinking/ AI tools/ Life Sciences for Engineers /internet of things	BS/ES	2	0	2		3	Common to all
3.	19EME202	Strength of Materials	PC	3	1	0		4	Branch Specific
4.	19EME232	Applied Thermodynamics	PC	2	1	3		4.5	Branch Specific
5.	19EME234	Fluid Mechanics	PC	3	1	3		5.5	Branch Specific
6	19EME204	Manufacturing Processes	PC	3	0	0		3	Branch Specific
7	19EMC282 /19EMC281	Environmental Sciences/Constitution of India	MC	3	0	0		0	Mandatory Course
8	19EME292	Comprehensive Skill Development III	PW	0	0	0	6	1	Branch Specific
		Total						**24**	

Semester V

S.No	Course Code	Course Name	Category	L	T	P	A	C	Remarks
1.	19EME331	Manufacturing Technology	PC	3	0	3		4.5	Branch Specific
2.	19EME301	Mechanics of Machinery	PC	3	1	0		4	Branch Specific
3.	19EID132/19EID134 /19EID234/19EID232	Design Thinking/ AI tools/ Life Sciences for Engineers /internet of things	ES/BS	2	0	2		3	Common to all
4.	19EME3XX	Program Elective I	PE	3	0	0		3	Program Elective
5.	19EID132/19EID134	Design Thinking/ AI tools/Life Sciences for Engineers/internet of things/	ES/BS	3	0	0		3	Open Elective

	/19EID234/19EID232								
6.	19EXX3XX	Inter disciplinary Elective I	ID	2	0	2		3	Inter disciplinary Elective
7.	19EME321	Material testing and characterization Lab	PC	0	0	3		1.5	Branch Specific
8.	19EME391	Comprehensive Skill Development IV	PW	0	0	0	6	1	Branch Specific
Total								**23**	

Semester VI

S. No	Course Code	Course Name	Category	L	T	P	A	C	Remarks
1.	19EME332	Heat and Mass Transfer	PC	3	1	3		5.5	Branch Specific
2.	19EME302	Design of Machine Elements	PC	3	1	0		4	Branch Specific
3.	19EME3XX	Program Elective II	PE	3	0	0		3	Program Elective
4.	19EME3XX	Program Elective III	PE	3	0	0		3	Program Elective
5.	19EOE3XX	Open Elective II	OE	3	0	0		3	Open Elective
6.	19EHS302	Engineering Economics and Management	HS	3	0	0		3	Humanities
7	19EME322	Design Analysis and Simulation lab	PC	0	0	3		1.5	Branch Specific
8.	19EMC382	Engineering Ethics	MC	3	0	0		0	Mandatory Course
9	19EME392	Comprehensive Skill Development V	PW	0	0	0	6	1	Branch Specific
Total								**24**	

Semester VII

S. No	Course Code	Course Name	Category	L	T	P	A	C	Remarks
1.	19EME431	Measurements and Metrology	PC	3	0	2		4	
2.	19EXX4XX	Inter Disciplinary Elective II	ID	2	1	0		3	
3.	19EME4XX	Program Elective IV	PE	3	0	0		3	
4.	19EME4XX	Program Elective V	PE	3	0	0		3	
5.	19EHS405	Operations Research	HS	3	0	0		3	
6	19EME491	Project Phase I	PW	0	0	6		1	
7	19EME493	Internship *	PW					1	
8	19EME495	Comprehensive Skill Development VI	PW	0	0	0	6	1	
Total								**19**	

***** Industrial Training / Research Projects in National Laboratories / Academic Institutions

Semester VIII

S. No	Course Code	Course Name	Category	L	T	P	C	Remark
1.	19EXX47X	Interdisciplinary Elective III	ID	2	1	0	3	
2.	19EME4XX	Program Elective VI	PE	3	0	0	3	
3.	19EME492	Project Phase II	PW	-	-	12	6	
4	GSS115	Gandhi for the 21st century	PW				1	
5.								
Total							**13**	

Total Credits 162

Total Number of Credits

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	**17.5/18.5**	**23/22**	**18.5**	**24**	**23**	**24**	**19**	**13**	**162**

Category and Credits

Category	**Category Code**	**Courses**	**Credits GITAM**	**Credits proposed by AICTE**
Humanities & Social Sciences	HS	Communicative English HS1 and HS2 (elective) Comprehensive Skill Development I to II	**11**	**12**
Basic Sciences	BS	Engineering Physics Engineering Chemistry Mathematics (4 Courses) Life Sciences for Engineers	**24**	**25**
Engineering Sciences	ES	Problem Solving and Programming Basic Electrical and Electronics Engineering AI Tools Engineering Graphics Workshop Design Thinking Internet of Things	**24**	**24**
Open Electives	OE	OE1, OE2	**6**	**18**
Interdisciplinary Electives	ID	ID1, ID2, ID3	**9**	
Program Electives	PE	PE1, PE2, PE3, PE4, PE5, PE6	**18**	**18**
Program Core	PC	PC1 – PC16	**55**	**48**
Project	PW	Internship Project Phase I Project Phase II Comprehensive Skill Development III to VI Venture Discovery Gandhi for 21st Century	**15**	**15**

Mandatory	MC	Environmental Science, Constitution of India, Engineering Ethics	-	-
Total			**162**	**160**

1st and 2nd Semester Mandatory Course

S. No	Course Code	Course Title	Category	L	T	P	C	Remarks
1.	19EMC181A	National Service Scheme	MC	0	0	2	0	Mandatory Course
2.	19EMC181B	National Cadet Corps	MC	0	0	2	0	Mandatory Course
3.	19EMC181C	National Sports Organization	MC	0	0	2	0	Mandatory Course
4.	19EMC181D	Yoga	MC	0	0	2	0	Mandatory Course

Engineering Mathematics II (Elective)

S.No	Course Code	Course Name	Category	L	T	P	C	Remarks
1.	19EMA102	Engineering Mathematics II	BS	3	0	0	3	
2.	19EMA104	Engineering Mathematics II	BS	3	0	0	3	
3.	19EMA106	Mathematics for Biotechnology II	BS	3	0	0	3	

Engineering Mathematics III (Elective)

S.No	Course Code	Course Name	Category	L	T	P	C	Remarks
1.	19EMA201	Engineering Mathematics III	BS	3	0	0	3	
2.	19EMA203	Engineering Mathematics III	BS	3	0	0	3	
3.	19EMA205	Engineering Mathematics III	BS	3	0	0	3	
4.	19EMA207	Mathematics for Biotechnology III	BS	3	0	0	3	

Engineering Mathematics IV (Elective)

S.No	Course Code	Course Name	Category	L	T	P	C	Remarks
1.	19EMA202	Engineering Mathematics IV	BS	3	0	0	3	
2.	19EMA204	Engineering Mathematics IV	BS	3	0	0	3	
3.	19EMA206	Engineering Mathematics IV	BS	3	0	0	3	
4.	19EMA208	Mathematics for Biotechnology IV	BS	3	0	0	3	

Engineering Physics (Elective)

S.No	Course Code	Course Name	Category	L	T	P	C	Remarks
1.	19EPH131	Engineering Physics	BS	3	0	3	4.5	
2.	19EPH 133	Applied Physics	BS	3	0	3	4.5	
3.	19EPH 135	Physics for Biotechnology	BS	3	0	3	4.5	

Engineering Chemistry (Elective)

S.No	Course Code	Course Name	Category	L	T	P	C	Remarks
1.	19ECY131	Engineering Chemistry	BS	3	0	3	4.5	
2.	19ECY133	Chemistry of materials	BS	3	0	3	4.5	
3.	19ECY135	Chemistry for Biotechnology	BS	3	0	3	4.5	

OPEN ELECTIVES

Open Elective I

S. No.	Course Code	Course Name	Category	L	T	P	C	Remarks
1	19EOE301	Japanese for Beginners	OE	3	0	0	3	All Branches
2	19EOE303	French for Beginners	OE	3	0	0	3	All Branches
3	19EOE305	Biotechnology and Society	OE	3	0	0	3	All Branches
4	19EOE307	Contemporary Relevance of Indian Epics	OE	3	0	0	3	All Branches
5	19EOE309	Indian National Movement	OE	3	0	0	3	All Branches
6	19EOE313	Personality Development	OE	3	0	0	3	All Branches
7	19LOE301	Fundamentals of Cyber Law	OE	3	0	0	3	All Branches
8	19MOE303	Introduction to International Business	OE	3	0	0	3	All Branches
9	19EOE319	Introduction to Music	OE	3	0	0	3	All Branches
10	19EOE321	Environment and Ecology	OE	3	0	0	3	All Branches
11	19EOE323	Indian History	OE	3	0	0	3	All Branches
12	19EOE327	Professional Communication	OE	3	0	0	3	All Branches
13	GEL244	English for Higher Education	OE	3	0	0	3	All Branches
14	19EOE224	Virtual Reality	OE	1	0	4	3	All Branches

Open Elective II

S. No.	Course Code	Course Name	Category	L	T	P	C	Remarks
1	19EOE302	German for Beginners	OE	3	0	0	3	All Branches
2	19EOE304	Chinese for Beginners	OE	3	0	0	3	All Branches
3	19EOE306	Analytical Essay Writing	OE	3	0	0	3	All Branches
4	19EOE308	Indian Economy	OE	3	0	0	3	All Branches
5	19EOE310	Public Administration	OE	3	0	0	3	All Branches
6	19EOE312	Environmental Management	OE	3	0	0	3	All Branches
7	19EOE315	Telecommunication for Society	OE	3	0	0	3	All Branches
9	19EOE327	Professional Communication	OE	3	0	0	3	All Branches
10	19EOE317	Electrical Safety	OE	3	0	0	3	All Branches
11	19MOE301	Basics of Finance	OE	3	0	0	3	All Branches
12	19LOE301	Fundamentals of Cyber Law	OE	3	0	0	3	All Branches
13	19EOE313	Personality Development	OE	3	0	0	3	All Branches

14	19MOE305	Basics of Marketing	OE	3	0	0	3	All Branches
15	GEL345	Workplace Communication-Basic	OE	3	0	0	3	All Branches
16	GEL347	Workplace Communication-Advanced	OE	3	0	0	3	All Branches

Coursera open electives

S.No.	Course Code	Course Title
1	19COE301	Become a journalist: Report the News!/ Introduction to Journalism
2	19COE302	Intellectual Property Law
3	19COE303	Interviewing and Resume Writing in English
4	19COE304	Human Resource Management: HR for People Managers
5	19COE305	Inspirational Leadership: Leading with Sense
6	19COE306	Facebook Social Media Marketing
7	19COE307	Trading Strategies in Emerging Markets
8	19COE308	Economics of Money and Banking
9	19COE309	Good with Words: Writing and Editing/ The Elements of Writing Skills

Program Elective I

S. No	Stream	Course Code	Course Name	Category	L	T	P	C	Remarks
1	Thermal/ Renewable Energy	19EME341	Turbo machinery	PE	3	0	0	3	
		19EME343	Power Plant Engineering	PE	3	0	0	3	
2	Automobile Engineering	19EME345	Automobile Engineering	PE	3	0	0	3	
3	Automation and Manufacturing	19EME347	Advances in Welding Technology	PE	3	0	0	3	
		19EME361	Additive manufacturing	PE	3	0	0	3	
4	Materials	19EME351	Mechanical Behaviour of Materials	PE	3	0	0	3	
5	Design/ Product Design	19EME353	Advanced Strength of Materials	PE	3	0	0	3	
		19EME355	Product Design	PE	3	0	0	3	
6	Industrial Engineering	19EME363	Industrial Engineering and Management	PE	3	0	0	3	
		19EME359	Materials Management	PE	3	0	0	3	

Program Elective II

S. No	Stream	Course Code	Course Name	Category	L	T	P	C	Remarks
1	Thermal/ Renewable Energy	19EME340	Heating Ventilation and Air Conditioning	PE	3	0	0	3	
		19EME342	**Renewable Energy Technology**	PE	3	0	0	3	
2	Automobile Engineering	19EME344	**Electric and Hybrid Vehicles**	PE	3	0	0	3	
3	Automation and Manufacturing	19EME346	**CAD/CAM**	PE	3	0	0	3	
		19EME348	**Robotics and Automation**	PE	3	0	0	3	
4	Materials	19EME350	Material Characterization	PE	3	0	0	3	
5	Design/ Product Design	19EME352	Finite Element Analysis	PE	3	0	0	3	
		19EME354	Design of Power Transmission Systems	PE	3	0	0	3	
6	Industrial Engineering	19EME356	**Enterprise Resource Planning**	PE	3	0	0	3	
		19EME358	**Statistical Quality Control**	PE	3	0	0	3	

Program Elective III

S. No	Stream	Course Code	Course Name	Category	L	T	P	C	Remarks
1	Thermal/ Renewable Energy	19EME360	Fuel Cells and Hydrogen Storage	PE	3	0	0	3	
		19EME362	**Solar Energy**	PE	3	0	0	3	
2	Automobile Engineering	19EME364	**Automotive transmission systems**	PE	3	0	0	3	
3	Automation and Manufacturing	19EME366	**CNC and Adaptive Control**	PE	3	0	0	3	
		19EME368	Manufacturing of Automobile Components	PE	3	0	0	3	
4	Materials	19EME370	**Non-Destructive Testing (NDT)**	PE	3	0	0	3	
5	Design/ Product Design	19EME372	Tribology	PE	3	0	0	3	
		19EME374	Design for Manufacturing and Assembly	PE	3	0	0	3	
6	Industrial Engineering	19EME376	**Inventory control**	PE	3	0	0	3	
		19EME378	**Plant Layout and Facilities Planning**	PE	3	0	0	3	

Program Elective IV

S.No	Stream	Course Code	Course Name	Category	L	T	P	C	Remarks
1	Thermal/ Renewable Energy	19EME441	Computational Fluid Dynamics	PE	3	0	0	3	
		19EME443	Wind Energy	PE	3	0	0	3	
2	Automation and Manufacturing	19EME447	Computer Integrated Manufacturing	PE	3	0	0	3	
3	Materials	19EME451	Mechanics of Composite Materials	PE	3	0	0	3	
4	Design/ Product Design	19EME455	Advanced mechanics of solids	PE	3	0	0	3	
5	Industrial Engineering	19EME457	Production Planning and Control	PE	3	0	0	3	
		19EME459	Logistics and Supply Chain Management	PE	3	0	0	3	

Program Elective V

S. No	Stream	Course Code	Course Name	Category	L	T	P	C
1	Thermal/ Renewable Energy	19EME461	Energy Conservation and Management	PE	3	0	0	3
		19EME463	Bioenergy	PE	3	0	0	3
2	Automation and Manufacturing	19EME467	Automation in Manufacturing	PE	3	0	0	3
		19EME469	Mobile Robotics	PE	3	0	0	3
3	Design/ Product Design	19EME473	Mechanical Vibrations	PE	3	0	0	3
		19EME475	Product Life Cycle Management (PLM)	PE	3	0	0	3
4	Industrial Engineering	19EME479	Management Information Systems	PE	3	0	0	3

Program Elective VI

S. No	Stream	Course Code	Course Name	Category	L	T	P	C
1	Thermal/ Renewable Energy	19EME440	Energy Storage and Conversion Systems	PE	3	0	0	3
2	Automation and Manufacturing	19EME446	Modern Manufacturing Methods	PE	3	0	0	3
		19EME448	Intelligent Manufacturing systems	PE	3	0	0	3
3	Industrial Engineering	19EME456	Optimization Techniques	PE	3	0	0	3
		19EME458	Project Planning and Management	PE	3	0	0	3

Interdisciplinary Elective I

S. No.	Stream	Course Code	Course Title	Category	L	T	P	C	Remarks Offered by
1	Professional Courses	19EEC371	Fundamentals of Communication Systems	ID	3	0	0	3	ECE
2		19EEC373	Fundamentals of Global Positioning System	ID	3	0	0	3	ECE
3		19EEI477	Industrial Automation	ID	3	0	0	3	EIE
5	Computer Oriented Courses	19ECS371	Introduction to Database Management Systems	ID	3	0	0	3	CSE
6		19ECS373	Object Oriented Programming with C++	ID	3	0	0	3	CSE
7		19ECS375	Introduction to Programming with JAVA	ID	3	0	0	3	CSE
8	Management Courses	19EHS375	Business Ethics and Corporate Governance	ID	3	0	0	3	MANAGEMENT

Interdisciplinary Elective II

S. No.	Stream	Course Code	Course Title	Category	L	T	P	C	Remarks Offered by
1	Professional Courses	19EEI472	Micro Electromechanical Systems	ID	2	1	0	3	EIE
2		19EEI371	Sensors and Signal Conditioning	ID	2	1	0	3	EIE
3	Computer Oriented Courses	19ECS473	Introduction to Software Engineering	ID	2	1	0	3	CSE
4									
5		19ECS475	Introduction to Web Technologies	ID	2	1	0	3	CSE
6	Management Courses	19EHS475	Entrepreneurship Development	ID	3	0	0	3	MANAGEMENT

Interdisciplinary Elective III

S. No.	**Stream**	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**	**Remarks** Offered by
1	Professional Courses	19EEC475	Microcontrollers and Interfacing	ID	2	1	0	3	ECE
2									
3		19EEI473	Virtual Instrumentation	ID	2	1	0	3	EIE
4		19EEI475	Medical Instrumentation	ID	2	1	0	3	EIE
5	Computer Oriented Courses	19ECS344	Introduction to Machine Learning	ID	2	1	0	3	CSE
6		19ECS472	Introduction Augmented Reality and Virtual Reality	ID	2	1	0	3	CSE
7		19ECS474	Introduction to Cloud Computing	ID	2	1	0	3	CSE
8									
9									
10	Management Courses	19EHS403	Organizational Behavior	ID	3	0	0	3	Management

19EMA101: ENGINEERING MATHEMATICS I
CALCULUS & ALGEBRA
(Common to all branches of Engineering except Biotechnology)

L	T	P	C
3	0	0	3

This course designed for the students of all B.Tech programmes except for Bio-Technology as a prerequisite for the core programmes.The course imparts knowledge on Matrix Algebra and basic concepts of Calculus as these concepts lay a strong foundation in applications in Engineering.

Course Objectives:
- To familiarize the students with the theory of matrices and quadratic forms.
- To explain the series expansions using mean value theorems.
- To teach basic concepts of partial derivatives.
- To explain the evaluation of double integrals and its applications.
- To demonstrate the evaluation and applications of triple integrals.

Bridge Course: Limits, Continuity, Types of Matrices

UNIT I **10 L**
Matrices: Rank of a matrix by echelon form, solving system of homogeneous and non-homogeneous linear equations. Eigen values, Eigen vectors and their properties, Cayley-Hamilton theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton theorem, diagonalisation of a matrix, quadratic forms and nature of the quadratic forms, reduction of quadratic form to canonical forms by orthogonal transformation.

Learning Outcomes:
At the end of this unit, the student will be able to
- solve systems of homogeneous and non-homogeneous linear equations (L3)
- calculate the eigenvalues and eigenvectors of a matrix (L3)
- identify special properties of a matrix (L3)

UNIT II **6 L**
Mean Value Theorems: Rolle’s Theorem, Lagrange’s mean value theorem, Cauchy’s mean value theorem, Taylor’s and Maclaurin’s theorems with remainders (without proof).

Learning Outcomes:
At the end of this unit, the student will be able to
- demonstrate the given function as series of Taylor’s and Maclaurin’s with remainders (L3)
- illustrate series expansions of functions using mean value theorems (L3)

UNIT III **8 L**
Multivariable Calculus: Partial derivatives, total derivatives, chain rule, change of variables, Jacobian, maxima and minima of functions of two variables, method of Lagrange multipliers.

Learning Outcomes:

At the end of this unit, the student will be able to

- interpret partial derivatives as a function of several variables (L3)
- evaluate maxima and minima of functions (L3)
- apply Jacobian concept to deal with the problems in change of variables (L3)

UNIT IV **8 L**

Multiple Integrals-I: Double integrals, change of order of integration, double integration in polar coordinates, areas enclosed by plane curves.

Learning Outcomes:

At the end of this unit, the student will be able to

- apply double integrals of functions of several variables in two dimensions in cartesian and polar coordinates (L4)
- calculate the areas bounded by a region using double integration techniques (L3)

UNIT V **8 L**

Multiple Integrals-II: Evaluation of triple integrals, change of variables between Cartesian, cylindrical and spherical polar co-ordinates, volume as triple integral.

Learning Outcomes:

At the end of this unit, the student will be able to

- apply multiple integrals in Cartesian, cylindrical and spherical geometries (L4)
- evaluate volumes using triple integrals (L4)

Course Outcomes:

At the end of the course, the student will be able to

- utilize the techniques of matrix algebra that is needed by engineers for practical applications (L3)
- apply mean value theorems to engineering problems (L3)
- utilize functions of several variables in optimization (L3)
- employ the tools of calculus for calculating the areas (L3)
- calculate volumes using multiple integrals (L3)

Text Book(s):

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2018.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.

References:

1. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002.
2. George B. Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 13/e, Pearson Publishers, 2013.
3. Glyn James, Advanced Modern Engineering Mathematics, 4/e, Pearson publishers, 2011.

GEL131: COMMUNICATIVE ENGLISH

B TECH, BBA & BSC SEMESTER I (2019-20)

L	T	P	C
2	**0**	**2**	**3**

The course is a unified approach to enhance language skills of learners with an aim to hone their social skills and to increase their employability. The course is designed to acquaint the learners with the necessary LSRW (Listening/ Speaking / Reading/ Writing) skills needed either for recruitment or further studies abroad for which they attempt international exams like TOEFL, IELTS and GRE. It enables the learners improve their communication skills which are crucial in an academic environment as well as professional and personal lives.

Course Objectives

- To enable learners to develop listening skills for better comprehension of academic presentations, lectures and speeches.
- To hone the speaking skills of learners by engaging them in various activities such as just a minute (JAM), group discussions, oral presentations, and role plays.
- To expose learners to key Reading techniques such as Skimming and Scanning for comprehension of different texts.
- To acquaint the learners with effective strategies of paragraph and essay writing, and formal correspondence such as email, letters and resume.
- To provide learners with the critical impetus necessary to forge a path in an academic environment, in the professional life and in an increasingly complex, interdependent world.

UNIT I

LISTENING: Listening for gist and specific information
SPEAKING: Introducing self and others; Developing fluency through JAM
READING: Skimming for gist and Scanning for specific information
WRITING: Paragraph writing-writing coherent and cohesive paragraph (narrative and descriptive); use of appropriate Punctuation.
GRAMMAR & VOCABULARY: Articles & Prepositions; Word Families (Verbs, Nouns, Adjectives, Adverbs; Prefixes and Suffixes)

Learning Outcomes:

After completion of this unit, the learners will be able to

- Apply the requisite listening skills and comprehend at local and global level. (L4 and L2) (L5)
- Introduce themselves with accurate structure in diverse social and professional contexts.(L3)
- Apply relevant reading strategies for comprehension of any given text(L3)
- Write a paragraph using cohesive devices maintaining coherence (L3)
- Understand the Use of Articles and Prepositions, and apply appropriately for meaningful communication (L3)
- Understand the relevance of various categories in word family and apply them meaningfully in context (L3)

UNIT II

LISTENING: Listening for Note taking and summarizing
SPEAKING: Role plays and Oral Presentations.
READING: Intensive Reading-Reading for implicit meaning
WRITING: Note making and summarizing
GRAMMAR & VOCABULARY: Verb forms-Tenses; synonyms to avoid repetition in speech and writing.

Learning Outcomes:

After completion of this unit, the learners will be able to

- Employ note taking and summarizing strategies to comprehend the listening text (L2)
- Use strategies for successful and relevant oral presentation (L3, L4)
- Demonstrate effective communication skills by applying turn-taking and role distribution techniques for meaningful and contextual Speaking (L3 and L4)
- Apply various reading strategies imbibing inferential and extrapolative comprehension of any given text. (L2, L3)
- Apply various note-making techniques while comprehending the reading text to present a complete and concise set of structured notes (, L3, L4, L5)
- Apply the notes to draft a summary (L3)
- Use correct tense forms and appropriate structures in speech and written communication (L3)
- Context specific use of Prefixes and Suffixes for meaningful communication (L3)

UNIT III

LISTENING: Listening for presentation strategies: introducing the topic, organization of ideas, conclusion.
SPEAKING: Aided presentations
READING: Inferring using textual clues
WRITING: Formal Letter and Email writing
GRAMMAR & VOCABULARY: Active and Passive Voice; linkers and discourse markers.

Learning Outcomes:

After completion of this unit, the learners will be able to

- Notice and understand effective listening strategies to identify discourse markers in presentations. (L1, L2)
- Make formal oral presentations using effective strategies such as audio – visual aids (L3)
- Infer meaning and inter – relatedness of ideas (L4)
- Understand relevant structures and draft formal letters in suitable format (L3, L4)
- Construct relevant sentences in active and passive voice for meaningful communication (L2, L3)
- Comprehend and apply available vocabulary items relevant to the context (L1, L2, L3)

UNIT IV

LISTENING: Listening for labeling-maps, graphs, tables, illustrations
SPEAKING: Aided group presentation using charts, graphs etc.
READING: Reading for identification of facts and opinions
WRITING: Information transfer (writing a brief report based on information from graph/chart/table)
GRAMMAR & VOCABULARY: Subject-verb agreement; language for comparison and contrast; Antonyms

Learning Outcomes:

After completion of this unit, the learners will be able to

- Match visual and auditory inputs and use the information comprehensively and will adequately demonstrate important relationships or patterns between data points (L2)
- choose and coordinate resources appropriate to context and speak intelligibly (L3, L4)
- Develop advanced reading skills for analytical and extrapolative comprehension (L4, L5)
- Make decisions on arrangement of ideas and transfer them from visual to verbal form using context appropriate structure. (L3, L4)
- Demonstrate ability to use task specific grammatically correct structures (L3)
  Comprehend and use expressions for negation/contradiction ((L2, L3)

UNIT V
LISTENING: Listening to discussions for opinions
SPEAKING: Group Discussion
READING: Reading for inferences
WRITING: Coursera Course-Essay Writing-Getting Started with Essay Writing (UCI Division of Continuing Education) 24 hours
GRAMMAR & VOCABULARY: Editing short texts: correcting common errors in grammar and usage; Action verbs for fluency and effective writing.

Learning Outcomes:
After completion of this unit, the learners will be able to

- Apply analytical and problem-solving strategies to identify and interpret facts and opinions from a dialogue. (L3)
- Able to administer group dynamics to contribute valid ideas to a discussion with clarity and precision (L3)
- Demonstrate techniques to analyze contextual clues(L4)
- Compare and correlate ideas and facts to produce an organized essay with adequate supporting evidences (L4, L5)
- Organize the available structural/grammatical knowledge and apply them in a real time context (L3)
- Comprehend meaning for new words/phrases used and apply them in a new context. (L2, L3)

Course Outcomes

By the end of the course, the learners will be able to:

- Think critically, analytically, creatively and communicate confidently in English in social and professional contexts with improved skills of fluency and accuracy.
- Write grammatically correct sentences employing appropriate vocabulary suitable to different contexts.
- Comprehend and analyze different academic texts.
- Make notes effectively and handle academic writing tasks such as Paragraph writing and Essay writing.
- Effectively handle formal correspondence like e-mail drafting and letter writing .

Reference Books:

1.Arosteguy, K.O. and Bright, A. and Rinard, B.J. and Poe, M. ***A Student's Guide to Academic and Professional Writing in Education***, UK, Teachers College Press,2019
2.Raymond Murphy, ***English Grammar in Use A Self-Study Reference and Practice Book for Intermediate Learners of English*** : Cambridge University Press;2019
3.Peter Watkins, ***Teaching and Developing Reading Skills***: UK, CUP, 2018
4.DeepthaAchar et al. ***Basic of Academic Writing***. (1and 2) parts New Delhi: Orient BlackSwan. (2012& 2013).
5.Kumar S and Lata P, ***Communication Skills***: New Delhi Oxford University Press, 2015

19EPH133: APPLIED PHYSICS
(Civil and Mechanical Branches)

L	T	P	C
3	**0**	**3**	**4.5**

This course is designed for students of Civil and Mechanical Engineering. It introduces fundamentals of elasticity and thermal properties – the essentials for understanding the behavior of materials. Mechanics of solids is taught to acquaint them with the behavior of rigid objects. An introduction to sensors will be useful for all the branches as an application of modern technology.

Course Objectives

- **To acquaint** the basic concepts of sound waves and principles in acoustic design
- **To introduce** the concepts of elasticity, strain hardening and failure in materials
- **To impart** the relation between stress and strain.
- **To impart** the phenomenon of heat transfer so as to understand a wide variety of practical engineering problems
- **To demonstrate** the use of Newton's laws of motion for understanding the mechanics of a particle
- **To explain** the working principle and construction of different types of sensors

UNITI: 10 L

Mechanics: Basic laws of vectors and scalars; Rotational frames; Conservative and non-conservative forces; F = **-** *grad* V; Central forces; Elliptical, parabolic and hyperbolic orbits; Noninertial frames of reference; Centripetal acceleration; Harmonic oscillator; Damped harmonic motion; Forced oscillations and resonance. Degrees of freedom.

Learning Outcomes

After completion of this unit the student will be able to

- **Explain** forces and moments in mechanical systems using scalar and vector techniques (L2)
- **interpret** the equation of motion of a rigid rotating body (torque on a rigid body) (L3)
- **apply** the Newton's second law for inertial and non inertial frame of reference (L3)
- **summarize** harmonic motion in undamped, damped and forced oscillations (L2)

UNIT II 8 L

Elasticity:Concepts of elasticity and plasticity, stress and strain, Hooke's law, different moduli of elasticity, Poisson's ratio, strain energy, stress-strain diagram, elastic behavior of a material, factors affecting elasticity, relation between different moduli of elasticity, determination of elastic moduli.

Learning Outcomes:

After completion of this unit the student will be able to

- **Explain** the basic concepts of elasticity, plasticity, strain hardening and failure in materials (L2) .
- **Determine** graphically a material's mechanical properties in terms of its one dimensional stress-strain curve (L2).
- **derive** the generalized Hooke's law by recognizing the basic stress-strain response of isotropic materials (L3).
- **Define** several elastic constants and **determine** the relationship between them (L1).
- **evaluate s**train energy under different loadings (L3).

UNIT III **10 L**

Thermal Properties: Transfer of heat energy; Thermal expansion of solids and liquids; Expansion joints -bimetallic strips; Thermal conduction, convection and radiation and their fundamental laws; Heat conductions in solids; Thermal conductivity - Forbe's and Lee's disc method: theory and experiment; Applications (qualitative only): heat exchangers, refrigerators, ovens and solar water heaters.

Learning Outcomes:

After completion of this unit the student will be able to

- **Explain** the process of thermal expansion in solids and liquids (L3).
- **Distinguish** fundamental laws related to conduction, convection and radiation of heat (L1).
- **determine** the thermal conductivity of a material by Forbes and Lee's disc method (L4).
- **summarize** the working of heat exchangers, refrigerators, ovens and solar water heaters (L2).

UNIT IV **8 L**

Acoustics: Characteristics of sound waves; Weber-Fechner Law; Absorption coefficient, determination of absorption coefficient; Reverberation time; Sabine's formula, derivation of Sabine's formula using growth and decay method; Intensity of sound; Acoustics of Buildings, Acoustic requirements of a good auditorium.

Learning Outcomes

After completion of this unit the student will be able to

- **explain** the basic concepts in acoustics and **describe** Weber-Fechner Law (L2)
- **determine** absorption coefficient and reverberation time (L3)
- **derive** Sabine's formula using growth and decay method (L4)
- **solve** problems involving the intensity of a sound wave (L4).
- **summarize** the principles of acoustics in designing an acoustically good auditorium (L3).

UNIT V **8 L**

Sensors: Sensors(qualitative description only); Different types of sensors and applications; Strain and pressure sensors- Piezoelectric, magnetostrictive sensors; Fibre optic methods of pressure sensing; Temperature sensor - bimetallic strip, pyroelectric detectors; Hall-effect sensor; Smoke and fire detectors.

Learning Outcomes

After completion of this unit the student will be able to

- **describe** the principle of strain and pressure sensors (L1)
- **explain** the principle and working of magnetostrictive and piezoelectric sensors (L3)
- **illustrate** the fibre optic methods of pressure sensing (L3)
- **infer** the functioning of temperature sensors like bimetallic strip and pyroelectric detectors (L2)
- **outline** the principle and working of Hall-effect sensor, smoke and fire detectors (L2)

Course Outcomes:

After completion of this course the student will be able to

- **describe** the fundamental principles of acoustics with emphasis on physical mechanisms, law and relationships (L1).
- **Apply** the concepts of strain, internal force, stress and equilibrium to deformation of solids (L3).
- **explain** the fundamental theory for the analysis of heat transfer processes in solids and liquids and to apply basic principles of heat transfer in design of refrigerators and heaters (L4).
- **estimate** forces and moments in mechanical systems using scalar and vector techniques (L4).
- **outline** the basic principle and operation of different types of *sensors (L2)***.**

Text book(s):

1. D.Kleppner and Robert Kolenkow“ An Introduction to Mechanics– II” Cambridge University Press,2015
2. A Textbook of Engineering Physics, Volume-I By M.N. Avadhanulu& T.V.S. Arun Murthy S Chand
3. Ian R Sinclair, Sensor and Transducers 3/e, 2001, Elsevier (Newnes)

Reference Books:

1. M K Varma “Introduction to Mechanics”-Universities Press,2015
2. PrithwirajPurkait, Budhaditya Biswas and ChiranjibKoley, Chapter 11 *Sensors and Transducers,* Electrical and Electronics Measurements and Instrumentation, 1/e., 2013 McGraw Hill Education (India) Private Limited, 2013.

APPLIED PHYSICS LABORATORY
(Civil and Mechanical Branches)

Learning Outcomes

After completion of this lab the student will be able to

- **determine**
    a. rigidity modulus and Poisson's ratio of a material (L5)
    b. thermal conductivity of bad and good conductors (L5)
- **apply** resonance to
    a. **estimate** the frequency of a tuning fork (L3, L5)**.**
    b. **Examine** the relation between frequency and volume of a cavity (L3, L4).
    c. an LCR circuit (L3).
- **demonstrate** elastic limit and stress-strain relationship using Hooke's law (L2)
- **evaluate** the acceptance angle and **determine** numerical aperture and bending loss of an optical fiber (L5).
- **identify** the type of semiconductor i.e., n-type or p-type using Hall effect (L3)
- **relate** damping and quality factor for simple pendulum (L4)
- **determine** resonant frequency of tuning fork using a sonometer (L5)
- **understand** damping using oscillating disc in different media (L2).

List of experiments

1. To determine rigidity modulus of material of a wire-dynamic method (torsional pendulum)
2. To determine the thermal conductivity of a bad conductor by Lee's disc method
3. To determine the numerical aperture of a given optical fiber and hence to find its acceptance angle
4. To determine the Hall coefficient using Hall effect experiment
5. To investigate Hooke's Law
6. To determine Poisson's Ratio of Rubber experiment
7. To determine thermal conductivity of good conductors (Forbe's Apparatus)
8. To determine the frequency of electrically maintained tuning fork by Melde's method
9. To verify the relation between the volume of the air in the resonator and the frequency of the note.
10. To determine coefficient of damping and quality factor for damped simple harmonic motion of a simple pendulum
11. To Study of resonance in a LCR circuit.
12. To determine resonance frequency using a sonometer.
13. To study of damping of an oscillating disc in air and water.

References

1. S. Balasubramanian , M.N. Srinivasan " A Text book of Practical Physics" - S Chand Publishers,2017

19ECY133: CHEMISTRY OF MATERIALS

(COMMON SYLLABUS for AERO, CIVIL and MECH)

L	T	P	C
3	**0**	**3**	**4.5**

The course enables the students to gain knowledge on application of basic principles of chemistry to address issues relevant to engineering. This includes various aspects of water, energy sources and applications, engineering materials and polymers, corrosion of materials, applications of nano and smart materials.

Course Objectives

- To acquaint the students with soft and hard water types and softening methods.
- To introduce the basic concepts to develop electrochemical cells, photovoltaic cells etc.
- To study the preparation of engineering materials, their properties and applications.
- To impart knowledge on corrosion and its significance.
- To expose to nano and smart materials

UNIT I **8T+6 P**

WATER TECHNOLOGY

Introduction –Hard and Soft water, Estimation of hardness by EDTA Method - Boiler troubles **-** scale and sludge-priming and foaming, specifications for drinking water, Bureau of Indian Standards (BIS) and World health organization (WHO) standards, Industrial water treatment – zeolite and ion-exchange processes- desalination of brackish water, reverse osmosis (RO) and electro dialysis.

Learning outcomes:

After the completion of the Unit I, the student will be able to

- **list** the differences between temporary and permanent hardness of water. (**L-1)**
- **explain** the principles of reverse osmosis and electrodialysis.**(L-2)**
- **compare** the quality of drinking water with BIS and WHO standards.**(L-2)**
- **illustrate** problems associated with hard water. (**L-2)**
- **demonstrate** the Industrial water treatment processes. (**L-2)**

UNIT II **9T +6 P**

ENERGY SOURCES AND APPLICATIONS

Electrode potential, determination of single electrode potential –Nernst's equation, reference electrodes, Weston Cd Cell, hydrogen and calomel electrodes – electrochemical series and its applications – primary cell, dry or Leclanche cell – secondary cell, lead acid storage cell, nickel-cadmium cell – lithium batteries (Lithium-MnO_2) – fuel cell, hydrogen-oxygen fuel cell, Solar energy, photovoltaic cell and applications.

Learning outcomes:

After the completion of the Unit II, the student will be able to

- **define** electrode potential. (**L-1)**
- **explain** Nernst's equation. (**L-2)**
- **illustrate** difference between primary and secondary cells. **(L-2)**
- **summarize** the applications of solar energy. **(L-2)**
- **construct** different cells. (**L-3)**

UNIT III **8T**

Corrosion Engineering

Corrosion: Definition – theories of corrosion, dry corrosion and electro chemical corrosion – factors affecting corrosion, nature of the metal and nature of the environment.

Corrosion controlling methods: Sacrificial and Impressed current cathodic protection, Metallic coatings, anodic coatings, cathodic coating, galvanizing and tinning, anodic inhibitors and cathodic inhibitors –organic coatings, paints and varnishes (constituents and their functions).

Learning outcomes:

After the completion of the Unit III, the student will be able to

- **explain** theories of corrosion. (**L-2)**
- **classify** different corrosion methods. (**L-2)**
- **summarize** the various factors affecting corrosion. (**L-2)**
- **identify** different organic coatings.(**L-3)**
- **apply** the principles of corrosion control. **(L-3)**

UNIT IV **9T+3P**

ENGINEERING MATERIALS AND POLYMERS

Steel – Types of Steel, chemical composition – applications of alloy steels

Cement: Portland cement, constituents, Manufacture of Portland Cement, chemistry of setting and hardening of cement (hydration, hydrolysis, equations).

Polymers: Introduction, differences between thermoplastic and thermo setting resins, Preparation, properties and uses of polystyrene and polyphosphazines.

Learning outcomes:

After the completion of the Unit IV, the student will be able to

- **classify** the types of steel. **(L-2)**
- **illustrate** the chemical reactions involved in the manufacturing of cement. **(L-2)**

- **identify** preparation and properties of inorganic polymers. **(L-3)**
- **distinguish** between thermoplastic and thermo setting resins. **(L-4)**

UNIT- V **8T+3 P**

NANO AND SMART MATERIALS

Nano Materials: Introduction to Nano materials, chemical synthesis of nanomaterials: Sol-gel method, Reverse micellar method, Characterization of nanoparticles by BET method, characterization of nanomateirals by TEM (includes basic principle of TEM), Applications of nanomaterials in waste water treatment, lubricants and engines.

Smart Materials: Introduction – Types of smart materials-self healing materials
Shape memory alloys and Uses of smart materials.

Learning outcomes:

After the completion of the Unit V, the student will be able to

- **classify** nanomaterials. **(L-2)**
- **explain** the synthesis and characterization methods of nano materials. **(L-2)**
- **build** smart materials and types of smart materials. **(L-3)**
- **compare** the principles of BET and TEM. **(L-4)**

Course Outcomes

After the completion of the course, the student will be able to

- **list** the difference between temporary and permanent hardness of water. **(L-1)**
- **illustrate** the principles and applications of solar and wind energy. **(L-2)**
- **identify** different organic coatings. **(L-3)**
- **analyze** the importance of nano and smart materials**.** **(L-4)**
- **distinguish** the principles of BET and TEM. **(L-4)**

Text Book(s):

1. P.C. Jain and M. Jain, Engineering Chemistry, 15/e, Dhanapat Rai & Sons, (2014).
2. B.K. Sharma, Engineering Chemistry, Krishna Prakasham, (2014).

References:

1. Sashichawla, A Textbook of Engineering Chemistry, Dhanapath Rai and sons, (2003)
2. B.S Murthy and P. Shankar, A Text Book of NanoScience and NanoTechnology, University Press (2013).
3. S.S. Dara, A Textbook of Engineering Chemistry, S.Chand& Co, (2010)
4. V.Raghavan, A Material Science and Engineering, Prentice-Hall India Ltd, (2004).
5. N.Krishna Murthy and Anuradha, A text book of Engineering Chemistry, Murthy Publications (2014).
6. K. SeshaMaheshwaramma and MridulaChugh, Engineering Chemistry, Pearson
India Edn services, (2016).

ENGINEERING CHEMISTRY LABORATORY
(COMMON SYLLABUS for AERO, CIVIL and MECH)

The course enables the students to gain knowledge on various volumetric analysis, measurements of physical parameters, instrumental methods of analysis, analysis of water, preparation of nonmaterials, chromatographic separation techniques and preparation of polymers.

Course Objectives

- To introduce the skills of basic Concepts in Engineering Chemistry.
- To rain the handling of different instruments.
- To familiarize the digital and instrumental methods of analysis.
- To enable the practical expertise of the theoretical aspects.

List of Experiments

1. Determination of sulphuric acid in lead-acid storage cell.
2. Estimation of iron as ferrous iron in an ore sample.
3. Estimation of calcium in portland cement.
4. Determination of chromium (VI) in potassium dichromate
5. Determination of copper in a copper ore.
6. Determination of viscosity of a liquid.
7. Determination of surface tension of a liquid.
8. Determination of Mohr's salt by potentiometric method.
9. Determination of strength of an acid by pH metric method.
10. Determination of Hardness of a ground water sample.
11. Estimation of active chlorine content in Bleaching powder.
12. Preparation of TiO_2/ZnOnano particles
13. Thin layer chromatography.
14. Preparation of Phenol-formaldehyde resin

Course Outcomes

After the completion of the laboratory course, the student will be able to

- **Illustrate** different ores (Fe, Cr & Cu) and their usage. **(L-2)**
- **Compare** the viscosities of oils. **(L-2)**
- **experiment with** the physical parameters of organic compounds. **(L-3)**
- **apply** the TLC technique for the identification of organic compounds. **(L-3)**
- **analyze** the quality of ground water sample. **(L-4)**

Text Book(s)

1.Mendham J, Denney RC, Barnes JD, Thosmas M and Sivasankar B Vogel's Quantitative Chemical Analysis 6/e, Pearson publishers (2000).

2.N.KBhasin and Sudha Rani Laboratory Manual on Engineering Chemistry 3/e, Dhanpat Rai Publishing Company (2007).

19EID131: PROBLEM SOLVING AND PROGRAMMING

L	T	P	C
3	**1**	**3**	**5.5**

This course focuses on problem solving using visual programming and flowchart tools. Python being simple and easy to learn syntax, it is used as an introductory coding platform to translate flow charts into programs. The course introduces fundamental programming concepts. Python language is used to present concepts including control structures, functions, data structures followed by important Python packages that will be useful in data analysis.

Course Objectives:

- To introduce programming through Visual programming tool - Scratch
- To teach problem solving through Flow charting tool - Raptor
- To elucidate problem solving through python programming language
- To introduce function-oriented programming paradigm through python
- To train in development of solutions using modular concepts
- To teach practical Pythonic solution patterns

Unit I

Computational Thinking and Visual Programming Concepts
Introduction to computational thinking. Visual programming concepts. Scratch environment: sprites -- appearance and motion, angles and directions, repetition and variation, changing costumes, adding background. Input/Output, variables and operators.

Learning Outcomes

After completion of this unit the student will be able to

- develop a program, controlled by a loop. (L3)
- experiment with “costumes” to change the appearance of sprites. (L3)
- perform Input, Output Operations using scratch. (L3)
- perform computation using common mathematical formulas. (L3)
- develop programs by passing messages between sprites. (L3)

Unit II

Algorithms and Flowchart design through Raptor
Introduction to the idea of an algorithm. Pseudo code and Flow charts. Flow chart symbols, Input/Output, Assignment, operators, conditional if, repetition, procedure and sub charts.
Example problems – Finding maximum of 3 numbers, Unit converters, Interest calculators, multiplication tables, GCD of 2 numbers
Example problems -- Fibonacci number generation, prime number generation. Minimum, Maximum and average of n numbers, Linear search, Binary Search.

Learning outcomes:

After completion of this unit the student will be able to

- Select flowchart symbols for solving problems. (l1)
- Develop basic flowcharts for performing input, output and computations (l3)
- Solve numerical problems using raptor (l3)
- Analyze problems by modular approach using raptor (l4)

Unit III
Introduction to Python

Python – Numbers, Strings, Variables, operators, expressions, statements, String operations, Math function calls, Input/Output statements, Conditional If, while and for loops, User defined Functions, parameters to functions, recursive functions, Turtle Graphics.

Learning outcomes:

After completion of this unit the student will be able to

- Interpret numbers, strings, variables, operators, expressions and math functions using Python Interactive Mode. (L2)
- Solve simple problems using control structures, input and output statements. (L3)
- Develop user defined functions (recursive and non-recursive). (L3)
- Build Python programs for section 1 raptor flowcharts. (L3)
- Develop Python programs for creating various graphical shapes using turtle graphics. (L3)

Unit IV

Data Structures and Idiomatic Programming in Python
Lists, Tuples, Dictionaries, Strings, Files and their libraries. Beautiful Idiomatic approach to solve programming problems.

Learning outcomes:

After completion of this unit the student will be able to

- Summarize the features of lists, tuples, dictionaries, strings and files. (l2)
- Demonstrate best practices of “beautiful idiomatic python”. (l2)
- Build python programs for section 2 raptor flowcharts. (l3).

Unit V

Packages

Numpy -- Create, reshape, slicing, operations such as min, max, sum , search, sort, math functions etc.

Pandas -- Read/write from csv, excel, json files, add/ drop columns/rows, aggregations, applying functions

Matplotlib -- Visualizing data with different plots, use of subplots.

User defined packages, define test cases and perform unit testing

Learning Outcomes:

After completion of this unit the student will be able to

- Read data from files of different formats and perform operations like slicing, insert, delete, update (L3)
- Visualize the data (L4)
- Ability to define packages (L2)
- Define test cases (L1)

Laboratory Experiments

1. Design a script in Scratch to make a sprite to draw geometrical shapes such as Circle, Triangle, Square, Pentagon.
2. Design a script in Scratch to make a sprite to ask the user to enter two different numbers and an arithmetic operator and then calculate and display the result.
3. Design a Memory Game in Scratch which allows the user to identify positions of similar objects in a 3 x 3 matrix.
4. Construct flowcharts to
a. calculate the maximum, minimum and average of N numbers
b. develop a calculator to convert time, distance, area, volume and temperature from one unit to another.
5. Construct flowcharts with separate procedures to
a. calculate simple and compound interest for various parameters specified by the user
b. calculate the greatest common divisor using iteration and recursion for two numbers as specified by the user
6. Construct flowcharts with procedures to
a. generate first N numbers in the Fibonacci series
b. generate N Prime numbers
7. Design a flowchart to perform Linear search on list of N unsorted numbers (Iterative and recursive)
8. Design a flowchart to perform Binary search on list of N sorted numbers (Iterative and recursive)
9. Design a flowchart to determine the number of characters and lines in a text file specified by the user
10. Design a Python script to convert a Binary number to Decimal number and verify if it is a Perfect number.
11. Design a Python script to determine if a given string is a Palindrome using recursion
12. Design a Python script to sort numbers specified in a text file using lists.
13. Design a Python script to determine the difference in date for given two dates in YYYY:MM:DD format (0 <= YYYY <= 9999, 1 <= MM <= 12, 1 <= DD <= 31) following the leap year rules.
14. Design a Python Script to determine the Square Root of a given number without using inbuilt functions in Python.
15. Design a Python Script to determine the time difference between two given times in HH:MM: SS format. (0 <= HH <= 23, 0 <= MM <= 59, 0 <= SS <= 59)

16. Design a Python Script to find the value of (Sine, Cosine, Log, PI, e) of a given number using infinite series of the function.
17. Design a Python Script to convert a given number to words
18. Design a Python Script to convert a given number to roman number.
19. Design a Python Script to generate the frequency count of words in a text file.
20. Design a Python Script to print a spiral pattern for a 2 dimensional matrix.
21. Design a Python Script to implement Gaussian Elimination method.
22. Design a Python script to generate statistical reports (Minimum, Maximum, Count, Average, Sum etc) on public datasets.
23. Design a Python script using the Turtle graphics library to construct a turtle bar chart representing the grades obtained by N students read from a file categorizing them into distinction, first class, second class, third class and failed.

Text Book(s):

1. Weingart, Dr. Troy, Brown, Dr. Wayne, An introduction to programming and algorithmic reasoning using raptor.
2. T R Padmanabhan, Programming with python, Springer. 3. ReemaThareja, Python Programming: Using Problem Solving Approach, Oxford University Press. 4. Wes McKinney , Python for Data Analysis, O.Reilly.

Course outcomes:

After the completion of the course, the student will be able to
 create interactive visual programs using Scratch. (L3)
 develop flowcharts using raptor to solve the given problems. (L3)
 build Python programs for numerical and text based problems (L3)
 develop graphics and event based programming using Python (L3)
 build Python programs using beautiful Pythonic idiomatic practices (L3)

19EEE131: BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

L	T	P	C
3	1	3	5.5

This course introduces the student, to the fundamental principles and building blocks of electrical and electronics engineering. The first three units cover the electric circuit laws, theorems and principles of electrical machines. The last two units cover semiconductor devices and their applications.

Course Objectives

- To familiarize the basic DC and AC networks used in electrical and electronic circuits.
- To explain the concepts of electrical machines and their characteristics.
- To identify the importance of transformers in transmission and distribution of electric power.
- To impart the knowledge about the characteristics, working principles and applications of semiconductor diodes, metal Oxide semiconductor field effect transistors (MOSFETs).
- To expose basic concepts and applications of Operational Amplifier and configurations.

UNIT-I **10L + 6P**

Basic laws and Theorems: Ohms law, Kirchoff's Laws, series and parallel circuits, source transformations, delta-wye conversion. Mesh analysis, nodal analysis. Linearity and superposition theorem, Thevenin's and Norton's theorem with simple examples, maximum power transfer theorem with simple examples.

Learning Outcomes

Upon successful completion of the course, the student will be able to

- state Ohms law and Kirchhoff's Laws **(L1)**
- identify and analyze series and parallel connections in a circuit **(L1)**
- predict the behavior of an electrical circuit **(L2)**
- determine the current, voltage and power in the given electrical circuit**(L4)**
- apply various techniques to analyze an electric circuit**(L3)**

UNIT II **10L + 6P**

DC Machines: Constructional features, induced EMF and torque expressions, different types of excitation, performance characteristics of different types of dc machines, Starters: 2-point, 3-point starters, losses and efficiency, efficiency by direct loading.

Learning Outcomes

Upon successful completion of the course, the student will be able to

- describe the constructional features of DC machines(L1)
- analyze EMF and torque expressions of DC machine(L4)
- demonstrate the performance characteristics of different types of dc machines (L3)
- explain types of starters used for starting of dc motors (L2)
- estimate losses and efficiency of electrical machine(L2)

UNIT III **12L + 9P**

Transformers: Constructional details, EMF equation, voltage regulation, losses and efficiency, open/short- circuit tests and determination of efficiency. **Three Phase Induction Motors**: Construction, working principle of three phase induction motor, Torque and Torque-Slip characteristics.

Learning Outcomes

Upon successful completion of the course, the student will be able to

- describe the constructional details of transformers **(L1)**
- demonstrate voltage regulation of transformer **(L3)**
- discuss about open and short- circuit tests of transformer**(L2)**
- explain the working principle of three phase induction motor **(L2)**
- describe torque and torque slip characteristics **(L1)**
- estimate losses and efficiency of three Phase Induction Motors**(L2)**

UNIT IV **12L + 9P**

Semiconductor Devices: p-n Junction diode - Basic operating principle, current-voltage characteristics, rectifier circuits (half-wave, full-wave, rectifier with filter capacitor), Zener diode as Voltage Regulator; Metal oxide semiconductor field effect transistor (MOSFET): Operation of NMOS and PMOS FETs, MOSFET as an amplifier and switch.

Learning Outcomes

Upon successful completion of the course, the student will be able to

- describe the device structure and physical operation of a diode **(L1)**
- discuss V-I characteristics of diodes **(L2)**
- explain the use of diode as switch and in electronic circuits**(L5)**
- describe the construction and operation of *n*-channel and *p*-channel MOSFETs **(L1)**
- explain the use of MOSFET as an amplifier and bidirectional switch **(L5)**

UNIT V **10L + 6P**

Operational Amplifiers: The Ideal Op Amp, The Inverting Configuration, The closed loop gain, Effect of Finite open-loop gain, The Noninverting Configuration, The closed loop gain, Characteristics of Non-Inverting Configuration, Effect of finite open loop gain, the voltage follower, Difference amplifiers, A Single Op-amp difference amplifier.

Learning Outcomes

Upon successful completion of the course, the student will be able to

- list the characteristics of an ideal Op Amp **(L1)**
- explain the Inverting and Noninverting configurations of Op-Amp **(L2)**
- construct a Single Op-amp difference amplifier **(L3)**

List of Laboratory Experiments

1. Verification of Kirchhoff's Laws KVL and KCL.
2. Verification of DC Superposition Theorem.
3. Verification of Thevenin's Theorem and Norton's Theorem.
4. OCC and External characteristics of separately excited DC generators.
5. Swinburne's test on a DC shunt motor.
6. OC and SC Tests on single phase transformer.
7. Brake Test on DC shunt motor.
8. Current Voltage Characteristics of a p-n Junction Diode/LED.
9. Diode Rectifier Circuits.
10. Voltage Regulation with Zener Diodes.
11. Design of a MOSTFET amplifier and MOSFET inverter/NOR gate
12. Inverting and Non-inverting Amplifier Design with Op-amps.
13. Simulation experiments using PSPICE
    (a) Diode and Transistor Circuit Analysis.
    (b) MOSFET Amplifier design.
    (c) Inverting and Noninverting Amplifier Design with Op-amps.

Course Outcomes

Upon successful completion of the course, the student will be able to

- predict and analyze the behavior of an electrical circuit **(L3)**
- analyze the performance quantities such as losses, efficiency and identify applications of DC machines**(L4)**
- explain the use of transformers in transmission and distribution of electric power and other applications **(L2)**
- demonstrate the operation and applications of various electronic devices **(L2)**
- construct Inverting and Noninverting configurations of Op-Amp **(L5)**

Text Book(s):

1. D.P.Kothari, I.J.Nagrath, Basic Electrical and Electronics Engineering, 1st edition, McGraw Hill Education (India) Private Limited,2017.
2. B.L.Theraja, Fundamentals of Electrical Engineering and Electronics, 1st edition,S.ChandPublishing,New Delhi, 2006.
3. Adel S. Sedra and Kenneth C. Smith, Microelectronic Circuits 6th edition, Oxford University Press, 2014.

References:

1. S.K. Bhattacharya, Basic Electrical and Electronics Engineering, Pearson Education,2011.
2. Dharma Raj Cheruku, B T Krishna, Electronic Devices and Circuits, 2/e, Pearson Education, 2008.
3. R.K.Rajput, Basic Electrical and Electronics Engineering, University Science Press, New Delhi,2012.

19EME121: BASIC WORKSHOP
(Common to all branches)

L	T	P	C
0	**0**	**3**	**1.5**

The objective of this course is to make sure that all the engineers gain practical expose to common trades. This course enables the students to gain hands on experience and skills necessary to perform basic mechanical operations such as carpentry, sheet metal working and fitting. It also familiarizes the students with basic electrical house wiring concepts.

Course Objectives

- Explain different tools used in carpentry.
- Impart the skills to do some carpentry operations.
- Demonstrate different types of tools used in fitting, soldering and brazing.
- Train fitting, soldering and brazing jobs.
- Familiarize different types of basic electric circuit connections.

Wood Working:

Familiarity with different types of woods and tools used in wood working and make following joints

a) Half – Lap joint.
b) Mortise and Tenon joint.
c) Corner Dovetail joint or Bridle joint.

Sheet Metal Working:

Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets

a) Tapered tray b) Conical funnel c) Elbow pipe d) Brazing

Fitting:

Familiarity with different types of tools used in fitting and do the following fitting exercises

a) V-fit b) Dovetail fit c) Semi-circular fit
d) Bicycle tire puncture and change of two wheeler tire

Electrical Wiring:

Familiarities with different types of basic electrical circuits and make the following connections

a) Parallel and series b) Two way switch c) Godown lighting
d) Tube light e) Three phase motor f) Soldering of wires

Course Outcomes:

After completion of this lab the student will be able to

- summarize various carpentry operation required to create a product in real time applications. (L1)
- develop different parts with metal sheet in real time applications. (L3)
- demonstrate fitting operations in various applications. (L2)
- perform soldering and brazing operations. (L3)
- select different types of electric circuits in practical applications (L3)

19EME131: ENGINEERING GRAPHICS

L	T	P	C
1	0	3	2.5

The course enables the students to convey the ideas and information graphically that come across in engineering. This course includes projections of lines, planes, solids sectional views, and utility of drafting and modeling packages in orthographic and isometric drawings.

Course Objectives

- Create awareness of the engineering drawing as the language of engineers.
- Familiarize how industry communicates, practices for accuracy in presenting the technical information.
- Develop the engineering imagination essential for successful design.
- Demonstrate the usage of drafting and modeling packages in representation of orthographic and isometric views.
- Train in 2D and 3D modeling softwares.
- Teach graphical representation of simple components.

Manual Drawing: **7 L**

Introduction to Engineering graphics: Principles of Engineering Graphics and their significance-Conventions in drawing-lettering - BIS conventions.
a) Conic sections - general method only,
b) Cycloid, epicycloids and hypocycloid
c) Involutes

Projection of points, lines and planes: **2L + 6P**

Projection of points in different quadrants, lines inclined to one and both the planes, finding true lengths and angles made by line. Projections of regular plane surfaces.

Projections of solids: **1L + 3P**

Projections of regular solids inclined to one and both the reference planes.

Sections of solids: **1L + 3P**

Section planes and sectional view of right regular solids- prism, cylinder, pyramid and cone. True shapes of the sections.

Development of surfaces: **1L+ 6P**

Development of surfaces of right regular solids-prism, cylinder, pyramid, cone and their sectional parts.

Computer Aided Drafting: **6 L**

Introduction to AutoCAD: **1L + 3P**
Basic drawing and editing commands: line, circle, rectangle, erase, view, undo, redo, snap, object editing, moving, copying, rotating, scaling, mirroring, layers, templates, polylines, trimming, extending, stretching, fillets, arrays, dimensions. Dimensioning principles and conventional representations.
Orthographic Projections: **3L + 9P**
Systems of projections, conventions and application to orthographic projections.

Isometric Projections: **2L + 6P**
Principles of isometric projection- Isometric scale; Isometric views: lines, planes, figures, simple and compound solids

Course Outcomes:

After completing the course, the student will be able to

- utilize Engineering Graphics as Language of Engineers. (L3)
- prepare drawings as per international standards .(L3)
- identify various engineering curves.(L1)
- solve plane geometry problems involving lines and plane figures (L3)
- represent solids and sections graphically. (L3)
- implement procedures to develop the surfaces of solids. (L3)
- create isometric and orthographic drawings using CAD packages. (L3)

Text Book(s):

1. K.L. Narayana & P. Kannaiah, Engineering Drawing, 3/e, Scitech Publishers, 2012.
2. N.D. Bhatt, Engineering Drawing, 53/e, Charotar Publishers, 2016.

References:

1. Dhanajay A Jolhe, Engineering Drawing, Tata McGraw-Hill, 2009.
2. Shah and Rana, Engineering Drawing, 2/e, Pearson Education, 2009.
3. Venugopal, Engineering Drawing and Graphics, 3/e, New Age Publishers, 2000.
4. K.C. John, Engineering Graphics, 2/e, PHI, 2013.
5. Basant Agarwal and C.M. Agarwal, Engineering Drawing, Tata McGraw Hill, 2008.

19EMC181A - NATIONAL SERVICE SCHEME (NSS)

L T P C
0 0 2 0

National Service scheme is a public service program encouraged by Ministry of Youth Affairs and Sports of the Government of India. NSS is a voluntary association of young people in Colleges, Universities and at +2 level working for a campus-community linkage. The objective of this course is to expose the students to theactivities of National Service Scheme, concept of social Service and principles of health, hygiene and sanitation.

Unit I **2 L**

Introduction and Basic concepts of NSS: History. Philosophy, aims and Objectives of NSS, Emblem, Flag, Motto, Song, Badge etc.: Organizational structure, role and responsibilities of various NSS Functionaries

Unit II **2 L**

Regular activities: College campus activities, NS.S, activities in Urban and Rural areas, NSS Annual Activities Calendar, Suggestive List of Activities, Role of Non-Government Organization (NGO) in scalariform) Red Cross ii) Rotary

Unit III **2 L**

Special Camp activities: Nature and its objectives: Selection of camp site -Identification of community problems- physical arrangement- Organization of N.S.S. camp through various committees and discipline in the camp- adaption of village-planning for pre -camp during and post campaigning. **Activities-** Activities to be undertaken during the N.S.S. camp- Use of the mass media in the N.S.S activities.

Unit IV **4 L**

Health, Hygiene and Sanitation: Definition, needs and scope of health education, food and Nutrition, Safe drinking water, Sanitation, Swachh Bharat Abhiyan. **Disaster Management:** Introduction to Disaster Management, Classification of Disasters. Role of Youth in Diasters Management, Home nursing, First Aid.**Civil Self Defense:** Civil Defense services, aims and objectives of civil defense, Need for self defence training

Unit V **10 L**

Social Project: Problems Identification - Data Collection- Preparation of a Questionnaire-Observation- Schedule Interview-Qualitative Research-Quantities Research-Major Findings-Suggestions-Conclusion-Report Writing.

Text Book(s):

National Service Scheme Manual (Revised) 2006, Government of India, Ministry of Youth Affairs and Sports, New Delhi

1) NSS Diaries

2) Sanjay Bhattachaya, Social Work Interventions and Management-Deep and Deep Publications, New Delhi

19EMC181B – NATIONAL CADET CORPS

L T P C
0 0 2 0

Unit I **5 L**

Aims and objectives of NCC: Organization and training, NCC song, incentives for cadets. national integration and awareness: religion, culture, traditions and customs of India, national integration – importance and necessity, freedom struggle and nationalist movement in India, national interests, objectives, threats and opportunities, problems/ challenges of national integration, national integration and awareness, unity and diversity, national integration council, images/ slogans for national integration, contribution of youth in nation building

Unit II **5 L**

Drill Attention, stand at ease and stand easy, turning and inclining at the at the halt, ceremonial drill- guard mounting, guard of honour, platoon / company drill, instructional practice, weapon training stripping, assembling, care and cleaning and sight setting of .22 rifle, the lying position, holding and aiming, trigger control and firing a shot, short range firing, aiming – alteration of sight

Unit III **5 L**

Personality development: Introduction to personality development, factors influencing / shaping personality – physical , social, psychological and philosophical self awareness – know yourself / insight, change your mindset, interpersonal relationship and communication skills – group discussion / lecturettes, leadership traits, types of leadership, attitude – assertiveness and negotiation, time management, personality development, effects of leadership with historical examples, stress management skills, interview skills, conflict motives – resolution, importance of group – team work, influencing skills, body language, sociability: social skills, values / code of ethics **Disaster Management:** Civil defence organization and its duties – ndma, types of emergencies / natural disasters, fire service and fire fighting, traffic control during disaster under police supervision, essential services and their maintenance, assistance during natural / other calamities / floods / cyclone / earth quake / accident, setting up of relief camp during disaster management, collection and distribution of aid material

Unit IV **5 L**

Social awareness and community development: Basics of social service, weaker sections of our society and their needs, social/ rural development projects – menrega , sgsy , nsapetc, ngos : role and contribution, contribution of youth towards social welfare, family planning, drug abuse and trafficking, civil responsibilities, causes and prevention of hiv/ aids role of youth, counter terrorism, corruption, social evils – dowry / female foeticide / child abuse and trafficking, rti and rte, traffic control organization and anti drunken driving, provision of protection of children from sexual harassmentact 2012.

Unit V **5 L**

Health and Hygiene: Structure and functioning of the human body, hygiene and sanitation (personal and food hygiene), physical and mental health, infectious and contagious diseases and its prevention, basic of home nursing and first aid in common medical emergencies, wounds and fractures, introduction to yoga and exercises. **Adventure training:** Para sailing, slithering, rock climbing, cycling / trekking, environment awareness and conservation natural resources conservation and management, water conservation and rain water harvesting, waste management, pollution control, water , air, noise and soil, energy conservation,. wildlife conservation – projects in india. obstacle training, obstacle course, practical training

Text Book(s)

1. Cadet Hand Book (Common Subjects), published by DG NCC.
2. Cadet Hand Book (Specialized Subjects), published by DG NCC.

Reference Books

1. Grooming Tomorrow's Leaders, published by DG, NCC.
2. Youth in Action, published by DG, NCC.
3. The Cadet, Annual Journal of the NCC.

19EMC181C: NATIONAL SPORTS ORGANIZATION
(COMMON TO ALL)

LTPC

002 0

National Sports Organisation is intended by the Government of India to promote the development of athletics and sporting activities of the nation's youth. This activity enables physical fitness, teamwork and mental health within the students. This course teaches the rules and skills of below sports and games to the students. Each student shall be made proficient in one of the chosen sport from the below list

1. Cricket
2. Volley Ball
3. Table Tennis
4. Foot Ball
5. Throw Ball (Only for Women)
6. Basket Ball
7. Athletics -100 Meters Run, Long Jump, Shot Put
8. Chess
9. Lawn Tennis
10. Kabaddi
11. Aerobics
12. Badminton

Text Book(s):

1. Myles Schrag, The Sport Rules Book, 4/e, Human Kinetics, 2018
2. DhamaPrakashJyoti, Rules. Of. Games. And. Sports,Laxmi Book Publication, 2018

19EMC181D: YOGA
(Common to all)

L T P C

0 0 2 0

The course is designed to enable the student to know about yoga an ancient Indian tradition. It embodies unity of mind and body; thought and action; harmony between human and nature and a holistic approach to health and well-being. It is not only exercise but to discover the sense of oneness with ourselves, the world and nature. The student will be able to learn about Yoga and practice different Yoga asana which influences his lifestyle and creating consciousness, it can help a student to deal with health issues and climate change.

Course Objectives:

- Familiarize the student with YOGA and ancient Indian tradition.
- Enable the student to know the different asana their advantages and disadvantages.
- Explain with the features of different Yoga asana.
- Demonstrate and perform Yoga asana.
- Enable the student to perform pranayama and meditation.

- **Introduction to Yoga:**Evolution of Yoga and Schools of Yoga, Origin of Yoga, History and Development of Yoga; Etymology and Definitions, Misconceptions, Nature and Principles of Yoga.
- **Guidelines to yoga practice:** Prayer, warmup exercises/ loosening exercises
- **Yoga Theory:** Therapeutic Benefits of Yoga – primitive, preventive and curative aspects of Yoga
- **Application of Yoga to students,** Suryanamaskaras, Tadasan, Natarajasan, Vrikshasan, Padahasthasan, Ardhachakrasan, Trikonasan, Bramari pranayama.
- **Yoga for allround fitness,** Bhadrasan, Vajrasan, ArdhaUstrasan, Nadishuddhi pranayama, Navasan, Janusirasan, Paschimotthanasan, Shashankasan, Vakrasan, Bhujangasan, Kapalabhati..
- **Meditative Postures**: Sukhasan, ArdhaPadmasan, Padmasan and Siddhasan,Meditation
- **Yoga Practice**: Makarasan, Sethubandhasan, Pavanmuktasan, Sarvangasan, Matsyasan, Halasan.

Text Book(s):

1. Swami MuktibodhandaSaraswathi Shay G.S., Hatha yoga Pradipika, Bihar School of yoga publications, Munger, 2000.
2. Hatha Yoga Pradeepika of Svatmarama, MDNY Publication, 2013
3. Svatmarama, Swami, The Hatha yoga Pradipika/ the original Sanskrit [by] Svatmarama; an English translation [by] Brian Dana Akers. Woodstock, NY:YogaVidya.com, 2002.

References:

1. Bharati, Swami Veda Reddy Venkata: Philosophy of Hatha Yoga (Englis), Himalayan, Pensylvania, Hatha Ratnavali.
2. Swami SatyanandaSaraswathi - Asana, Pranayama, Mudra & Bandha. Bihar School of Yoga, Munger
3. B.KS.Iyenger- The Illustrated Light on Yoga. Harper Collins, New Deli

Course Outcomes:

After completion of this course the student will be able to

- understand history and evolution of Yoga (L2).
- list different schools of yoga (L2).
- interpret the aim and objectives of yoga to students (L2).
- perform yoga asana, pranayama, and meditation (L2).

19EMA102: ENGINEERING MATHEMATICS II
ODE, PDE AND MULTIVARIABLE CALCULUS
(Common to all branches of Engineering except CSE & IT)

L	T	P	C
3	**0**	**0**	**3**

This course is designed to impart knowledge on ordinary, partial differential equations and vector calculus so as to understand concepts like fluid mechanics, signals and systems etc., in engineering applications

Course Objectives:

- To familiarize the students in the concepts of linear differential equations.
- To explain the concept of reducing linear differential equations with variable Coefficients to constant coefficients and their applications.
- To demonstrate the concepts of partial differential equations.
- To explain the concepts of vector differentiation and integration

UNIT I **8 L**

Linear differential equations of higher order: Definitions, complete solution, operator D, rules for finding complimentary function, inverse operator, rules for finding particular integral, method of variation of parameters.

Learning Outcomes:

At the end of this unit, the student will be able to

- classify and interpret the solutions of linear differential equations (L3)
- identify the essential characteristics of linear differential equations with constant coefficients (L3)
- solve the linear differential equations with constant coefficients by appropriate methods (L3)

UNIT II **8 L**

Equations reducible to Linear Differential Equations and Applications: Cauchy's and Legendre's linear equations, simultaneous linear equations with constant coefficients, Applications: Mass spring system and L-C-R Circuit problems.

Learning Outcomes:

At the end of this unit, the student will be able to

- examine the special type of nonlinear differential equations (L4)
- analyze physical situations using higher differential equations (L4)

UNIT III **8 L**

Partial Differential Equations – First order: First order partial differential equations, solutions of first order linear PDEs, Charpit's method. Solutions to homogenous and non-homogenous linear partial differential equations.

Learning Outcomes:

At the end of this unit, the student will be able to

- apply a range of techniques to find solutions of PDEs (L3)
- identify the basic properties of PDEs (L3)

UNIT IV **8 L**

Multivariable Calculus (Vector differentiation): Scalar and vector point functions, vector operator del, del applies to scalar point functions-Gradient, del applied to vector point functions-Divergence and Curl, vector identities.

Learning Outcomes:

At the end of this unit, the student will be able to

- apply del to Scalar and vector point functions (L3)
- illustrate the physical interpretation of Gradient, Divergence and Curl (L3)

UNIT V **10 L**

Multivariable Calculus (Vector integration: Line integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof).

Learning Outcomes:

At the end of this unit, the student will be able to

- find the work done in moving a particle along the path over a force field (L3)
- construct the rate of fluid flow along and across curves (L3)
- apply Green's, Stokes and Divergence theorem in evaluation of line, surface and volume integrals (L3)

Course Outcomes:

At the end of the course, the student will be able to

- solve the differential equations related to various engineering fields (L3)
- Identify solution methods for partial differential equations that model physical processes (L3)
- inspect the physical meaning of gradient, curl and divergence (L4)
- examine the work done against a field, circulation and flux using vector calculus (L4)

Text book(s):

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.

References:

1. Dennis G. Zill and Warren S. Wright, Advanced Engineering Mathematics, Jones and Bartlett, 2011.
2. Michael Greenberg, Advanced Engineering Mathematics, 2/e, Pearson, 2018
3. George B. Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 13/e, Pearson Publishers, 2013.
4. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002.
5. Glyn James, Advanced Modern Engineering Mathematics, 4/e, Pearson publishers, 2011.

19EID132: DESIGN THINKING

L	T	P	C
2	0	2	3

Design is a realization of a concept or idea into a configuration, drawing or a product. Design Thinking is cognitive and practical processes by which design concepts are developed by designers. Innovation is a new idea or a new concept. Product development is the creation of a new or different product that offers new benefits to the end user. This course introduces the design thinking in product innovation.

Course Objectives:

1. To familiarize product design process
2. To introduce the basics of design thinking
3. To bring awareness on idea generation
4. To familiarize the role of design thinking in services design

UNIT I **8 L**

Introduction to design, characteristics of successful product development, product development process, identification of opportunities, product planning, Innovation in product development.

Learning Outcomes:

After completing this unit, the student will be able to

- identify characteristics of successful product development(L3)
- identify opportunities for new product development(L3)
- plan for new product development(L3)

UNIT II **8 L**

Design Thinking: Introduction, Principles, the process, Innovation in Design Thinking, benefits of Design thinking, design thinking and innovation, case studies.

Learning Outcomes:

After completing this unit, the student will be able to

- explain the principles of Design Thinking(L2)
- identify the benefits of Design Thinking(L3)
- use innovations in Design Thinking(L3)

UNIT III **10 L**

Idea generation: Introduction, techniques, Conventional methods, Intuitive methods, Brainstorming, Gallery method, Delphi method, Synectics etc Select ideas from ideation methods, case studies.

Learning Outcomes:

After completing this unit, the student will be able to

- explain the techniques in idea generation(L2)
- select ideas from ideation methods(L3)
- identify the methods used in idea generation in some case studies(L3)

UNIT IV **10 L**

Design Thinking in Information Technology, Design Thinking in Business process model, Design Thinking for agile software development, virtual collaboration, multi user and multi account interaction, need for communication, TILES toolkit, Cloud implementation.

Learning Outcomes:

After completing this unit, the student will be able to

- use Design Thinking in business process model(L3)
- apply Design Thinking for Agile software development(L3)
- use TILES toolkit(L3)

UNIT V **8 L**

Design thinking for service design: How to design a service, Principles of service design, Benefits of service design, Service blueprint, Design strategy, organization, principles for information design, principles of technology for service design.

Learning Outcomes:

After completing this unit, the student will be able to

- use principles of service design(L3)
- explain the benefits of service design(L5)
- apply principles of technology for service design(L3)

Text Book(s):

1. Pahl, Beitz, Feldhusen, Grote – Engineering Design: a systematic approach, Springer, 2007
2. Christoph Meinel and Larry Leifer, Design Thinking, Springer, 2011
3. Aders Riise Maehlum - Extending the TILES Toolkit – from Ideation to Prototyping
4. http://www.algarytm.comA/it-executives-guide-to-design-thinking:e-book.
5. Marc stickdorn and Jacob Schneider, This is Service Design Thinking, Wiely, 2011

Course Outcomes:

At the end of this course, the student will be able to
innovate new methods in product development(L6)

- apply Design Thinking in developing the new designs(L3)
- select ideas from ideation methods in new product development(L5)
- use Design Thinking in developing software products(L3)
- apply principles of Design Thinking in service design(L3)

19EID134: AI TOOLS
(Common to all)
Effective for admitted batch 2019-20

L T P C
2 0 2 3

The surge in the production of data has led to the development of various technologies. The term "Artificial Intelligence (AI)" has become ubiquitous in everyday applications from virtual assistants to self- driving cars. Several applications such as Healthcare, Finance, Bioinformatics etc. are benefitting from the advances in the domain. The global market for artificial intelligence is going to face a phenomenal growth over the coming years with organizations across the world capitalizing on the disruptive technologies that AI is offering. This course introduces the recent applications of AI namely, Virtual Assistants, Computer Vision, along with trending topics such as Deep Learning and Reinforcement Learning. The idea of the course is to introduce the basic concepts of AI as well as latest trends in the domain. This course is envisaged to provide a basic understanding on latest developments of AI to all disciplines engineering undergraduates.

Course Objectives:

- To provide a basic foundation on different concepts of Artificial Intelligence.
- To investigate various applications of AI such as Virtual Assistants, Computer Vision, as well as other Smart Applications.
- Explore the scope, advantages as well as limitations of intelligent systems.
- Experiment with different machine learning concepts such as Deep Learning and Reinforcement Learning
- To expose students to the AI-intensive computing and information system frameworks.

UNIT I **10L**

Introduction to Artificial Intelligence: Basics of AI Applications of AI.Advanced search Constraint satisfaction problems, Knowledge representation & reasoning, Non-standard logics, Uncertain and probabilistic reasoning.

Conceptual introduction to Machine Learning: Introduction to Neural Networks, Supervised, Unsupervised, and Semi-Supervised Learning Deep Learning, Reinforcement Learning Linear Regression.

Conceptual introduction to Natural Language Processing: Natural language Understanding Sentiment Analysis, Segmentation and recognition.

Conceptual introduction to Speech Recognition & Synthesis: Speech Fundamentals, Speech Analysis, Speech Modelling, Speech Recognition, Speech Synthesis, Text-to-Speech.

Conceptual introduction to Image Processing & Computer Vision: Introduction to Image processing, Image Noise, Removal of Noise from Images, Color Enhancement, Segmentation, Edge Detection, Optical Character Recognition, Feature Detection & Recognition

Learning Outcomes:

After completion of this unit, the student will be able to

- Recognize various domains in which AI can be applied(L2)
- Define machine learning and forms of learning(L1)
- describenaturallanguageprocessingandconceptsforconvertingspeechtodifferentforms(L2)
- identify the concepts of image processing(L3)

UNIT II **12L**

BOT Technologies and Virtual Assistants: Catboats: Introduction to a Chabot, Architecture of a Chabot. NLP in the cloud, NL Interface, how to Build a Chabot, Transform native user experience of catboats, Designing elements of a Chabot, Best practices for Chabot development. NLP components. NLP wrapper to catboats. Audio bots and Music bots.
Virtual Assistants: Architecture of a Virtual Assistant.

Learning Outcomes:

After completion of this unit, the student will be able to
- analyze the architecture of a Chabot(L4)
- illustrate how to construct a Chabot(L2)
- differentiate various catboats(L4)
- interpret the architecture of a virtual assistant(L3)

UNIT III **12L**

Image Processing &Computer Vision: Image-Definition and Tagging. Classification of images. Tagging. Image formation, Deep Learning algorithms for Object detection & Recognition. Face recognition Instance recognition, Feature detection and matching, Segmentation, Recognition Databases and test sets Applications --Feature extraction, Shape identification. Fane detection.
Applications: Automation, Agriculture [Crop and Soil Monitoring, grading farm produce, Predictive Analytics], Retail and Retail Security[Amazon Go],Autonomous vehicles.

Learning Outcomes:

After completion of this unit, the student will be able to
- classify the properties of images(L3)
- interpret the concepts of image processing(L2)
- implement the methods in processing an image(L3)
- analyze and apply the concepts of image processing in automation and agriculture(L4)

UNIT IV **12L**

Reinforcement Learning: Introduction to Reinforcement Learning, Game Playing [Deep Blue in Chess, IBMWatson in Jeopardy, Google's Deep Mind in AlphaGo], Agents and Environment, Action-Value

Function, Deep Reinforced Learning
Applications: Robotics, Gaming, Diagnostic systems, Virtual Assistants.

Learning Outcomes:

After completion of this unit, the student will be able to
- illustrate reinforcement learning(L2)
- employ the reinforcement learning in game playing(L3)
- use reinforcement learning in agent based environment(L3)
- practice learning processsindiagnosticandvirtualassistantsystems(L3)

UNIT V **10L**

Smart Applications: Smart Manufacturing, Smart Agriculture, Smart Healthcare, Smart Education, SmartGrids, Smart Transportation and Autonomous Vehicles, Smart Homes, Smart Cities.

Learning Outcomes:

After completion of this unit, the student will be able to
- understand the application of intelligence in various domains(L2)
- apply the artificial intelligence in various applications(L3)
- correlate the intelligence to advanced applications(L4)

Text Book(s)

1. Tom Markiewicz &Josh Zheng, Getting started with Artificial Intelligence, O'Reilly Media,2017.
2. Stuart J. Russell and Peter Norvig, Artificial Intelligence A Modern Approach. Prentice Hall

References

1. Aurélien Géron, Handson Machine Learning with Scikit- Learn and Tensor Flow [Concepts, Tools, and Techniques to Build Intelligent Systems], Published by O'Reilly Media, 2017.
2. BuildanAIAssistantwithWolframAlphaandWikipediainPython.https://medium.com/@salisuwy/build-an-ai-assistant-with-wolfram-alpha-and-wikipedia-in-python-d9bc8ac838fe
3. JosephHowse,PrateekJoshi,MichaelBeyeler-Opencv_ComputerVisionProjectswithPython- Packt Publishing(2016).
4. CuratedDatasetsonKagglehttps://www.kaggle.com/datasets.

AI TOOLS LABORATORY

List of Practical Experiments:

1. Supervisely-PerformDataLabellingforvariousimagesusingobjectrecognition
2. Lobe.ai-BuildcustommodelsusingthevisualtoolforObjectrecognitionandsentimentanalysisthatcan convert facial expressions into emoticons
3. TeachableMachine-InBrowserObjectRecognitionthroughBrain.JS
4. Liv.ai-App for Speech recognition and Synthesis through APIs
5. Building a Chabot using AWS Lex, Pandorabots
6. Configure an existing Neural Network by manipulating various parameters involved
7. Build a virtual assistant for Wikipedia using Wolfram Alpha and Python
8. Build a Convolutional Neural Network for Cat vs. Dog Image Classification

Online Resources:
Pytorch:
https://pytorch.org/https://git hub.com/pytorch
Keras:
https://keras.io/https://github
.com/keras-team
Theano:
http://deeplearning.net/software/theano/https://github.com/T heano/Theano
Cafee2:
https://caffe2.ai/https://githu b.com/caffe2
Deeplearning4j:
https://deeplearning4j.org/

Scikit-learn:
https://scikit- learn.org/stable/https://github.com/scikit
-learn/scikit-learn

DeepLearning.Ai:
https://www.deeplearning.ai/
OpenCv:
https://opencv.org/https://github.com/q qwweee/keras-yolo3
YOLO:
https://www.pyimagesearch.com/2018/11/12/yolo-object-detection-with- opencv/
nVIDIA:CUDA:
https://developer.nvidia.com/cuda-math-library

Course Outcomes

After completion of this course, the student will be able to

- Distinguish the concepts of artificial intelligence, machine learning, natural language processing, image processing. (L4)
- Illustrate the architectures of Chabot and virtual assistant(L2)
- Analyze image based applications by using image processing concepts(L4)
- Employ reinforcement learning in different applications(L3)
- Identify smart applications(L3)

19EID134: AI TOOLS
(Common to all)
Effective from admitted batch 2020-21 onwards

L T P C
2 023

The surge in the production of data has led to the development of various technologies. The term “Artificial Intelligence (AI)” has become ubiquitous in everyday applications from virtual assistants to self-driving cars. Several applications such as Healthcare, Finance, Bioinformatics etc. are benefitting from the advances in the domain. The global market for artificial intelligence is going to face a phenomenal growth over the coming years with organizations across the world capitalizing on the disruptive technologies that AI is offering. This course introduces the recent applications of AI namely, Virtual Assistants, Computer Vision, along with trending topics such as Deep Learning and Reinforcement Learning. The idea of the course is to introduce the basic concepts of AI as well as latest trends in the domain. This course is envisaged to provide a basic understanding on latest developments of AI to all disciplines engineering undergraduates.

Pre-Requisites:
Courser code: 19EID131
Course Name: Problem Solving and Programming

Course Objectives:

- Provide introduction to basic concepts of Artificial Intelligence.
- Explore applications of AI
- Explore the scope, advantages of intelligent systems
- Experiment with different machine learning concepts
- Exposure to AI-intensive computing and information system frameworks

Unit I **6L+6P**

Introduction to Artificial Intelligence: :Basics of AI. Agents and Environment, The Nature of Environment, Applications of AI:Game Playing [Deep Blue in Chess, IBM Watson in Jeopardy, Google’s Deep Mind in AlphaGo]

Learning Outcomes:

After completion of this unit, the student will be able to

- recognize various domains in which AI can be applied (L2)

Unit II **6L+6P**

Conceptual introduction to Machine Learning:

Supervised, Unsupervised, and Semi-Supervised Learning, Reinforcement Learning, Introduction to Neural Networks, Deep Learning.

Learning Outcomes:

After completion of this unit, the student will be able to

- define machine learning and forms of learning (L1)
- identify types of machine learning(L1)

Unit III **7L+6P**

Image Processing & Computer Vision:

Introduction to Image processing, Image Noise, Removal of Noise from Images, Color Enhancement, Edge Detection, Segmentation, Feature Detection & Recognition. Classification of images. Face recognition, Deep Learning algorithms for Object detection & Recognition.

Learning Outcomes:

After completion of this unit, the student will be able to

- identify the concepts of image processing (L2)
- implement the methods in processing an image (L3)

Unit IV **6L+4P**

Conceptual introduction to Natural Language Processing: Speech Recognition & Synthesis: Speech Fundamentals, Speech Analysis, Speech Modelling, Speech Recognition, Speech Synthesis, Text-to-Speech, Sentiment Analysis, Segmentation and recognition.

Learning Outcomes:

After completion of this unit, the student will be able to

- illustrate how to construct a Chabot (L4)
- describe natural language processing and concepts for converting speech to different forms (L2)

Unit V **7L+6P**

BOT Technologies: Chatbots: Introduction to a Chatbot, Architecture of a Chatbot. NLP in the cloud, NL Interface, how to Build a Chatbot, Transformative user experience of chatbots, Designing elements of a chatbot, Best practices for chatbot development. NLP components. NLP wrapper to chatbots. Audiobots and Musicbots.

Smart Applications: Smart Manufacturing, Smart Agriculture, Smart Healthcare, Smart Education, Smart Grids, Smart Transportation and Autonomous Vehicles, Smart Homes, Smart Cities

Learning Outcomes:

After completion of this unit, the student will be able to

- understand the application of intelligence in various domains(L2)
- correlate Artificial Intelligence to advanced applications(L4)

Text Book(s)

1. Tom Markiewicz & Josh Zheng, Getting started with Artificial Intelligence, Published by O'Reilly Media,2017
2. Stuart J. Russell and Peter Norvig, Artificial Intelligence A Modern Approach.

References

1. AurélienGéron, Hands on Machine Learning with Scikit-Learn and TensorFlow [Concepts, Tools, and Techniques to Build Intelligent Systems], Published by O'Reilly Media,2017
2. Build an AI Assistant with Wolfram Alpha and Wikipedia in Python. https://medium.com/@salisuwy/build- an-ai-assistant-with-wolfram-alpha-and-wikipedia-in-python-d9bc8ac838fe
3. Joseph Howse, Prateek Joshi, Michael Beyeler - Opencv_ Computer Vision Projects with Python-Packt Publishing (2016).
4. Curated Datasets on Kagglehttps://www.kaggle.com/datasets.

AI TOOLS LABORATORY

List of Practical Experiments:

1. Supervisely - Perform Data Labelling for various images using object recognition
2. Teachable Machine - In Browser Object Recognition through Brain.JS
3. Lobe.ai - Build custom models using the visual tool for Object recognition and sentiment analysis that can convert facial expressions into emoticons
4. Haar Cascade Object detection for Eye and Face in Python using OpenCV
5. Text to Speech recognition and Synthesis through APIs
6. Sentiment Analysis and Polarity detection
7. Building a Chatbot using IBM Watson visual studio
8. Building a Chatbot using Pandora bots
9. Build a virtual assistant for Wikipedia using Wolfram Alpha and Python

Online Resources:

Pytorch: https://pytorch.org/ https://github.com/pytorch Keras:
https://keras.io/ https://github.com/keras-team Theano:
http://deeplearning.net/software/theano/ https://github.com/Theano/Theano Cafee2:
https://caffe2.ai/ https://github.com/caffe2 Deeplearning4j:
https://deeplearning4j.org/ Scikit-learn:
https://scikit-learn.org/stable/ https://github.com/scikit-learn/scikit-learn

Deep Learning.Ai:
https://www.deeplearning.ai/ OpenCv:
https://opencv.org/ https://github.com/qqwweee/keras-yolo3 YOLO:
https://www.pyimagesearch.com/2018/11/12/yolo-object-detection-with-opencv/
nVIDIA:CUDA:
https://developer.nvidia.com/cuda-math-library

Course Outcomes:
After completion of this course, the student will be able to

- able to grasp the concepts of artificial intelligence, machine learning, natural language processing, image processing. (L1)
- recognize various domains in which AI can be applied.(L2)
- implement the methods in processing an image.(L3)
- implement simple of chatbots.(L4) .
- identify smart applications. (L4)

19EME122: MECHANICAL ENGINEERING WORKSHOP

L	T	P	C
0	0	3	1.5

The course enables the students of mechanical engineering to gain hands on experience and skills necessary to perform traditional manufacturing operations such as moulding, casting and welding. It also introduces the students to modern manufacturing techniques such as development of composites and use of power tools. The major objective of this course is to make sure that all the mechanical engineering graduates gain practical exposure to manufacturing methods and various manufacturing tools.

Course Objectives

- introduce concepts of moulding and casting techniques .
- train on different types of welding joints.
- impart assembling or disassembling skills.
- demonstrate the manufacturing of plastic components.
- familiarize the use of power tools.

Foundry Practice: (2 Sessions)

i a) Determination of average grain size for sand sample using sieve shaker.
b) Preparation of a green sand mould using single piece pattern.
ii. Preparation of a green san mould using split piece pattern with core and demonstration of casting.

Welding Practice: (2 Sessions)

i. Lap joint, butt joint and T joint using arc welding.
ii. a) Lap joint using resistance spot welding.
b) Lap and butt joints using gas welding.

Assembling/Disassembling Practice: (3 Sessions)

i. Bicycle.
ii. Clutch and carburetor.
iii. Two wheeler engine.

Manufacture of a Plastic Component (2 Sessions)

i. Use of injection moulding machine.
ii. FRP composite using hand layup method.
iii. Joining of plastic components.

Design and manufacture any two domestic utility productswith any material (2 Sessions)
Use of Power Tools (2 Sessions)

Course Outcomes:

After completion of this lab student will be able to

- Make moulds for sand casting. (L3)
- Create different welded joints. (L3)
- Assemble or disassemble simple machine components. (L3)
- create plastic components.(L3)
- Use power tools for different applications. (L1)
- Outline the applications of hydraulic and pneumatic circuits. (L2)

19EHS122: COMPREHENSIVE SKILL DEVELOPMENT I

L	T	P	A	C
0	0	0	6	1

Course Objectives:

- To encourage the all round development of students by focusing on soft skills, Coding & domain skills.
- To make the engineering students aware of the importance, the role and the content of soft skills, Coding and domain skills through instruction, knowledge acquisition, demonstration and practice.
- To develop and nurture the soft skills, coding and domain skills of the students through individual and group activities.
- To expose students to right attitudinal and behavioral aspects and to build the same through activities

Course Outcomes:

- On completion of the course, student will be able to– Effectively communicate through verbal/oral communication and improve the listening skills
- Write precise briefs or reports and technical documents, Actively participate in group discussion / meetings / interviews and prepare & deliver presentations. Become more effective individual through goal/target setting, self motivation and practicing creative thinking.
- Student will be able to understand the problems and develop his competitive coding skills.
- Apply the skills in various domains and will be able to solve complex problems faced by the industry.
- Function effectively in multi-disciplinary and heterogeneous teams through the knowledge of team work, Inter-personal relationships, conflict management and leadership quality

Part-1

A. Verbal and Soft Skills

Self Awareness and Motivation, Goal Setting and Time Management, Interpersonal Skills, Team Work.

B. Quantitative Aptitude and Reasoning

Puzzles, Non-Verbal Reasoning, Data Sufficiency, Analytical Reasoning,

Part-2

Coding: **GitHub** – Accepting assignments pull and push the code or resource, GitHub configuration,
Visual Studio code – Configuring, integrating Git for assignment submission
Online competitive coding platforms – Introduction to online coding platforms to get prepared for competitive coding.
Problem Solving with Python: Collections, Techniques for manipulating Strings, Recursion, Searching, Sorting, Stacks and Queues.
Problem Solving with C: Memory, C Syntax, Conditions and Loops, Functions and Recursion, Arrays, Techniques for manipulating Strings, Searching, Sorting, Stacks and Queues, Structures.

VDC111: Venture Discovery

L	T	P	A	C
0	0	4	0	2

India as part of its Make in India initiative has been focusing on creating incubation centers within educational institutions, with an aim to generate successful start-ups. These start-ups will become employment creators than employment seekers, which is the need of the hour for our country.
This common course for all the disciplines is a foundation on venture development. It is an experiential course that lets students venture and find out what is a business, financial and operating models of a business are. How to design and prototype a solutions that meets their customers' needs and generate revenue for the business.

COURSEOBJECTIVES

- Discover who you are – Values, Skills, and Contribution to Society.
- Gain experience in actually going through the innovation process.
- Conduct field research to test or validate innovation concepts with target customers.
- Understand innovation outcomes: issues around business models, financing for start-ups, intellectual property, technology licensing, corporate ventures, and product line or service extensions.

On successful completion of this course, students will be able to:

	COURSEOUTCOME	Assessment
1	Understand conceptual framework of the foundation of a venture	A1, A2
2	Understand the concept of purpose, mission and value-add service offered by a venture	A3
3	Analyze design and positioning of the product	A3
4	Demonstrate prototyping	A3
5	Analyze business, revenue and operating models	A3

Course outline and indicative content

Unit I (6 sessions)

Personal Values: Defining your personal values, Excite & Excel, Build a Team, Define purpose for a venture. Four stages: Personal Discovery, Solution Discovery, Business Model Discovery, Discovery Integration.

Unit II (6 sessions)

Solution Discovery: Craft and mission statement, Experience design, Gaining user insight, Concept design and positioning, Product line strategy, Ideation & Impact.

Unit III (6 sessions)

Business Model Discovery: Prototyping solutions, Reality Checks, Understand your industry, Types of business models, Define Revenue Models, Define Operating Models

Unit IV (6 sessions)

Discovery Integration: Illustrate business models, Validate business models, Define company impact

Unit V (6 sessions)

Tell a Story: Can you make money, Tell your venture story.

Assessment methods

Task	Task type	Task mode	Weightage (%)
A1. Assignments	Individual	Report/Presentation	20
A2. Case / Project/Assignment	Groups* or Individual	Presentations/Report/Assignment	40
A3. Project	Individual/Group	Report/Pitch	40

Transferrable and Employability Skills

	Outcomes	Assessment
1	Know how to use online learning resources: G-Learn, online journals, etc.	A1 & A2
2	Communicate effectively using a range of media	A1& A2
3	Apply teamwork and leadership skills	A2
4	Find, evaluate, synthesize & use information	A1 & A2
5	Analyze real world situation critically	A3
6	Reflect on their own professional development	A3
7	Demonstrate professionalism & ethical awareness	A2
8	Apply multidisciplinary approach to the context	A2

Learning and teaching activities

Mixed pedagogy approach is adopted throughout the course. Classroom based face to face teaching, directed study, independent study via G-Learn, case studies, projects and practical activities (individual & group)

Teaching and learning resources

Soft copies of teaching notes/cases etc. will be uploaded onto the G-learn. Wherever necessary, printouts, handouts etc. will be distributed in the class. Prescribed text book will be provided to all. However you should not limit yourself to this book and should explore other sources on your own. You need to read different books and journal papers to master certain relevant concepts to analyze cases and evaluate projects. Some of these reference books given below will be available in our library.

***Prescribed Modules*:**

Access to NU-IDEA online modules will be provided.

***Referential text books and journal papers*:**

Personal Discovery Through Entrereneurship, Marc H. Meyer and Chaewon Lee, The Institute of Enterprise Growth, LLC Boston, MA.

Suggested journals:

Vikalpa, Indian Institute of Management, Ahmedabad

Journal of General Management, Mercury House Business Publications, Limited

Harvard Business Review, Harvard Business School Publishing Co. USA

19EMA201: ENGINEERING MATHEMATICS III
(APPLICATIONSOFPDE, COMPLEX VARIABLES AND TRANSFORM TECHNIQUES)
(Common to CIVIL & MECH)

L	T	P	C
3	0	0	3

This course is developed on concepts in applications of partial differential equations and transform techniques to get understand the applications in engineering.

Course Objectives:

- To explain the concept of complex functions and their applications.
- To explore the concept of Laplace and inverse Laplace transforms.
- To express a periodic function by Fourier series and a non-periodic function by Fourier transform.
- To familiarize the students with the techniques of partial differential equations.

UNIT I **10 L**

Complex Variables: Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate. Cauchy theorem, Cauchy integral formula, Taylor's series, Laurent's series, singularities, residues, Cauchy residue theorem (All theorems without proof).

Learning Outcomes:

At the end of this unit, the student will be able to

- identify continuous and differentiable complex functions (L3)
- apply Cauchy-Riemann equations to complex functions in order to determine whether a given continuous function is analytic (L3)
- evaluate the Taylor and Laurent expansions of simple functions, determining the nature of the singularities and calculating residues (L5)
- make use of the Cauchy residue theorem to evaluate certain integrals (L3)

UNIT II **9 L**

Laplace transforms: Definition of Laplace transform, existence conditions, properties of Laplace transforms, inverse Laplace transforms, transforms of derivatives, transforms of integrals, multiplication by t^n, division by t, convolution theorem, periodic functions, unit step function, unit impulse function, applications to ordinary differential equations. (Without proofs)

Learning Outcomes:

At the end of this unit, the student will be able to

- examine the properties of Laplace transformation (L4)
- apply the Laplace and inverse Laplace transformations for different types of functions (L3)
- solve ordinary differential equations by using Laplace transformation technique (L3)

UNIT III **6 L**

Fourier series: Fourier series, Dirichlet's conditions, functions of any period, odd and even functions - half range series.

Learning Outcomes:

At the end of this unit, the student will be able to

- build the Fourier series expansion for different periodic functions (L3)
- analyze the nature of the Fourier series that represent even and odd functions and how derivation of a Fourier series can be simplified in this way (L4)

UNIT IV **8 L**

Fourier Transforms: Fourier integrals, Fourier cosine and sine integrals, Fourier transform, sine and cosine transform, properties, convolution theorem.

Learning Outcomes:

At the end of this unit, the student will be able to

- examine the properties of Fourier transformation (L4)
- apply Fourier transformation for different functions (L3)

UNIT V **9 L**

Applications of Partial Differential Equations: Classification of second order partial differential equations, method of separation of variables, solutions of one dimensional wave equation, one dimensional heat equation and two dimensional Laplace's equation in Cartesian coordinates.

Learning Outcomes:

At the end of this unit, the student will be able to

- classify the nature of the partial differential equations (L4)
- solve the boundary value problems (related to heat diffusion, one dimensional wave equation) (L3)

Course Outcomes:

At the end of the course students will be able to

- make use of differentiation and integration of complex functions in engineering problems (L3)
- apply the Laplace transform for solving differential equations (continuous systems) (L3)
- find the Fourier series of periodic signals (L3)
- know and apply integral expressions for the forwards and inverse Fourier transform to a range of non-periodic waveforms (L3)

- solve the boundary value problems pertaining to partial order differential equations (L3)

Text Book(s):

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2018.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.

References:

1. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9/e, Wiley India, 2009.
2. E. A. Coddington, an Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
3. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7/e, Mc-Graw Hill, 2004.
4. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, 2008.

19EID132: DESIGN THINKING

L	T	P	C
2	**0**	**2**	**3**

Design is a realization of a concept or idea into a configuration, drawing or a product. Design Thinking is cognitive and practical processes by which design concepts are developed by designers. Innovation is a new idea or a new concept. Product development is the creation of a new or different product that offers new benefits to the end user. This course introduces the design thinking in product innovation.

Course Objectives:

1. To familiarize product design process
2. To introduce the basics of design thinking
3. To bring awareness on idea generation
4. To familiarize the role of design thinking in services design

UNIT I **8 L**

Introduction to design, characteristics of successful product development, product development process, identification of opportunities, product planning, innovation in product development

Learning Outcomes:

After completing this unit, the student will be able to
- identify characteristics of successful product development(L3)
- identify opportunities for new product development(L3)
- plan for new product development(L3)

UNIT II **8 L**

Design Thinking: Introduction, Principles, the process, Innovation in Design Thinking, benefits of Design thinking, design thinking and innovation, case studies.

Learning Outcomes:

After completing this unit, the student will be able to
- explain the principles of Design Thinking(L2)
- identify the benefits of Design Thinking(L3)
- use innovations in Design Thinking(L3)

UNIT III **10 L**

Idea generation: Introduction, techniques, Conventional methods, Intuitive methods, Brainstorming, Gallery method, Delphi method, Synectics etc Select ideas from ideation methods, case studies.

Learning Outcomes:

After completing this unit, the student will be able to

- explain the techniques in idea generation(L2)
- select ideas from ideation methods(L3)
- identify the methods used in idea generation in some case studies(L3)

UNIT IV **10 L**

Design Thinking in Information Technology, Design Thinking in Business process model, Design Thinking for agile software development, virtual collaboration, multi user and multi account interaction, need for communication, TILES toolkit, Cloud implementation.

Learning Outcomes:

After completing this unit, the student will be able to

- use Design Thinking in business process model(L3)
- apply Design Thinking for Agile software development(L3)
- use TILES toolkit(L3)

UNIT V **8 L**

Design thinking for service design: How to design a service, Principles of service design, Benefits of service design, Service blueprint, Design strategy, organization, principles for information design, principles of technology for service design.

Learning Outcomes:

After completing this unit, the student will be able to

- use principles of service design(L3)
- explain the benefits of service design(L5)
- apply principles of technology for service design(L3)

Text Book(s):

1. Pahl, Beitz, Feldhusen, Grote – Engineering Design: a systematic approach, Springer, 2007
2. Christoph Meinel and Larry Leifer, Design Thinking, Springer, 2011
3. Aders Riise Maehlum - Extending the TILES Toolkit – from Ideation to Prototyping
4. http://www.algarytm.comA/it-executives-guide-to-design-thinking:e-book.
5. Marc stickdorn and Jacob Schneider, This is Service Design Thinking, Wiely, 2011

Course Outcomes:

At the end of this course, the student will be able to innovate new methods in product development(L6)

- apply Design Thinking in developing the new designs(L3)
- select ideas from ideation methods in new product development(L5)
- use Design Thinking in developing software products(L3)
- apply principles of Design Thinking in service design(L3)

19EME201: ENGINEERING MECHANICS

L	T	P	C
3	0	0	3

This course is an introduction to learning and applying the principles required to solve engineering mechanics problems. Concepts will be applied in this course from previous courses of basic mathematics and physics This course addresses the modeling and analysis of static equilibrium problems with an emphasis on real world engineering applications and problem solving. This course forms the backbone of mechanical engineering design and acts as a prerequisite to mechanics of solids, design of machine elements and kinematics and dynamics of machinery.

Course Objectives:

- Explain the conditions for mechanical quillibrium of the systems subjected to forces and moments.
- Compute geometric properties such as centroid and moment of inertia of various plane sections.
- Explain kinematics of particles and rigid bodies.
- Analyze the rigid bodies under dynamic conditions.
- Expose the concepts of work-energy, conservation of energy and momentum to rigid bodies.

UNIT I **8 L**

Introduction to Engineering Mechanics: Units, Significance of Engineering Mechanics, Composition and resolution of forces, parallelogram law, principle of transmissibility, types of force systems - concurrent and non-concurrent, coplanar forces, resultant of coplanar force systems, couple, moment of a force, Varignon's theorem, concept of free body diagrams, concept of equilibrium of coplanar force systems.

Learning Outcomes:

At the end of this unit, the student will be able to

Recognize the significance of Engineering Mechanics in engineering applications. [**L-1**]
Calculate the resultant of forces and moments of the system of forces. [**L-3**]
Draw free body diagrams of mechanical systems under loads. [**L-3**]
Apply the concept of mechanical equilibrium of the systems. [**L-3**]

UNIT II **8 L**

Friction: Laws of friction, types of friction, equilibrium of force systems involving frictional forces, wedge friction. Free body diagrams involving frictional forces.
Analysis of Structures: Introduction to plane trusses, analysis of plane trusses by method of joints and method of sections.

Learning Outcomes:

At the end of this unit, the student will be able to

- Comprehend the role of friction in engineering applications. [**L-2**]
- Identify different types of trusses. [**L-2**]
- Analyze the plane trusses by method of joints and the method of sections. [**L-4**]

UNIT III **8 L**

Properties of Surfaces: Centroid and center of gravity, derivation of centroids from first moment of area, centroids of composite areas.
Moment of Inertia: Area moment of inertia of plane and composite shapes, parallel axis theorem, perpendicular axis theorem, polar moment of inertia, radius of gyration.

Learning Outcomes:

At the end of this unit, the student will be able to

- Locate the Centre of gravity of plane figures. [**L-1**]
- Calculate the center of gravity of composite plane shapes. [**L-3**]
- Understand the concepts of moment of inertia and radius of gyration. [**L-2**]
- Determine moment of inertia for composite plane shapes. [**L-3**]

UNIT IV **8 L**

Kinematics: Equations of motion for rigid bodies under constant and variable acceleration, rectilinear and curvilinear motion, projectile motion, use of rectangular coordinates, tangential and normal coordinates, radius of curvature, rotation of a rigid body about a fixed axis.

Learning Outcomes:

At the end of this unit, the student will be able to

- Develop equations of motion for particles and rigid bodies in motion. [**L-3**]
- Find velocity and acceleration in rectilinear and curvilinear motions. [**L-3**]
- Trace the path of projectile. [**L-2**]

UNIT V **8 L**

Kinetics: Principles of dynamics - Newton's Laws of motion, D'Alembert's principle in rectilinear translation, principle of work and energy.
Ideal Systems: Principle of conservation of energy, concept of power, conservation of linear momentum, principle of momentum and impulse, impact - types of impact.

Learning Outcomes:

At the end of this unit, the student will be able to

- Apply Newton’s laws and D'Alembert's principle in rectilinear translation. [**L-3**]
- Apply the principle of work and energy in dynamic systems. [**L-3**]
- Use of principles of momentum and impulse on dynamic systems . [**L-3**]

Course Outcomes:

Upon successful completion of the course, the students will be able to

- Apply equilibrium concepts on mechanical systems [**L-3**]
- Analyse the forces and moments on the mechanical systems [**L-5**]
- Calculate the physical properties of rigid bodies in engineering systems. [**L-3**]
- Understand the role of friction in engineering practices [L1]
- Analyze various static and dynamic engineering mechanical systems and understand the mechanics and identify the drawbacks/problems. [**L-4**]

Text Book(s):

1. N.H. Dubey, Engineering Mechanics: Statics and Dynamics, Tata McGraw Hill, 2014.
2. S. Timoshenko, D.H. Young, J.V. Rao, Sukumar Pati, Engineering Mechanics (in SI units), 5/e, McGraw Hill, 2013.

References:

1. Basudeb Bhattacharya, Engineering Mechanics, 2/e, Oxford University Press (India), 2015.
2. Irving Shames, G.K.M. Rao, Engineering Mechanics: Statics and Dynam-ics, 4/e, Pearson, 2009.
3. K.L. Kumar, Veenu Kumar, Engineering Mechanics, 4/e, Tata McGraw Hill, 2010.
4. S.S. Bhavikatti, Engineering Mechanics, 4/e, New Age International, 2008.

19EME203: THERMODYNAMICS

L	T	P	C
2	**1**	**0**	**3**

The course thermodynamics is foundation course in thermal stream, which draws the attention by connecting day-to-day activities with thermodynamic concepts. The basic concepts such as internal energy, enthalpy, entropy and flow and non-flow process are able to develop the problem solving skills pertinent to thermodynamics. Further, the course provides enhanced insight in to the steam and usage of steam tables

Course Objectives

- Familiarize concepts of heat, work, energy and governing rules for conversion of one form to other.
- Explain relationships between properties of matter and basic laws of thermodynamics.
- Teach the concept of entropy for identifying the disorder and feasibility of a thermodynamic process.
- Introduce the concept of available energy for maximum work conversion.
- Familiarize steam properties to understand working of steam power plants.

UNIT I **10 L**

Introduction: Macroscopic and microscopic viewpoints, definitions of thermodynamic terms, quasi – static process, point and path function, forms of energy, ideal gas and real gas, Zeroth law of thermodynamics.
First law of Thermodynamics: Joule's experiment - first law of thermodynamics, corollaries-perpetual motion machines of first kind, first law applied to non-flow and flow process- limitations of first law of thermodynamics**.**

Learning Outcomes:

At the end of this Unit, the student will be able to

- Identify thermodynamic systems, properties and their importance in solving engineering problems. (L2)
- explain energy balance for closed systems and open systems. (L3)
- solve simple thermodynamics problems. (L3)

UNIT II **8 L**

Second Law of Thermodynamics: Kelvin - Planck statement and Clausius statement and their equivalence, corollaries - perpetual motion machines of second kind - reversibility and irreversibility, cause of irreversibility - Carnot cycle, heat engine, heat pump and refrigerator, Carnot theorem, Carnot efficiency.

Learning Outcomes:

At the end of this Unit, the student will be able to

- apply second law of thermodynamics in design of heat engine, refrigerator and heat pump.(L3)
- explain the efficiency of thermodynamic systems.(L2)
- enumerate the causes for poor performance of thermodynamic systems.(L3)

UNIT III **8 L**

Entropy: Clausius inequality -Concept of Entropy- entropy equation for different processes and systems

Availability and Irreversibility: Definition of exergy and energy, expressions for availability and irreversibility. Availability in steady flow, non-flow processes, irreversibility.

Learning Outcomes:

At the end of this Unit, the student will be able to

- apply entropy affects to estimate the performance of systems. (L3)
- evaluate entropy changes in a wide range of processes and determine the reversibility or irreversibility of a process.(L3)
- explain thermo-economics.(L3)

UNIT IV **8 L**

Properties of Steam and use of Steam Tables: Pure Substances, P-V-T surfaces, T-s and h-s diagram, Mollier chart, dryness fraction, property tables, analysis of steam undergoing various thermodynamic processes using Mollier chart– steam calorimetry.

Learning Outcomes:

At the end of this Unit, the student will be able to

- apply properties of steam to design steam systems.(L3)
- examine steam systems using conservation equations.(L3)
- evaluate the performance of steam systems.(L4)

UNIT V **8 L**

Thermodynamic Relations: Maxwell relations, TdS equations, difference in heat capacities, ratio of heat capacities, Energy equation, Joule Thompson coefficient, Clausius-Clapeyron equation.

Learning Outcomes:

At the end of this Unit, the student will be able to

- Explain the importance of T-ds equations. (L2)
- Relate specific heats, internal energy, enthalpy and Joule-Thomson coefficient in standard form. (L3)

Course Outcomes:

After completing the course, the student will be able to

- explain the importance of thermodynamic properties related to conversion of heat energy into work.(L3)
- Apply the laws of thermodynamics to boilers, heat pumps, refrigerators, heat engines, compressors and nozzles. (L3)
- apply concept of entropy for identifying the disorder and feasibility of a thermodynamic process
- Utilize steam properties to design steam based components. (L4)
- apply the thermodynamic equations studied to design thrmal systems (L4)

Text Book(s)

1. P.K.Nag, Engineering Thermodynamics, 5/e, Tata McGraw Hill, 2013.
2. Yunus A. Cengel, Michaela A. Boles, Thermodynamics, 7/e, Tata McGraw Hill, 2011.

References

1. J.B.Jones and G.A.Hawkins, Introduction to Thermodynamics, 2/e, John Wiley & Sons, 2012.
2. Moran, Michael J. and Howard N. Shapiro, Fundamentals of Engineering Thermodynamics, 3/e, Wiley, 2015
3. Claus Borgnakke Richard E. Sonntag, Fundamentals of Thermodynamics, 7/e, Wiley, 2009
4. R.K. Rajput, S.Chand& Co., Thermal Engineering, 6/e, Laxmi publications, 2010.

19EME205: MATERIAL SCIENCE AND ENGINEERING

L	T	P	C
3	0	0	3

The focus of the course is on crystal structures of metals. The course addresses both theoretical and practical aspects of materials engineering. It imparts knowledge on the microstructure, mechanical properties and heat treatment methods of ferrous and nonferrous metals and alloys. This course also gives an insight in to the properties and applications of ceramics, polymers, composites and nanomaterials.

Course Objectives:

- To teach the principles of physical metallurgy, i.e. crystallography of metals, constitution of alloys and construction of phase diagrams.
- To explain the methods to change the properties of steels through various heat treatment processes.
- To explain the properties and applications of commercially important steels and cast irons with their engineering constraints.
- To explain the properties and applications of important non ferrous metals/alloys.
- To familiarize students with the structure, properties and applications of ceramics, polymers, composite materials and nanomaterials.

.

UNIT I **10 L**

Structure of Metals: Crystal Structures: Unit cells, Metallic crystal structures. Imperfection in solids: Point, Line and Volume imperfections. Dislocation strengthening mechanisms and slip systems, critically resolved shear stress.
Constitution of Alloys: Necessity of Alloying, substitutional and interstitial solid solutions, Intermediate alloy phases. Phase diagrams: Phase rule, methods of construction of phase diagrams, lever rule. Eutectic, peritectic, peritectoid and monotectic reactions. Study of Iron - Iron carbide diagram and microstructural aspects of ferrite, cementite, austenite, ledeburite and pearlite.

Learning Outcomes:

At the end of this unit the student will be able to

- Recall crystallography of various metals.(L1)
- Distinguish between metals and alloys. (L4)
- Construct binary phase diagrams.(L3)
- Identify various invariant reactions in binary phase diagrams.(L3)

UNIT II **8 L**

Heat Treatment of Steels: Annealing, normalizing, hardening and tempering. Isothermal transformation diagrams for steels and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties.Austemperingmartempering. Case hardening: Carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening.

Learning Outcomes:

At the end of this unit the student will be able to

- Explain the importance of heat treatment of metals and alloys. (L2)
- Summarize the effect of heat of treatment on modification of properties of steels. (L2)
- Develop a heat treatment cycle based on properties required.(L3)
- Explain the principles of various surface hardening methods.(L2)

UNIT III **8 L**

Steels: Plain carbon steels, use and limitations of plain carbon steels. Classification of alloys steels. Microstructure, properties and applications of alloy steels - stainless steels and tool steels.
Cast Irons: Microstructure, properties and applications of white cast iron, malleable cast iron, grey cast iron, nodular cast iron and alloy cast irons.

Learning Outcomes:

At the end of this unit the student will be able to

- Explain the uses and limitations of plain carbon steels. (L2)
- Classify various types of alloy steels and explain their microstructure, properties and applications. (L2)
- Identify various types of cast irons and explain their microstructure, properties and applications. (L3)
- Compare properties of steels and cast irons and their limitations. (L4)

UNIT IV **8 L**

Non-ferrous Metals and Alloys: Microstructure, properties and applications of copper and its alloys, aluminium and its alloys. Study of Al-Cu phase diagram, precipitation hardening. Microstructure, properties and applications of titanium and its alloys.

Learning Outcomes:

At the end of this unit the student will be able to

- Identify the differences between ferrous and non-ferrous metals and alloys. (L3)
- Explain the importance of non-ferrous metals and alloys in engineering applications. (L2)
- Explain various microstructures, properties and applications of commercially important non-ferrous alloys. (L2)

- Identity the difference between hardening method of ferrous and non-ferrous alloys. (L3)

UNIT V **8 L**

Ceramics, Polymers and Composites: Structure, properties and applications of ceramics, polymers and composites. Introduction to super alloys and nanomaterials.

Learning Outcomes:

At the end of this unit the student will be able to

- Explain the structure, properties and applications of ceramics. (L2)
- Summarize the structure and properties of polymers and composites and their uses. (L2)
- Explain the properties of nanomaterials and their applications.(L2)
- Identify the difference between the micro and nano scale materials and their uses. (L3)

Course Outcomes:

After completing the course, the student will be able to

- Explain the crystallography of metals, constitution of alloys and also can construct binary phase diagrams. (L2)
- Select an appropriate heat treatment method to modify the properties of steels. (L3)
- Select a suitable type of steel, cast iron for a given application. (L3)
- Choose an appropriate non ferrous metal/alloy for various applications. (L3)
- Explain the structure, properties and applications of composite, polymer, ceramic materials and nanomaterials. (L2)

Text Book(s):

1. V. Raghavan, Material Science and Engineering, 5/e, Prentice Hall of India, 2004.
2. R. Balasubramaniam, Callister's, Material Science and Engineering, 2/e, Wiley India, 2014.

References:

1. Y. Lakhtin, Engineering Physical Metallurgy, University Press of the Pacific, 2000.
2. S.H. Avner, Introduction to Physical Metallurgy, 2/e, Tata McGraw Hill, 1997.
3. L.H. VanVlack, Elements of Material Science and Engineering, 6/e, Pearson Education, 2008.
4. George E. Dieter, Mechanical Metallurgy, 3/e, Tata McGraw Hill, 2013.

19EME231: COMPUTER AIDED MACHINE DRAWING

L	T	P	C
1	0	3	2.5

This course familiarizes the students to representation of mechanical components such as threads, keys, joints etc. and introduces modeling software to represent assembling and disassembling of mechanical components with emphasis on dimensioning and tolerancing. This course acts as a prerequisite to computer aided engineering software to perform structural and thermal analysis on structures.

Course Objectives

- Introduce conventional representations of materials and machine components.
- Provide Training on 2D and 3D modeling software for creating 2D assembly drawings from 3D assemblies.
- Give exposure to thread profiles, riveted, welded and key joints.
- Teach solid modeling techniques for drawing of machine parts and their sections.
- Familiarize with limits, fits and tolerances in mating components.

The following contents are to be done by any 2D software package
Conventional representation of materials and components:

Detachable joints: Drawing of thread profiles, hexagonal and square-headed bolts and nuts, bolted joint, bolted joint with washer and locknut, stud joint, screw joint.
Riveted joints: Drawing of rivet, lap joint, butt joint with single strap, single riveted, double riveted double strap joints.
Welded joints: Lap joint and T joint with fillet, butt joint with conventions.
Keys: Taper key, sunk taper key, round key, saddle key, feather key, woodruff key.
Shaft coupling, bushed pin-type flange coupling, universal coupling, Oldhams' coupling.
The following contents to be done by any 3D software package
Sectional views
Creating solid models of complex machine parts and create sectional views.
Assembly drawings: (Any four of the following using solid model software)
Lathe tool post, tool head of shaping machine, tail stock, machine vice, gate valve, carburettor, piston, connecting rod, excentric, screw jack, plumber block, axle bearing, pipe vice, clamping device, Geneva cam, universal coupling,
Manufacturing drawing:
Representation of limits fits and tolerances for mating parts.Use any four parts of above assembly drawings and prepare manufacturing drawing with dimensional and geometric tolerances.

Course Outcomes:

After completion of this lab student will be able to

- Demonstrate the conventional representations of materials and machine components.**[L-2]**
- Draw riveted, welded and key joints using CAD system.**[L-3]**
- Create solid models and sectional views of machine components.**[L-3]**
- Generate solid models of machine parts and assemble them.**[L-3]**
- Translate 3D assemblies into 2D drawings. **[L-3]**
- Create manufacturing drawing with dimensional and geometric tolerances.**[L-3]**

Text Book(s):

1. K.L. Narayana, P. Kannaiah, A text book on Engineering Drawing, SciTech Publications, 2014.

References:

1. Cecil Jensen, Jay Helsel and Donald D. Voisinet, Computer Aided Engineering Drawing, Tata McGraw Hill, 2000.
2. James Barclay, Brain Griffiths, Engineering Drawing for Manufacture, Kogan Page Science, 2003.
3. N.D. Bhatt, Machine Drawing, 50/e, Charotar, 2014.
4. K.L. Narayana, Production Drawing, 3/e, NewAge International Publishers, 2014.

19EMC281: CONSTITUTION OF INDIA (Mandatory Course)

L	T	P	C
3	0	0	0

UNIT I **10 L**

Introduction to Indian Constitution: Constitutional history, constituent assembly, salient features of the constitution, significance of preamble, amending process of the constitution.

UNIT II **8 L**

Rights and Duties: Citizenship, fundamental rights and directive principles, fundamental duties.

UNIT III **8 L**

Union Government: President and vice president, election, removal and powers, prime minister and council of ministers, parliament, supreme court, union, state relations, emergency provisions.

UNIT IV **8 L**

State and Local Governments: Governor, state legislature, assembly and council, chief minister and council of ministers, high court, rural and urban local governments with special reference to 73rd and 74th constitutional amendment acts.

UNIT V **8 L**

Other Constitutional and Statutory Bodies: Comptroller and auditor gen-eral, election commission, finance commission, attorney general and advocate general, union public service commission (UPSC), state public service commissions (SPSCs), tribunals, national human rights commission (NHRC).

Text Book(s):

1. J. C. Johari, Indian Government and Politics, Vishal Publications, Delhi, 2009.
2. M. V. Pylee, Introduction to the Constitution of India, 5/e, Vikas Publishing House, Mumbai, 2007.

References:

1. D.D. Basu, Introduction to the Indian Constitution, 21/e, Lexis Nexis, Gurgaon, India, 2011.
2. Subhas C. Kashyap, Our Constitution, 2/e, National Book Trust India, New Delhi, 2013.

19EMC282: ENVIRONMENTAL SCIENCES (COMMON SYLLABUS FOR ALL BRANCHES)

L	T	P	C
3	**0**	**0**	**0**

The course enables the students to adapt eco-centric thinking and actions rather than human-centric thinking on natural resources, their utilization and conservation. The course also focuses on the importance of ecosystems, biodiversity and their degradation leads to pollution, finding solutions through application of control measures to combat pollution and legal measures to achieve sustainable development.

Course Objectives:

- To familiarize the students about the importance of the environmental studies.
- To acquaint with different natural resources and their associated problems.
- To introduce various ecosystems, values of biodiversity and their conservation.
- To expose to today's pollution levels and their impacts.
- To create awareness on different social issues such as conservation of water, green building concept.
- To study on present population scenario, its impacts and role of informational technology on environment and human health.

UNIT – I **10 L**

Introduction to Environment and Natural Resources: Introduction to environment: Definition, scope and importance, multidisciplinary nature of environment, need for public awareness. Natural Resources: Renewable and non-renewable resources, natural resources and associated problems. Forest resources: Uses, Reasons for over-exploitation, deforestation effects, timber extraction, case studies. Water resources: Use and over – utilization of surface and ground water, floods, drought, conflicts over water, dams- benefits and problems. Mineral resources: Uses, environmental effects of extracting and using mineral resources, case studies. Food resources: World food problems, Impacts of overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. Energy resources: Growing energy needs, use of renewable and non renewable energy sources, case studies. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

Learning Outcomes:

After the completion of the Unit I, the student will be able to

- **list** different renewable and non-renewable resources. **(L1)**
- **learn how** the over-exploitation of natural resources impact human life. **(L1)**
- **demonstrate** the role of an individual in the conservation of natural resources. **(L1)**
- **explain** the equitable use of natural resources for sustainable lifestyles. **(L2)**

UNIT - II **9 L**

Ecosystems and Biodiversity: Structure components of ecosystem: Biotic and Abiotic components. Functional components of an ecosystem: Food chains, Food webs, Ecological pyramids, Energy flow in the ecosystem (10% law), Ecological succession. Biogeochemical cycle: (Nitrogen, carbon, Phosphorus cycle). Introduction, types, structure and function of the following ecosystem:- Forest ecosystem. Grassland ecosystem. Desert ecosystem. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries). Biodiversity: Definition, Levels of biodiversity: genetic, species and ecosystem diversity. Biogeographical classification of India, Values of biodiversity: consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega – diversity nation.Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Conservation of biodiversity: In – situ and Ex-situ conservation of biodiversity.

Learning Outcomes:

After the completion of the Unit II, the student will be able to

- **Learn** ecosystem functions. **(L1)**
- **Explain** the structure and function of terrestrial and aquatic ecosystems. **(L2)**
- **Illustrate** the values and threats to biodiversity. **(L2)**
- **Explain** the importance of conservation of biodiversity. **(L2)**

UNIT – III **8 L**

Environmental Pollution and Control: Environmental Pollution: Definition, causes, effects and control measures: Air Pollution, Water pollution, Soil pollution, Marine pollution, Thermal pollution, Nuclear hazards, Solid waste Management, e-waste, Hazardous waste management. Role of an individual in prevention of pollution. Pollution case studies. Disaster Management: floods, earthquake, cyclone and landslides.

Learning Outcomes:

After the completion of the Unit III, the student will be able to

- **List** causes, effects and control measures of pollution (air, water & soil). **(L1)**
- **Classify** different types of pollutants. **(L2)**
- **Explain** disaster management of floods, earthquake, cyclone and landslides. **(L2)**
- **Identify** the pollution related case studies. **(L3)**
- **Demonstrate** the role of an individual in prevention of pollution. **(L3)**

UNIT – IV **9 L**

Social Issues and Global Environment Problems and Efforts: From unsustainable to sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed management, and remote sensing and GIS methods. Resettlement and rehabilitation of people: its problems and concerns. Case Studies, Environmental ethics: Issues and possible solutions. Green building concept, Environmental Impact Assessment (Checklists, matrix methods), Environmental Management Plan, Climate change: global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.

Learning Outcomes:

After the completion of the Unit IV, the student will be able to

- **Explain** different water conservation methods. **(L2)**
- **Compare** remote sensing and GIS methods. **(L2)**
- **Apply** green building concept. **(L3)**
- **Demonstrate** the consequences of global warming, acid rains and ozone layer depletion. **(L3)**
- **Analyze** environmental impact assessment and management plan. **(L4)**

UNIT - V **6 L**

Human Population and Environment Legislation: Population growth, variation among nations. Family Welfare programme. Environment and human health. HIV/AIDS, Human rights. Value Education. Women and Child Welfare. Role of Information Technology in Environment and human health. Environment Legislation. Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act .Wildlife Protection Act .Forest Conservation Act. Environmental Protection Act, Pollution prevention act. Issues involved in enforcement of environmental legislation. Public awareness. Project Work.

Learning Outcomes:

After the completion of the Unit V, the student will be able to

- **Compare** population growth and variation among nations. **(L2)**
- **Apply** value education. **(L3)**
- **Classify** women and child welfare. **(L3)**
- **Distinguish** different environmental legislation acts and issues involved in enforcement of legislation. **(L4)**
- **Analyze** the role of information technology in environment and human health. (**L4)**

Course Outcomes:

After the completion of the course, the student will be able to

- **Explain** about environment and natural resources. **(L2)**
- **Illustrate** the values and threats to biodiversity. **(L2)**
- **Identify** the pollution related case studies. **(L3)**
- **Demonstrate** the consequences of global warming, acid rains and ozone layer depletion. **(L3)**
- **Analyze** the role of information technology in environment and human health. **(L4)**

Text Book(s):

1. Anubha Kaushik and C.P. Kaushik, Text book of environmental studies New Age International Publisher (2014).
2. ErachBarucha, Text book of environmental studies for undergraduates courses, published by – University Grants Commission, University Press (2005)
3. AninditaBasak, Environmental Studies. Pearson (2009)

References:

1. D.K. Asthana and Meera Asthana, A Text book of Environmental Studies, S. Chand (2010).
2. P.M Cherry Solid and Hazardous waste Management, CBS Publisher (2016).
3. Charles H. Ecclestion, Environmental Impact Assessment, CRC Press (2011).
4. K.K. Singh, Natural Resources Conservation and Management, MD Publications (2008).
5. J. Jeffrey Peirce, Ruth F. Weiner and P. AarneVesilind, Environmental Pollution and Control, Butterworth-Heinemann (1998).
6. James Maclaurin and Kim Sterelny, What is Biodiversity, The University of Chicago Press (2008).
7. R.B. Mandal, Introductory Methods in Population Analysis, Concept Publishing Co, (2007).

19EHS221: COMPREHENSIVE SKILL DEVELOPMENT II

L	T	P	A	C
0	**0**	**0**	**6**	**1**

Course Objectives:

- To encourage the all-round development of students by focusing on soft skills, Coding & domain skills.
- To make the engineering students aware of the importance, the role and the content of soft skills, Coding and domain skills through instruction, knowledge acquisition, demonstration and practice.
- To develop and nurture the soft skills, coding and domain skills of the students through individual and group activities.
- To expose students to right attitudinal and behavioral aspects and to build the same through activities

Course Outcomes:

- On completion of the course, student will be able to– Effectively communicate through verbal/oral communication and improve the listening skills
- Write precise briefs or reports and technical documents, actively participate in group discussion / meetings / interviews and prepare & deliver presentations. Become more effective individual through goal/target setting, self-motivation and practicing creative thinking.
- Student will be able to understand the problems and develop his competitive coding skills.
- Apply the skills in various domains and will be able to solve complex problems faced by the industry.
- Function effectively in multi-disciplinary and heterogeneous teams through the knowledge of team work, Inter-personal relationships, conflict management and leadership quality

Part-1

A. Verbal and Soft Skills:
Communication Skills, Presentation Skills, Decision Making and Problem-Solving, Group Discussion.

B. Quantitative Aptitude and Reasoning
Puzzles, Numbers, Arithmetic, Data Interpretation.

Part-2

Coding: Complex problem solving using Data Structures in terms of improving efficiency:
Time Complexity and Space Complexity, Linked List, Stacks and Queues using Linked List, Binary Trees, Binary Search Trees, Trie, Representation of graphs, Breadth First Search, Depth First Search, Dynamic Programming.

SEMESTER IV

19EMA202: ENGINEERING MATHEMATICS - IV

(Common to EEE, MECH and CIVIL)

L	T	P	C
3	0	0	3

This course is designed to cover basic numerical methods, probability& statistical concepts. The first two units focus on solution of algebraic equations, interpolation and numerical methods for differentiation and integration, the other three units cover the concepts of probability and statistics to lay a strong foundation in engineering applications.

Course Objectives:

- To familiarize the students with the ways of solving nonlinear equations numerically.
- To teach various topics such as interpolation, numerical differentiation, numerical integration and numerical solution of ordinary differential equations.
- To impart knowledge on the concepts in probability, random variables and several distributions in engineering applications.
- To demonstrate the concept of Testing of hypothesis for large and small samples.

UNIT I: **9 L**

Solution to Algebraic Equations: Solution of polynomial and transcendental equations: bisection method and Newton-Raphson method. Finite differences, relation between operators, interpolation using Newton's forward and backward difference formulae, interpolation with unequal intervals: Lagrange's formula.

Learning Outcomes:

At the end of this unit, the student will be able to

- find approximate roots of the an equation by using different numerical methods (L3)
- explain various discrete operators and find the relation among operators(L3)
- apply Newton's forward and backward formulae for equal and unequal intervals (L3)

UNIT II: **10 L**

Numerical Differentiation and Integration: Numerical Differentiation- Newton's forward and backward difference formulae, numerical integration- trapezoidal rule and Simpson's 1/3rd and 3/8 rules. Ordinary differential equations- Euler, modified Euler's, Runge-Kutta method of fourth order for solving first and second order equations.

Learning Outcomes:

At the end of this unit, the student will be able to

- find differentiation of a function by using different numerical methods (L3)
- find integration of a function by using different numerical methods (L3)

- solve ordinary differential equations by using different numerical schemes (L3)

UNIT III: **8 L**

Probability: Random variables (discrete and continuous), probability distribution: Binomial - Poisson approximation to the binomial distribution, normal distribution and exponential distribution-their properties (mathematical expectation and variance).

Learning Outcomes:

At the end of this unit, the student will be able to

- apply Binomial and Poisson distributions for real data to compute probabilities, theoretical frequencies (L3)
- interpret the properties of normal distribution, exponential distribution and their applications (L3)

UNIT IV: **8 L**

Testing of Hypothesis: Formulation of null hypothesis, critical regions, level of significance.
Large sample tests: test for single proportion, difference of proportions, test for single mean and difference of means.

Learning Outcomes:

At the end of this unit, the student will be able to

- explain the concept of estimation, interval estimation and confidence intervals (L3)
- apply the concept of hypothesis testing for large samples (L3)

UNIT V: **7 L**

Small Sample Tests: Student t-distribution (single mean, two means and paired t-test), Testing of equality of variances (F-test), $\chi 2$ - test for goodness of fit.

Learning Outcomes:

At the end of this unit, the student will be able to

- apply the concept of testing hypothesis for small samples to draw the inferences (L3)
- test for the goodness of fit (L4)

Course Outcomes:

At the end of the course students will be able to

- solve approximating the roots of polynomial and transcendental equations by different algorithms (L3)

- apply different algorithms for approximating the solutions of ordinary differential equations to its analytical computations (L3)
- apply discrete and continuous probability distributions (L3)
- identify the components of a classical hypothesis test (L3)
- inference based on small and large sampling tests using statistical methods (L4)

Text Book(s):

1. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.
2. P. Kandasamy, K. Thilagavathy, K. Gunavathi, Numerical Methods, S. Chand & Company, 2/e, Reprint 2012.

References:

1. Veerarajan T., Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2008.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9/e, John Wiley & Sons, 2006.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

19EID234: LIFE SCIENCES FOR ENGINEERS

L	T	P	C
2	0	2	3

This course introduces the student, to the basics of biology such as cell structure, bimolecular structure and function, metabolism, inheritance and basic concepts of recombinant DNA technology.

Course Objectives

- Introduce the molecular basis of life.
- Provide the basis for classification of living organisms.
- Describe the transfer of genetic information**.**
- Introduce the techniques used for modification of living organisms**.**
- Describe the applications of biomaterials

UNIT I **(5+5) L**

Introduction to Biology: Comparison of eye and camera, flying bird and aircraft, Biological observations and major discoveries- genera, species and strains, and Classification of living organisms: Cellularity, Ultrastructure, carbon and energy sources, excretion, habitat and molecular taxonomy.

Learning Outcomes:

After completing this unit, the student will be able to

- Summarize the basis of life. (L2)
- Distinguish prokaryotes from eukaryotes. (L3)
- Compare biological organisms and manmade systems. (L2)
- Classify organisms. (L2)

UNIT II **(6+6) L**

Water, Biomolecules: sugars, starch and cellulose, Amino acids and proteins, lipids, Nucleotides and DNA/RNA, structure and functions of proteins and nucleic acids, hemoglobin, antibodies and enzymes, Industrial applications of enzymes, Fermentation and its industrial applications

Learning Outcomes:

After completing this unit, the student will be able to

- Outline the importance of water. (L2)
- explain the relationship between monomeric units and polymeric units (L2)
- Explain the relationship between the structure and function of proteins. (L2)
- Interpret the relationship between the structure and function of nucleic acids. (L2)
- Summarize the applications of enzymes in industry. (L2)
- Explain the applications of fermentation in industry. (L2)

UNIT III **(6+6) L**

Bioenergetics, Respiration: Glycolysis and TCA cycle, Electron transport chain and oxidative phosphorylation, Mechanism of photosynthesis, Human physiology, neurons, synaptic and neuromuscular junctions

Learning Outcomes:

After completing this unit, the student will be able to

- Apply thermodynamic principles to biological systems. (L2)
- Explain the mechanism of respiration and photosynthesis. (L2)
- Summarize the principles of information transfer and processing in humans. (L2)

UNIT IV **(6+6) L**

Mendel’s laws, gene mapping, Mitosis and Meiosis, Epistasis, single gene disorders in humans, Genetic code, DNA replication, Transcription, Translation

Learning Outcomes:

After completing this unit, the student will be able to

- Define Mendel’s laws. (L1)
- Demonstrate the mapping of genes. (L2)
- explain interactions among genes and their significance
- Differentiate the mitosis and meiosis. (L3)
- Explain the medical importance of gene disorders. (L2)
- Identify DNA as a genetic material in the molecular basis of information transfer. (L2)

UNIT V **(5 +5) L**

Recombinant DNA Technology: recombinant vaccines, transgenic microbes, plants and animals, animal cloning, biosensors, biochips.

Learning Outcomes:

After completing this unit, the student will be able to

- Outline the principles of recombinant DNA technology. (L2)
- Appreciate the potential of recombinant DNA technology.(L2)
- Summarize the use of biological materials for diagnostic devises. (L2)

Course Outcomes:

After studying the course, the student will be able to:

- Explain catalytic properties of enzymes. (L2)
- Summarize application of enzymes and fermentation in industry. (L2)
- Identify DNA as a genetic material in the molecular basis of information transfer. (L2)
- Apply thermodynamic principles to biological systems. (L2)
- Analyze biological processes at the reductionistic level. (L4)
- Appreciate the potential of recombinant DNA technology. (L2)

Lab Experiments (Virtual or Field Experiments)

Microscopy, Mendel's laws, mapping, interactions, - 4 lab experiments
Nitrogen cycle, Species interactions, Sterilization, Bacterial population growth, - 4 lab experiments

Text book(s):

1. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A global approach", Pearson Education Ltd, 2018.
2. Arthur T Johnson, Biology for Engineers, CRC press, 2011

Reference Books:

1. Alberts Et.Al. The molecular biology of the cell, 6/e, Garland Science, 2014
2. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, "Outlines of Biochemistry", John Wiley and Sons, 2009.
3. John Enderle and Joseph Bronzino Introduction to Biomedical Engineering, 3/e, 2012

19EID232: INTERNET OF THINGS
(For 2020-21 Odd and Even Sems and 2021-22 Odd Sem only)
(Common to all)

L	T	P	C
2	0	2	3

The Internet of Things (IoT) is a network of a wide variety of devices like vehicles, humans, soil etc. These devices gather data using sensors, which can be used for monitoring or control. This course is an introduction to the embedded devices, communication protocols and APIs used in IoT.

Course Objectives

- To introduce the fundamental concepts of IoT and physical computing
- To expose the student to a variety of embedded boards and IoT Platforms
- To create a basic understanding of the communication protocols in IoT communications.
- To familiarize the student with application program interfaces for IoT.
- To enable students to create simple IoT applications.

UNIT I **5L + 2 P**

Overview of IoT: The Internet of Things: An Overview, The Flavor of the Internet of Things, The "Internet" of "Things", The Technology of the Internet of Things, Enchanted Objects, Who is Making the Internet of Things?, Design Principles for Connected Devices, Calm and Ambient Technology, Privacy, Keeping Secrets, Whose Data Is It Anyway?, Web Thinking for Connected Devices, Small Pieces, Loosely Joined, First-Class Citizens On The Internet, Graceful Degradation, Affordances.

Learning Outcomes:

After completion of this unit, student will be able to
- explain IoT architecture (L2)
- interpret the design principles that govern connected devices (L2)
- summarize the roles of various organizations for IoT (L2)

UNIT II **6 L + 6 P**

Embedded Devices - I: Embedded Computing Basics, Microcontrollers, System-on-Chips, Choosing Your Platform, Arduino, Developing on the Arduino, Some Notes on the Hardware, Openness.

Learning Outcomes:

After completion of this unit, student will be able to
- explain the basics of microcontrollers (L2)
- outline the architecture of Arduino (L2)
- develop simple applications using Arduino (L3)

UNIT III **6 L + 6 P**

Embedded Devices - II: Raspberry Pi , Cases and Extension Boards, Developing on the Raspberry Pi, Some Notes on the Hardware, Openness, Other notable platforms, Mobile phones and tablets, Plug Computing: Always-on Internet of Things.

Learning Outcomes:

After completion of this unit, student will be able to

- outline the architecture of Raspberry Pi (L2)
- develop simple applications using Raspberry Pi (L3)
- select a platform for a particular embedded computing application (L3)

UNIT IV **6 L + 6 P**

Communication in the IoT: Internet Principles, Internet Communications: An Overview, IP, TCP, The IP Protocol Suite (TCP/IP), UDP, IP Addresses, DNS,Static IP Address Assignment, Dynamic IP Address Assignment, IPv6, MAC Addresses, TCP and UDP Ports, An Example: HTTP Ports, Other Common Ports, Application Layer Protocols- HTTP, HTTPS: Encrypted HTTP, Other Application Layer Protocols.

Learning Outcomes:

After completion of this unit, student will be able to

- interpret different protocols and compare them (L2)
- select which protocol can be used for a specific application (L3)
- Utilize the Internet communication protocols for IoT applications (L3)

UNIT V **6 L + 6 P**

Prototyping Online Components: Getting Started with an API, Mashing Up APIs, Scraping, Legalities, Writing a New API, Clockodillo, Security, Implementing the API, Using Curl to Test, Going Further, Real-Time Reactions, Polling, Comet, Other Protocols, MQ Telemetry Transport, Extensible Messaging and Presence Protocol, Constrained Application Protocol.

Learning Outcomes:

After completion of this unit, student will be able to

- select IoT APIs for an application: (L3)
- design and develop a solution for a given application using APIs: (L6)
- test for errors in the application: (L4)

INTERNET OF THINGS LAB

List of Practical Experiments:

1. Select any one development board (Eg., Arduino or Raspberry Pi) and control LED using the board.
2. Using the same board as in (1), read data from a sensor. Experiment with both analog and digital sensors.
3. Control any two actuators connected to the development board using Bluetooth.
4. Read data from sensor and send it to a requesting client. (using socket communication) Note: The client and server should be connected to same local area network.
5. Create any cloud platform account, explore IoT services and register a thing on the platform.
6. Push sensor data to cloud.
7. Control an actuator through cloud.
8. Access the data pushed from sensor to cloud and apply any data analytics or visualization services.
9. Create a mobile app to control an actuator.
10. Identify a problem in your local area or college which can be solved by integrating the things you learned so far and create a prototype to solve it (Mini Project).

Text Book(s):

1. Adrian McEwen, Hakim Cassimally - Designing the Internet of Thing Wiley Publications, 2012.

Reference Books:

1. ArshdeepBahga, Vijay Madisetti - Internet of Things: A Hands-On Approach, Universities Press, 2014.
2. Pethuru Raj, Anupama C. Raman, The Internet of Things, Enabling technologies and use cases –CRC Press 2017.

Reference:

https://www.arduino.cc/
https://www.raspberrypi.org/

19EID232: INTERNET OF THINGS
(w.e.f. 2021-22AY Even Semester)

L T P C
2 0 2 3

The Internet of Things (IoT) is a network of a wide variety of devices like vehicles, humans, soil etc. These devices gather data using sensors, which can be used for monitoring or control. This course is an introduction to the embedded devices, communication protocols and APIs used in IoT.

Course Objectives

- Introduce the fundamental concepts of IoT and its characteristics
- Expose the student to sensors used for sensing different physical quantities
- Create a basic understanding of the communication protocols in IoT communications.
- Familiarize the student with different application program interfaces for accessing Cloud services.
- Enable students to create simple IoT applications.

Unit I **5 Hours**

Introduction to Internet of Things (IoT): Introduction and Definition of Internet of Things, IoT Growth, Application Areas of IoT, Characteristics of IoT, Things in IoT, IoT Stack, Enabling Technologies, IoT Challenges, IoT Levels, IoT vs. Cyberphysical Systems, IoT vs WSN

Learning Outcomes:

After completion of this unit, the student will be able to

- describe IoT architecture and application areas (L2)
- interpret the design principles that govern connected devices(L2)
- summarize the different IoT levels and compare with different systems (L2)

Unit II **6 Hours**

Introduction to Sensors, Microcontrollers, and Their Interfacing: Introduction to Sensor Interfacing, Types of Sensors, Controlling Sensors through Webpages, Microcontrollers

Learning Outcomes:

After completion of this unit, the student will be able to

- list the different physical quantities and their sensing mechanisms (L1)
- describing the interfacing of sensors with embedded computing systems (like Arduino/Raspberry Pi and electrical signal relationships(L2)
- demonstrate the control of sensors using webpage interfaces (L4)

Unit III **6 Hours**

Protocols for IoT – Messaging and Transport Protocols: Messaging Protocols, Transport Protocols (Li-Fi, BLE), Protocols for IoT – Addressing and Identification: Internet Protocol Version 4 (IPv4), Internet Protocol Version 6 (IPv6), Uniform Resource Identifier (URI)

Learning Outcomes:

After completion of this unit, the student will be able to

- interpret different protocols and compare them(L2)
- select which protocol can be used for a specific application(L3)
- utilize the Internet communication protocols for IoT applications(L3)

Unit IV **5 Hours**

Cloud for IoT: IoT with Cloud – Challenges, Selection of Cloud Service Provider for IoT Applications, Introduction to Fog Computing, Cloud Computing: Security Aspects, Case Study: How to use Adafruit Cloud?

Learning Outcomes:

After completion of this unit, the student will be able to

- describe the cloud architecture for collecting data from different sensors and analyzing them (L2)
- choose a service provider for a specific IoT application(L3)
- analyze different case studies involving Cloud IoT and discuss the security aspects (L3)

Unit V **6 Hours**

Data Analytics – Visualizing the Power of Data from IoT, Data Analysis, Machine Learning, Types of Machine Learning Models, Model Building Process, Modelling Algorithms, Model Performance. Application Building with IoT: Smart Perishable Tracking with IoT and Sensors, Smart Healthcare – Elderly Fall Detection with IoT and Sensors, IoT–Based Application to Monitor Water Quality Smart Warehouse Monitoring, Smart Retail

Learning Outcomes:

After completion of this unit, the student will be able to

- describe the architecture of IoT involving data collection and analysis
- list the types of machine learning models used to analyze collected data (L2)
- discuss different applications of IoT illustrating the use of different data analyses and machine learning algorithms (L3)

Text Book:

1. Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram, Internet of Things, Wiley India, 2019

List of Experiments (2 Hours each)

1. Blinking led with Arduino using software delay, LED Control with switch
2. Temperature measurement using LM35 and display both on LCD and serial monitor
3. Control DC motor with H-bridge and as well as PWM
4. Raspberry pi installation and led control
5. DHT11 sensor interfacing to Raspberry pi and Transfer the data to Thingspeak server
6. Interfacing camera and raspberry pi
7. Accelerometer ADXL345 with i2c with raspberry pi
8. Nodemcu to control LED with thinger.io
9. With Nodemcu HTTP protocol get and post
10. With nodemcu Webserver control led
11. MQTT protocol using Nodemcu
12. Blinky app with led control

Text Book(s)

1. Simon Monk, Programming Arduino: Getting Started with Sketches, Mc Graw Hill Publications, 2011
2. Simon Monk, Programming the Raspberry Pi, Getting Started with Python, Mc Graw Hill Publications, 2015
3. Simon Monk, Hacking Electronics: Learning Electronics with Arduino and Raspberry Pi, Mc Graw Hill Publications, 2017
4. Manoj R. Thakur, NodeMCU ESP8266 Communication Methods and Protocols : Programming with Arduino IDE Amazon Media, 2018.

19EME202: STRENGTH OF MATERIALS

L	T	P	C
3	1	0	4

This course helps in understanding the material and geometrical behavior of solid structures such as beams, shafts and other membersx. This courses teaches the fundamentals required to perform design calculations to check the safety, reliability and life of structures and other mechanical components and hence central to the whole activity of engineering design. The basic knowledge gained from this course is vital to understanding advanced material behavior which can later be studied in courses such as design of machinery and polymer materials

Course Objectives:

- Introduce the concepts of different stresses, strains and their relationships.
- Explain shear force and bending moment of different beams under different loading conditions.
- Demonstrate the calculation of bending stresses and shear stresses on beams and to predict the slope and deflection of beams
- Explain shearing stresses and strains in a circular shaft subject to torsion
- Discuss the principal stresses and components of stress on different planes under different loads

UNIT I **10 L**

Simple Stresses and Strains: Types of stresses and strains - Hooke's law in three dimensions, stress-strain diagrams - Axially loaded bars of uniform and varying cross section, Compound bars, Relation between elastic moduli, Thermal stresses.

Learning Outcomes:

After completing this unit, the student will be able to

- Determine the stresses and deformation due to axial loads in simple structures. (L3)
- analyse the stresses in compound bars. (L4)
- Understand the relationships between various elastic constants. (L1)
- analyse the stresses in bars due to temperature change.(L4)

UNIT II **10 L**

Shear Force and Bending Moment Diagrams: Types of beams and loads, Shear force and bending moment diagram for cantilever, simply supported and overhanging beams for different types of loadings, Point of contra flexure, Relation between load, shearing force and bending moment.

Learning Outcomes:

After completing this unit, the student will be able to

- draw shear force and bending moment diagrams of beams under different loading conditions.(L3)
- Evaluate the maximum shear force and bending moment and their location in beams. (L3)
- Locate contraflexural points

UNIT III **10 L**

Bending and Shear stresses in beams: Flexural formula, distribution of bending and shear stresses across various cross sections of beams.

Learning Outcomes:

After completing this unit, the student will be able to

- Determine bending and shear stresses in beams under different loading. (L3)

UNIT IV **10 L**

Torsion of Circular Shafts: Torsion - Torsion equation - solid and hollow circular shaft - Torsional rigidity - power transmitted by the shafts, combined bending and torsion.
Complex stresses: Biaxial state of stress with and without shear- principal stresses - Mohr's circ

Learning Outcomes:

After completing this unit, the student will be able to

- analyse circular shafts subjected to twisting couple. (L4)
- Design shafts for power transmission. (L4)
- Understand the principal stresses and planes
- construct the Mohr's circle for calculating stresses on oblique planes.(L4)

UNIT V **8 L**

Deflection of Beams: Differential equations of the deflection curve, Slope and deflection using double integration method, Macaulay's method.

Learning Outcomes:

After completing this unit, the student will be able to

- compute the slope and deflection in beam under different loading.(L3)
- Distinguish various approaches for calculating slope and deflection. (L2)v

Text Book(s):

1. F.P. Beer, E.R. Johnston, Jr&John.T. DeWolf, Mechanics of Materials, 7/e, Tata McGraw-Hill, 2016.
2. SS Rattan, Strength of materials, 3/e, Tata McGraw-Hill, 2016.

References:

1. Timoshenko, Strength of Materials Part-I& II, 3/e, CBS Publishers, 2004.
2. Popov, Mechanics of Solids, 2/e, New Pearson Education, 2015.

Course Outcomes:

After successful completion of this course student will be able to

- Understand the concepts of stress and strains in members due to different types of loading. (L1)
- Interpret the significance of shear forces and bending moments in beams. (L2)
- Apply the concepts of shear forces and bending moments to find the stresses, slopes and deflections in beams.(L3)
- Analyse the stresses and strains in various mechanical Engineering components.(L5)

19EME232: APPLIED THERMODYNAMICS

L	T	P	C
2	1	3	4.5

The course Applied Thermodynamics is the application of the concepts acquired course from previous courses you have taken in Engineering Thermodynamics. This course mainly focus on air-standard and vapour cycles where thermodynamic process involving energy conversion takes place in power plants, compressors, turbines or rocket engines, IC engines, refrigeration systems. The knowledge of this course is essential in solving several practical applications in the power sector.

Course Objectives

- provide fundamental concepts of thermodynamic cycles used in steam power plants, IC engines and gas turbines
- Familiarize the developments in IC engines.
- Teach combustion process in SI and CI engines.
- familiarize concepts of thermodynamic cycles used in steam power plants and gas turbines
- impart knowledge on the working of nozzles, refrigeration and air conditioning

UNIT I **10 L**

Air Standard Cycles: Otto, Diesel and dual cycles, P-V and T -S diagrams - description and efficiencies, mean effective pressures. Comparison of Otto, Diesel and dual cycle
IC Engines: Working and classification of IC engines, comparison of two stroke and four stroke engines, comparison of SI and CI Engines.

Learning Outcomes:

At the end of this Unit, the student will be able to
- Examine the importance of compression ratio. (L2)
- Explain the cycles on which internal combustion engines work. (L3)
- Understand working of IC engines on the basis of thermodynamic cycles. (L2)

UNIT II **10 L**

Testing and Performance of IC Engines: Methods of testing IC Engines, performance analysis of IC Engines.
Combustion in IC Engines: SI engine: stages of combustion, normal combustion, abnormal combustion, variables effecting delay period and knocking, pre-ignition. CI engine: stages of combustion, normal combustion, abnormal combustion, variables effecting delay period and knocking. Fuel requirements and fuel rating.

Learning Outcomes:

After completion of this unit, students will be able to

- Estimate engine performance. (L4)
- Identify the effects of abnormal combustion in IC engines. (L3)

UNIT III **8 L**

Vapour Power Cycles: Vapour power cycle, simple Rankine cycle, mean temp of heat addition thermodynamic variables effecting efficiency and output of Rankine cycle
Nozzles: Type of nozzles - air and steam nozzles. Compressible flow through nozzle- condition for maximum discharge - nozzle efficiency.

Learning Outcomes:

After completion of this unit, students will be able to

- Explain concepts of vapour power cycle used in steam power plant. (L2)
- Compare the performance of nozzles, used in turbines. (L2)

UNIT IV **8 L**

Gas power Cycle: Brayton cycle, Simple gas turbine plant, closed cycle and open cycle for gas turbines, condition for maximum pressure ratio and optimum pressure ratio, actual cycle

Learning Outcomes:

After completion of this unit, students will be able to

- Evaluate the cycles used in gas turbines. (L4)
- outline the jet propulsion system (L2)

UNIT V **8 L**

Refrigeration: Bell-Coleman cycle - vapour compression cycle, effect of vapour condition on COP of VCR, vapour absorption cycle, properties of common refrigerants
Principles of Psychrometry and Air Conditioning: Psychometric terms, psychometric processes and air conditioning systems.

Learning Outcomes:

After completion of this unit, students will be able to

- Outline the operation of refrigerators. (L2)
- identify different refrigerants and applications.(L3)
- Use properties of moist air in calculations for air-conditioning system. (L3)

Text Book(s)

1. Ganesan V, Internal Combustion Engines, Tata McGraw Hill, 2017.
2. M.L.Mathur and F.S.Mehta, Thermal Engineering, Jain brothers,2014

References:

1. Cengal Y.A and Boles M.A, Thermodynamics: An Engineering Approach, 5/e, McGraw-Hill, 2006.
2. Yahya, S. M., Turbines, Compressors and Fans, 4/e, Tata McGraw Hill, 2010.
3. Nag P.K, Engineering Thermodynamics, 4/e, Tata McGraw-Hill, 2008.
4. Onkar Singh, Thermal Turbomachines, 3/e, Wiley India, 2014.
5. P.L.Ballaney, Thermal Engineering, 2/e, Khanna, 2005.

Course Outcomes:

After completing this course, the students will be able to

- Compare thermodynamic relations and air standard cycles. (L2)
- Explain working of IC engines with combustion process. (L2)
- use T-s diagram in vapour power and gas power cycles.(L3)
- select appropriate refrigerant for different applications.(L3)

THERMAL ENGINEERING LAB

Course Objectives:

- Understand the functioning and performance of I.C. Engines
- Find heat losses in various engines

LIST OF EXPERIMENTS

1. Demonstration of diesel and petrol engines by cut models
2. Valve timing diagram of 4-stroke diesel engine
3. Port timing diagram of 2-stroke petrol engine
4. Performance of 2-stroke single cylinder petrol engine
5. Morse test on multi cylinder petrol engine
6. Performance of 4-stroke single cylinder diesel engine
7. Performance of two stage reciprocating air compressor
8. Performance of Refrigeration system
9. Performance of Air conditioning system
10. Assembly and disassembly of diesel and petrol engines
11. Performance of heat pipe
12. Performance of heat pump
13. Exhaust gas analysis of orsat apparatus.
14. Determinations of nozzle characteristics.

Course Outcomes:

Upon the successful completion of course, students will be able to

- explain different working cycles of engine
- describe various types of combustion chambers in IC engines
- illustrate the working of refrigeration and air conditioning systems
- Evaluate heat balance sheet of IC engine.

19EME234: FLUID MECHANICS

L	T	P	C
3	**1**	**3**	**5.5**

This course provides an introduction to the properties of fluids. It introduces concepts of statics, kinematics and dynamics of fluids and unfolds the procedure to develop the underlying governing equations that explains the behavior of fluids in motion. Successively, solutions to various practical problem involving internal flows and external flows are covered. This course extends to compressible fluid flow concepts at fundamental level and addresses the dimensional analysis and enables to apply the concepts in wide range of disciplines engineering.

Course Objectives

- To impart the knowledge of fluid properties and their behavior in static and dynamic states.
- To acquaint mathematical techniques to fluid flow problems.
- To familiarize solution methods in one dimensional viscous flow of different cases
- To introduce the concepts of boundary layer
- To teach the concepts of compressible fluids

UNIT-I **9 L**

Definition of fluid. Properties of fluid, compressibility, surface tension, vapour pressure, Newton's law of viscosity, Newtonian and Non-Newtonian fluids. Pressure and its measurement, basic principles of hydrostatic forces on surfaces.
Fluid kinematics: Classification of flows-steady and unsteady, uniform and non-uniform, laminar and turbulent, rotational and irrational, viscous and inviscid, internal and external flows, continuity equation,stream line, stream tube, stream function, potential function, vorticity and circulation, vortex motion, free and forced vortices.

Learning Outcomes:

After completion of this unit, students will be able to

- interpret the properties of fluid and their application (L2)
- select appropriate method for analyzing fluid flow problems (L1)
- understand principles of continuity in fluid motions (L2)

UNIT – II **9 L**

Fluid Dynamics: Conservation of momentum, conservation of energy, Euler's equation, Bernoulli’s equation Measurement of flow- Venturimeter, Orificemeter and Pitot tube.
Flow through pipes: Loss of head due to friction in pipes, Darcy-Weisbach equation - friction factor, minor losses. Laminar and turbulent flow through pipes, Hagen-Poiseuille flow.

Learning Outcomes:

After completion of this unit, students will be able to

- convert conservation laws into flow governing equations (L3)
- apply Bernoulli's principle for determining flow in measuring devices (L3)
- solve governing equations for solutions of simple fluid flow problems (L3)
- compute major and minor losses in pipe flows (L4)

UNIT – III

Boundary layer theory: Concept of boundary layer, boundary layer thicknesses, von-Karman momentum integral method, effect of pressure gradient, Boundary layer separation, Methods to prevent separation.

Learning Outcomes:

After completion of this unit, students will be able to

- identify importance of boundary layer theory (L3)
- evaluate factors influencing laminar and turbulent flow (L4)
- employ suitable method to control flow separation(L4)

UNIT – IV **9 L**

Dimensional analysis: Fundamental and derived dimensions, Rayleigh method, Buckingham theorem, dimensionless groups, application of dimensional groups, model testing and similitude, types of similarity - geometric, kinematic and dynamic, model testing methods.

Learning Outcomes:

After completion of this unit, students will be able to

- Identify repeating and non-repeating variables to form π- terms
- employ suitable scaling laws for converting model to prototype (L3)
- use similitude principle to test prototypes of machines (L3)

UNIT – V **9 L**

Compressible fluid flow: Introduction, thermodynamic relations, basic equations in compressible flow, velocity of pressure wave in a fluid, propagation of pressure waves, Mach number, stagnation properties, area and velocity relation in compressible flow, applications

Learning Outcomes:

After completion of this unit, students will be able to

- identify the difference between compressible and incompressible flows (L2)
- use the gas equation for compressible fluid flow (L2)

- apply Mach number in compressible fluid flow applications (L3)

Text Book(s)

1) S K Som, Gautam Biswas, S. Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, McGraw Hill Education, 2017

References:

2) C.S.P.Ojha, R. Berndtsson and P. N. Chadramouli, Fluid Mechanics and Machinery, OxfordUniversity Press, 2010
3) P N Modi and S M Seth, Hydraulics & Fluid Mechanics Including Hydraulics Machines, Standard Book House, 2017
4) YunusCengel, John Cimbala, Fluid Mechanics, McGraw Hill Education, 2017
5) Jagdish Lal, Hydraulic Machines Including Fluidics, Metropolitan Book Co. Pvt. Ltd., 2016

Course Outcomes:

At the end of the course, student will be able to

- Interpret the behavior under static and dynamic conditions. (L2)
- analyze one dimensional viscous flows using conservation laws for compressible and incompressible flows. (L4)
- Apply boundary layer flows for laminar and turbulent regimes. (L3)
- Explain procedure of dimensional analysis and its application. (L3)
- compare compressible and incompressible flows and interpret significance of Mach number (L2)

FLUID MECHANICS AND HYDRAULIC MACHINERY LAB

Course Objectives:

- Explain the application of Bernoulli's equation in internal flows
- Familiarize with the performance of turbines and pumps
- Develop skill for measurement of pressure in external flows

LIST OF EXPERIMENTS

1. Free and Forced vortex apparatus
2. Calibration of Venturi meter / Orifice meter
3. Resistance characteristics of pipes – friction factor.
4. Minor losses in pipes – sudden contraction/bends/valves
5. Impact of a jet on flat and curved plates
6. Performance characteristics of single and multi stage centrifugal pump.
7. Performance characteristics of reciprocating pump.
8. Performance characteristics of Pelton wheel turbine.

9. Performance characteristics of Francis turbine.
10. Performance characteristics of Kaplan turbine.

Course Outcomes:

Upon the successful completion of course, students will be able to

- explain the devices used for measuring flow
- compute major losses in pipes
- illustrate the operating parameters of turbines
- explain the working of different types of pumps

19EME204: MANUFACTURING PROCESSES

L	T	P	C
3	0	0	3

This course emphasizes the basics of various manufacturing processes so that the student will able to choose an appropriate manufacturing process for a given application.It imparts knowledge of unconventional processes and their application.

Course Objectives:

- To explain different casting processes and gating systems.
- To familiarize with different welding processes and welding defects.
- To teach plastic deformation, cold and hot working process, different types of rolling mills.
- To explain forging tools and dies.
- To familiarize manufacturing methods of plastics, ceramics and powder metallurgy components.

UNIT I **8 L**

Introduction: Importance and selection of manufacturing processes.
Casting Processes: Introduction to casting process. Process steps. Pattern: types, materials and allowance. Cores: Types of cores, core prints. Principles and design of gating system. Solidification of casting: Concept, solidification of pure metal and alloy. Special casting processes: Shell casting, investment casting, die casting, centrifugal casting. Casting defects and remedies.

Learning Outcomes:

At the end of this unit, the student will be able to

- Select suitable manufacturing process for a given product. (L3)
- Describe steps involved in metal casting, pattern making. (L2)
- Choose gating systems and risers. (L3)
- Compare the working of various metal casting processes. (L2)
- Identify the various casting defects. (L3)

UNIT II **8 L**

Metal Forming: Introduction, nature of plastic deformation, hot and cold working of metals, mechanics of metal forming; Rolling: Principle, types of rolling mill and products, roll passes, forces in rolling and power requirements. Extrusion: Basic extrusion process and its characteristics, hot extrusion and cold extrusion, wire drawing, tube drawing.
Forging: Principle of forging. Tools and dies used in forging. Types: Smith forging, drop forging, forging hammers, rotary forging and forging defects. Sheet metal forming: Mechanics of sheet metal working, blanking, piercing, bending, stamping.

Learning Outcomes:

At the end of this unit, the student will be able to

- Compare cold working and hot working processes. (L2)
- Explain the working of rolling mills. (L2)
- Evaluate the forces and power in rolling and extrusion processes. (L3)
- Summarize the working of various extrusion processes. (L2)
- Identify the principles of forging, tools and dies. (L3)
- Summarize the various operations of Sheet metal forming. (L2)

UNIT III **8 L**

Metal Joining Processes: Classification of welding processes, types of welds and welded joints and V-I characteristics, arc welding, weld bead geometry, submerged arc welding, gas tungsten arc welding, gas metal arc welding. Applications, advantages and disadvantages of the above processes. Heat affected zone in welding. Soldering and brazing: Types and their applications. Welding defects: causes and remedies.

Learning Outcomes:

At the end of this unit, the student will be able to

- Classify various welding processes. (L2)
- Explain V-I characteristics of different welding processes. (L2)
- Summarize the applications, advantages of various welding processes. (L2)
- Identify the defects in welding. (L3)

UNIT IV **8 L**

Plastic Processing, Ceramics and Powder Metallurgy:
Plastics: Processing of plastics, extrusion of plastics, transfer molding and compression molding, injection molding, thermoforming, rotational molding and blow molding.
Ceramics: Ceramic powder preparation; Processing of ceramic parts: Pressing, casting, sintering; secondary processing of ceramics: Coatings, finishing.
Powder Metallurgy: Manufacture of powders, steps involved in making a component using powder metallurgy.

Learning Outcomes:

At the end of this unit, the student will be able to

- Explain methods of manufacturing plastics parts. (L2)
- Explain the steps in making ceramics parts. (L2)
- Explain the steps in manufacturing of powder metallurgy parts. (L2)
- Illustrate the application of plastic, ceramics and power metallurgy. (L2)

UNIT V **10 L**

Unconventional Machining Processes: Principle and processes parameters of Electrical discharge machining (EDM), electro-chemical machining (ECM) Laser beam machining (LBM), plasma arc machining (PAM), electron beam machining (EBM), Abrasive jet machining (AJM), water jet machining and ultrasonic machining

Learning Outcomes:

At the end of this unit, the student will be able to

- Identify different unconventional machining processes. (L2)
- evaluate process parameters of EDM, ECM, LBM, PAM and AJM.(L4)
- Apply various unconventional machining processes. (L3)

Course Outcomes:

At the end of the course, the student will be able to

- Demonstrate different metal casting processes and gating systems. (L2)
- Classify working of various welding processes. (L2)
- Evaluate the forces and power requirements in rolling process. (L4)
- Explain the principles of various forging operations. (L3)
- Outline the manufacturing methods of plastics, ceramics and powder metallurgy. (L1)
- Identify different unconventional processes and their applications. (L3)

Text Book(s):

1. S. Kalpakjain andS.R.Schmid, Manufacturing Engineering and Technology, 7/e, Pearson, 2018.
2. P.N.Rao, Manufacturing Technology – Volume I, 5/e, McGraw-Hill Education, 2018.

Reference Books:

1. P.Millek. Groover, Fundamentals of Modern Manufacturing: Materials, Processes and Systems, 4/e, John Wiley and Sons Inc, 2010.
2. P.C.Sharma, A Text book of Production Technology, 8/e, S Chand Publishing, 2014.
3. Ian Gibson, David W. Rosen, Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, 1st Edition, Springer, 2010.

19EMC281: CONSTITUTION OF INDIA
(Mandatory Course)

L	T	P	C
3	**0**	**0**	**0**

UNIT I **10 L**

Introduction to Indian Constitution: Constitutional history, constituent assembly, salient features of the constitution, significance of preamble, amending process of the constitution.

UNIT II **8 L**

Rights and Duties: Citizenship, fundamental rights and directive principles, fundamental duties.

UNIT III **8 L**

Union Government: President and vice president, election, removal and powers, prime minister and council of ministers, parliament, supreme court, union, state relations, emergency provisions.

UNIT IV **8 L**

State and Local Governments: Governor, state legislature, assembly and council, chief minister and council of ministers, high court, rural and urban local governments with special reference to 73rd and 74th constitutional amendment acts.

UNIT V **8 L**

Other Constitutional and Statutory Bodies: Comptroller and auditor gen-eral, election commission, finance commission, attorney general and advocate general, union public service commission (UPSC), state public service commissions (SPSCs), tribunals, national human rights commission (NHRC).

Text Book(s):

1. J. C. Johari, Indian Government and Politics, Vishal Publications, Delhi, 2009.
2. M. V. Pylee, Introduction to the Constitution of India, 5/e, Vikas Publishing House, Mumbai, 2007.

References:

1. D.D. Basu, Introduction to the Indian Constitution, 21/e, Lexis Nexis, Gurgaon, India, 2011.
2. Subhas C. Kashyap, Our Constitution, 2/e, National Book Trust India, New Delhi, 2013.

19EMC282 - ENVIRONMENTAL SCIENCES
(COMMON SYLLABUS FOR ALL BRANCHES)

L	T	P	C
3	**0**	**0**	**0**

The course enables the students to adapt eco-centric thinking and actions rather than human-centric thinking on natural resources, their utilization and conservation. The course also focuses on the importance of ecosystems, biodiversity and their degradation leads to pollution, finding solutions through application of control measures to combat pollution and legal measures to achieve sustainable development.

Course Objectives

- To familiarize the students about the importance of the environmental studies.
- To acquaint with different natural resources and their associated problems.
- To introduce various ecosystems, values of biodiversity and their conservation.
- To expose to today's pollution levels and their impacts.
- To create awareness on different social issues such as conservation of water, green building concept.
- To study on present population scenario, its impacts and role of informational technology on environment and human health.

UNIT – I **10 L**

Introduction to Environment and Natural Resources: Introduction to environment: Definition, scope and importance, multidisciplinary nature of environment, need for public awareness. Natural Resources: Renewable and non-renewable resources, natural resources and associated problems. Forest resources: Uses, Reasons for over-exploitation, deforestation effects, timber extraction, case studies. Water resources: Use and over – utilization of surface and ground water, floods, drought, conflicts over water, dams- benefits and problems. Mineral resources: Uses, environmental effects of extracting and using mineral resources, case studies. Food resources: World food problems, Impacts of overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. Energy resources: Growing energy needs, use of renewable and non renewable energy sources, case studies. Role of an individual in conservation of natural resources.Equitable use of resources for sustainable lifestyles.

Learning Outcomes:

After the completion of the Unit I, the student will be able to

- **List** different renewable and non-renewable resources. **(L1)**
- **Learn how** the over-exploitation of natural resources impact human life. **(L1)**
- **Demonstrate** the role of an individual in the conservation of natural resources. **(L1)**
- **Explain** the equitable use of natural resources for sustainable lifestyles. **(L2)**

UNIT - II **9 L**

Ecosystems and Biodiversity: Structure components of ecosystem: Biotic and Abiotic components. Functional components of an ecosystem: Food chains, Food webs, Ecological pyramids, Energy flow in the ecosystem (10% law), Ecological succession. Biogeochemical cycle: (Nitrogen, carbon, Phosphorus cycle). Introduction, types, structure and function of the following ecosystem:- Forest ecosystem. Grassland ecosystem. Desert ecosystem. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries). Biodiversity: Definition, Levels of biodiversity: genetic, species and ecosystem diversity. Biogeographical classification of India, Values of biodiversity: consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega – diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Conservation of biodiversity: In – situ and Ex-situ conservation of biodiversity.

Learning Outcomes:

After the completion of the Unit II, the student will be able to

- **Learn** ecosystem functions. **(L1)**
- **Explain** the structure and function of terrestrial and aquatic ecosystems. **(L2)**
- **Illustrate** the values and threats to biodiversity. **(L2)**
- **Explain** the importance of conservation of biodiversity. **(L2)**

UNIT – III **8 L**

Environmental Pollution and Control: Environmental Pollution: Definition, causes, effects and control measures: Air Pollution, Water pollution, Soil pollution, Marine pollution, Thermal pollution, Nuclear hazards, Solid waste Management, e-waste, Hazardous waste management. Role of an individual in prevention of pollution. Pollution case studies. Disaster Management: floods, earthquake, cyclone and landslides.

Learning Outcomes:

After the completion of the Unit III, the student will be able to

- **List** causes, effects and control measures of pollution (air, water & soil). **(L1)**
- **Classify** different types of pollutants. **(L2)**
- **Explain** disaster management of floods, earthquake, cyclone and landslides. **(L2)**
- **Identify** the pollution related case studies. **(L3)**
- **Demonstrate** the role of an individual in prevention of pollution. **(L3)**

UNIT – IV **9 L**

Social Issues and Global Environment Problems and Efforts: From unsustainable to sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed management, and remote sensing and GIS methods. Resettlement and rehabilitation of people: its problems and concerns. Case Studies, Environmental ethics: Issues and possible solutions. Green building concept, Environmental Impact Assessment (Checklists, matrix methods), Environmental Management Plan, Climate change: global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.

Learning Outcomes:

After the completion of the Unit IV, the student will be able to

- **Explain** different water conservation methods. **(L2)**
- **Compare** remote sensing and GIS methods. **(L2)**
- **Apply** green building concept. **(L3)**
- **Demonstrate** the consequences of global warming, acid rains and ozone layer depletion. **(L3)**
- **Analyze** environmental impact assessment and management plan. **(L4)**

UNIT - V **6 L**

Human Population and Environment Legislation: Population growth, variation among nations. Family Welfare programme. Environment and human health. HIV/AIDS, Human rights. Value Education.Women and Child Welfare. Role of Information Technology in Environment and human health. Environment Legislation. Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act.Wildlife Protection Act.Forest Conservation Act. Environmental Protection Act, Pollution prevention act. Issues involved in enforcement of environmental legislation. Public awareness. Project Work.

Learning Outcomes:

After the completion of the Unit V, the student will be able to

- **Compare** population growth and variation among nations. **(L2)**
- **Apply** value education. **(L3)**
- **Classify** women and child welfare. **(L3)**
- **Distinguish** different environmental legislation acts and issues involved in enforcement of legislation. **(L4)**
- **Analyze** the role of information technology in environment and human health. (**L4)**

Course outcomes:

After the completion of the course, the student will be able to

- **Explain** about environment and natural resources. **(L2)**
- **Illustrate** the values and threats to biodiversity. **(L2)**
- **Identify** the pollution related case studies. **(L3)**
- **Demonstrate** the consequences of global warming, acid rains and ozone layer depletion. **(L3)**
- **Analyze** the role of information technology in environment and human health. **(L4)**

Text Book(s):

1. Anubha Kaushik and C.P. Kaushik, Text book of environmental studies New Age International Publisher (2014).
2. ErachBarucha, Text book of environmental studies for undergraduates courses, published by – University Grants Commission, University Press (2005)
3. AninditaBasak, Environmental Studies. Pearson (2009)

References:

1. D.K. Asthana and Meera Asthana, A Text book of Environmental Studies, S. Chand (2010).
2. P.M Cherry Solid and Hazardous waste Management, CBS Publisher (2016).
3. Charles H. Ecclestion, Environmental Impact Assessment, CRC Press (2011).
4. K.K. Singh, Natural Resources Conservation and Management, MD Publications (2008).
5. J. Jeffrey Peirce, Ruth F. Weiner and P. AarneVesilind, Environmental Pollution and Control, Butterworth-Heinemann (1998).
6. James Maclaurin and Kim Sterelny, What is Biodiversity, The University of Chicago Press (2008).
7. R.B. Mandal, Introductory Methods in Population Analysis, Concept Publishing Co, (2007).

19EME292: COMPREHENSIVE SKILL DEVELOPMENT III

L	T	P	A	C
0	0	0	6	1

Course Objectives:

- To encourage the all round development of students by focusing on soft skills, Coding & domain skills.
- To make the engineering students aware of the importance, the role and the content of soft skills, Coding and domain skills through instruction, knowledge acquisition, demonstration and practice.
- To develop and nurture the soft skills, coding and domain skills of the students through individual and group activities.
- To expose students to right attitudinal and behavioral aspects and to build the same through activities

Course Outcomes:

- On completion of the course, student will be able to– Effectively communicate through verbal/oral communication and improve the listening skills
- Write precise briefs or reports and technical documents, Actively participate in group discussion / meetings / interviews and prepare & deliver presentations. Become more effective individual through goal/target setting, self motivation and practicing creative thinking.
- Student will be able to understand the problems and develop his competitive coding skills.
- Apply the skills in various domains and will be able to solve complex problems faced by the industry.
- Function effectively in multi-disciplinary and heterogeneous teams through the knowledge of team work, Inter-personal relationships, conflict management and leadership quality

Part-1

A. Verbal and Soft Skills:
Vocabulary Builder, Reading Comprehension, Fill-in-the-Blanks, General Usage
B. Quantitative Aptitude and Reasoning
Puzzles, Arithmetic, Geometry, Mensuration.

Part-2

Coding:-Medium Level problem solving techniques:
Permutations and Combination, Probability, Hash Tables, Heap, Greedy Method, Backtracking

19EME331: MANUFACTURING TECHNOLOGY

L	T	P	C
3	0	3	4.5

The course enables the students of mechanical engineering to gain hands on experience and skills necessary to perform traditional manufacturing operations such as moulding, casting and welding. It also introduces the students to modern manufacturing techniques such as development of composites and use of power tools. The major objective of this course is to make sure that all the mechanical engineering graduates gain practical exposure to manufacturing methods and various manufacturing tools.

Course Objectives:

- To teach various cutting tools, tool materials and metal cutting process.
- To explain tool wear and tool life and the variables that control them.
- To teach calculation of machining time for different machining processes.
- To impart various metal cutting processes. (lathe, drilling, boring shaping, slotting, milling and grinding).
- To introduce principles of jigs and fixtures and types of clamping and work holding devices.

UNIT I **6 L**

Metal Cutting: Single and multi-point machine tools. Orthogonal cutting, various force components, chip formation, tool wear and tool life, surface finish and integrity, machinability, cutting tool materials, cutting fluids, coatings.

Learning Outcomes:

At the end of the this UNIT, the student will be able to

- describe cutting processes and variables. (L2)
- classify various types of chips, cutting tool materials and cutting fluids.(L2)
- calculate cutting forces, speed and feed in machining. (L3)

UNIT II **10 L**

Lathe and Lathe Operations: Principle of working, specifications, types of lathes, operations performed, work holders and tool holders. Taper turning, thread turning attachments for lathes. Machining time calculations. Turret and capstan lathes - Principle of working, collect chucks, other work holders - tool holding devices.
Shaping, Slotting and planning machines -Principles of working - principal parts, specification, classification, operations performed, machining time calculations.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- explain the specifications and operations performed on lathe, shaping, slotting and planning machines.(L2)
- calculate machining time. (L3)
- identify parts of drilling, boring, reaming machines.(L2)

UNIT III **8 L**

Milling operations and Milling machines-Principle of working, specifications. Classifications of milling machines, machining operations. Types and geometry of milling cutters, methods of indexing and accessories to milling machines. Machining time calculations.
Grinding and grinding machines: Grinding process, types of grinding machines, grinding process parameters, honing, lapping, other finishing processes.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- explain the specifications and operations performed milling and grinding machines.(L2)
- understand the principles of abrasive processes. (L2)
- identify parts of milling and grinding machines.(L2)
- differentiate honing, lapping and other finishing processes (L2)

UNIT IV **8 L**

Drilling and Drilling Machines: Principle of working, specifications, types and operations performed. Tool holding devices. Nomenclature of twist drill.
Boring and Boring Machines- Principle of working, specifications, types, and operations performed - tool holding devices - nomenclature of boring tools.

Learning Outcomes:
At the end of this UNIT, the student will be able to

- explain the specifications and principle of working of drilling and boring machines.(L2)
- explain various operations performed on drilling and boring machines (L2)
- identify parts of drilling and boring machines.(L2)

UNIT V **8 L**

Jigs and Fixtures: Principles of design of Jigs and fixtures and uses, 3-2-1 principle of location and clamping, classification of Jigs & Fixtures, types of clamping and work holding devices, typical examples of jigs and fixtures. Introduction to additive manufacturing.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- classify various types of jigs and fixtures. (L2)
- identify various types of work and tool holding devices. (L2)
- explain the design principles of jigs and fixtures. (L2)
- choose jig and fixture for a given application. (L3)

Text book(s):

1. P.N. Rao, Manufacturing Technology: Metal Cutting and Machine Tools, (Volume 2), 3/e,Tata McGraw-Hill Education, 2013
2. R.K. Jain and S.C. Gupta, Production Technology, 17/e,Khanna Publishers, 2012.

Reference book(s):

1. S.Kalpakzian and S.R. Schmid, Manufacturing Engineering and Technology,7/e, Pearson,2018.
2. Milton C.Shaw, Metal Cutting Principles, 2/e, Oxford, 2012
3. Hindustan Machine Tools, Production Technology,TMH, 2001
4. V.K.Jain, Advanced Machining Process,12/e, Allied Publications, 2010
5. AB. Chattopadhyay, Machining and Machine Tools, 2/e, Wiley, 2017
6. Halmi A Yousuf and Hassan, Machine Technology: Machine Tools and Operations, CRC Press Taylor and Francis Group, 2008

Course Outcomes:

At the end of the course, the student will be able to

- select cutting tools, tool materials for various metal cutting process. (L2)
- calculate machining time, tool wear and tool life. (L3)
- identify suitable machining methods to generate different types of surfaces. (L2)
- choose suitable work-holding requirements. (L3)
- choose jigs and fixtures for a given application.(L3)

MACHINE TOOLS LABORATORY

Course objectives:

- To familiarize with the construction and working of various machine tools.
- To Teach selection of parameters for different machining processes.

Contents:

1. Demonstration of construction and operations of general purpose machines : Lathe, drilling machine, milling machine, shaper, slotting machine, cylindrical grinder and surface grinder.
2. Measure the characteristic features of lathe with simple step turning operation.
3. Job on step turning, taper turning, knurling, thread cutting on lathe machine.
4. Perform drilling, reaming and tapping operations.
5. Job on milling (Groove cutting/Gear cutting).
6. Job on shaping and planning.
7. Job on slotting.
8. Job on cylindrical and surface grinding.
9. Job on grinding of tool angles.

Course outcomes:

After completion of this course the student may be able to

- explain the concept of machining on various machine tools.
- get hands on experience on various machine tools and machining operations

19EME301: MECHANICS OF MACHINERY

L	T	P	C
3	**1**	**0**	**4**

This course provides adequate knowledge on kinematic and dynamic Behavior of common machine elements and mechanisms. Students should be able to do basic calculation for force, moment, and motion analysis of mechanical systems. It introduces the concepts of vibrations, gyroscopes and develops problem solving skills in engineering problems.

Course Objectives:

- Introduce various basic mechanisms and their applications.
- Explain importance of degree of freedom.
- Familiarize velocity and acceleration in mechanisms.
- Describe the cams and follower motions.
- Explain the importance of gyroscopic couples.
- Introduce the equations of motion of systems with single degree freedom.

UNIT I **10 L**

Simple Mechanisms: Classification of mechanisms – Basic kinematic concepts and definitions – Degrees of freedom, mobility – Grashof's law, kinematic inversions of four bar chain, single slider, and double slider crank chains -Mechanical advantage- Transmission angle–steering gear mechanisms- Universal Joint – Simple problems.

Learning outcomes:

After completion of this UNIT, students will be able to

- **contrast** between machine and structure (L2)
- **identify** different types of kinematic pairs, kinematic chains (L3)
- **find** degrees of freedom for different mechanisms (L1)
- **identify** the inversions of four bar mechanism (L3)
- **explain** the difference between Davis and Ackerman steering gear mechanisms (L2)
- **explain** Universal joint mechanisms (L2)

UNIT II **12 L**

Velocity and acceleration in Mechanisms: Velocity analysis of simple mechanisms by Instantaneous center method, relative velocity method (graphical method), Kennedy's theorem.
Acceleration analysis of simple mechanisms- Slider crank mechanism, Coriolis component of acceleration, crank and slotted lever mechanism.

Learning outcomes:

After completion of this UNIT, students will be able to

- **calculate** the velocities and acceleration of various links in a mechanism (L4)
- **determine** instantaneous centers for a given mechanism (L4)
- **determine** Coriolis component of acceleration (L4)

UNIT III **10 L**

Gears and Gear trains: Classification of Gears, gear terminology, fundamental law of gearing, Involute and cycloidal gear profiles, spur gear contact ratio and interference/undercutting-helical, bevel, worm, rack & pinion gears, Simple, compound, reverted and epicyclic gear train, Analysis of epicyclic gear train.

Cams: Classification of cams and followers- Terminology and definitions- Displacement diagrams-Uniform velocity, simple harmonic and uniform acceleration and retardation, Design of cam profiles.

Learning outcomes:

After completion of this UNIT, students will be able to

- **explain** the different gear profiles and parameters (L2)
- **identify** different types of gears and application (L3)
- **explain** the working of cams and followers (L2)
- **analyze** the different motions in cam and followers (L4)

UNIT IV **12 L**

Balancing of Rotating and reciprocating machines: Need for balancing, static and dynamic balancing, balancing of single mass and several masses in different planes, using graphical methods. Balancing of reciprocating mass, Balancing of locomotives, effects of partial balancing of locomotives.

Gyroscope: Principle of gyroscope, gyroscopic effect in an aeroplane, ship, two and four wheeler, simple problems

Learning outcomes:

After completion of this UNIT, students will be able to

- **explain** the importance of balancing (L2)
- **analyze** balancing problems in rotating engines (L4)
- **explain** the concept of gyroscopic couple (L2)
- **analyze** the effects of gyroscopic couple on an aeroplane, ship and road vehicles (L4)

UNIT V **12 L**

Vibrations: Introduction, degree of freedom, types of vibrations, free natural vibrations, Newton method and energy method for single degree of freedom. Damped vibrations- under damped, critically damped; and over damped systems, forced vibrations with and without damping in single degree of freedom; Vibration isolation and transmissibility, torsional vibrations- rotor systems.

Learning outcomes:

After completion of this UNIT, students will be able to

- **formulate** equations of motion and solve for single degree of freedom system with damping. (L5)
- **estimate** natural frequency of vibratory systems. (L5)

- **explain** concept of vibration isolation and transmissibility. (L2)

Text Book(s)

1. S.S.Rattan,Theory of Machines, 4/e, Tata Mc-Graw Hill, 2014
2. G.K.Groover, Mechanical Vibrations, 8/e,Nemchand Bros, 2009

References

1. F. Haidery, Dynamics of Machines, 5/e,NiraliPrakashan, Pune, 2003
2. J.E.Shigley, Theory of Machines and Mechanisms, 4/e, Oxford, 2014
3. P.L.Ballaney, Theory of Machines & Mechanisms, 25/e, Khanna Publishers, Delhi, 2003.
4. Norton, R.L., ,Design of Machinery - An introduction to Synthesis and Analysis of Mechanisms and Machines,2/e, McGraw Hill, New York, 2000.
5. William T. Thomson, Theory of vibration with applications, 4/e, Englewood Cliffs, N.J. : Prentice Hall, 1993.

Course Outcomes:

At the end of the course the students will be able to

- Understand different mechanisms and their inversions. (L2)
- calculate velocity and acceleration of different links in a mechanism (L4)
- apply the effects of gyroscopic couple in ships, aero planes and road vehicles.(L3)
- Calcultae the the dimensions of different gears for power transmission (L$)

19EID234: LIFE SCIENCES FOR ENGINEERS

L	T	P	C
2	0	2	3

This course introduces the student, to the basics of biology such as cell structure, bimolecular structure and function, metabolism, inheritance and basic concepts of recombinant DNA technology.

Course Objectives

- Introduce the molecular basis of life.
- Provide the basis for classification of living organisms.
- Describe the transfer of genetic information**.**
- Introduce the techniques used for modification of living organisms**.**
- Describe the applications of biomaterials

UNIT I **10 L**

Introduction to Biology: Comparison of eye and camera, flying bird and aircraft, Biological observations and major discoveries- genera, species and strains, and Classification of living organisms: Cellularity, Ultrastructure, carbon and energy sources, excretion, habitat and molecular taxonomy.

Learning Outcomes:

After completing this UNIT, the student will be able to

- summarize the basis of life. (L2)
- distinguish prokaryotes from eukaryotes. (L3)
- compare biological organisms and manmade systems. (L2)
- classify organisms. (L2)

UNIT II **12 L**

Water, Biomolecules: sugars, starch and cellulose, Amino acids and proteins, lipids, Nucleotides and DNA/RNA, structure and functions of proteins and nucleic acids, hemoglobin, antibodies and enzymes, Industrial applications of enzymes, Fermentation and its industrial applications

Learning Outcomes:

After completing this UNIT, the student will be able to

- outline the importance of water. (L2)
- explain the relationship between monomeric UNITs and polymeric UNITs (L2)
- explain the relationship between the structure and function of proteins. (L2)
- interpret the relationship between the structure and function of nucleic acids. (L2)
- summarize the applications of enzymes in industry. (L2)
- explain the applications of fermentation in industry. (L2)

UNIT III **12 L**

Bioenergetics, Respiration: Glycolysis and TCA cycle, Electron transport chain and oxidative phosphorylation, Mechanism of photosynthesis, Human physiology, neurons, synaptic and neuromuscular junctions

Learning Outcomes:

After completing this UNIT, the student will be able to

- apply thermodynamic principles to biological systems. (L2)
- explain the mechanism of respiration and photosynthesis. (L2)
- summarize the principles of information transfer and processing in humans. (L2)

UNIT IV **12 L**

Mendel's laws, gene mapping, Mitosis and Meiosis, Epistasis, single gene disorders in humans, Genetic code, DNA replication, Transcription, Translation

Learning Outcomes:

After completing this UNIT, the student will be able to

- define Mendel's laws. (L1)
- demonstrate the mapping of genes. (L2)
- explain interactions among genes and their significance
- differentiate the mitosis and meiosis. (L3)
- explain the medical importance of gene disorders. (L2)
- identify DNA as a genetic material in the molecular basis of information transfer. (L2)

UNIT V **10 L**

Recombinant DNA Technology: recombinant vaccines, transgenic microbes, plants and animals, animal cloning, biosensors, biochips.

Learning Outcomes:

After completing this UNIT, the student will be able to

- outline the principles of recombinant DNA technology. (L2)
- appreciate the potential of recombinant DNA technology.(L2)
- summarize the use of biological materials for diagnostic devises. (L2)

Course Outcomes

After studying the course, the student will be able to:

- explain catalytic properties of enzymes. (L2)
- summarize application of enzymes and fermentation in industry. (L2)

- identify DNA as a genetic material in the molecular basis of information transfer. (L2)
- apply thermodynamic principles to biological systems. (L2)
- analyze biological processes at the reductionistic level. (L4)
- appreciate the potential of recombinant DNA technology. (L2)

Lab Experiments (Virtual or Field Experiments)

Microscopy, Mendel's laws, mapping, interactions, - 4 lab experiments
Nitrogen cycle, Species interactions, Sterilization, Bacterial population growth, - 4 lab experiments

Text book(s):

1. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A global approach", Pearson Education Ltd, 2018.
2. Arthur T Johnson, Biology for Engineers, CRC press, 2011

Reference Book(s):

1. Alberts Et.Al. The molecular biology of the cell, 6/e, Garland Science, 2014
2. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, "Outlines of Biochemistry", John Wiley and Sons, 2009.
3. John Enderle and Joseph Bronzino Introduction to Biomedical Engineering, 3/e, 2012

19EME391 COMPREHENSIVE SKILL DEVELOPMENT IV

Course Objectives:

- To encourage the all round development of students by focusing on soft skills, Coding & domain skills.
- To make the engineering students aware of the importance, the role and the content of soft skills, Coding and domain skills through instruction, knowledge acquisition, demonstration and practice.
- To develop and nurture the soft skills, coding and domain skills of the students through individual and group activities.
- To expose students to right attitudinal and behavioral aspects and to build the same through activities

Course Outcomes:

- On completion of the course, student will be able to– Effectively communicate through verbal/oral communication and improve the listening skills
- Write precise briefs or reports and technical documents, actively participate in group discussion / meetings / interviews and prepare & deliver presentations. Become more effective individual through goal/target setting, self motivation and practicing creative thinking.
- Student will be able to understand the problems and develop his competitive coding skills.
- Apply the skills in various domains and will be able to solve complex problems faced by the industry.
- Function effectively in multi-disciplinary and heterogeneous teams through the knowledge of team work, Inter-personal relationships, conflict management and leadership quality

Soft skills

Stream	Course Code	Course Title	Category	L	T	P	C	Marks
Comprehensive Skill Development	Department Specific	Soft Skills and Quantitative Aptitude	PW	1	2		1	50
		Coding				3		50
Total number of hrs per week						6		100

Coding: -Medium Level problem solving techniques:
Permutations and Combination, Probability, Hash Tables, Heap, Greedy Method, Backtracking.

Analytical and reasoning skills

UNIT	UNIT/ Topics	Hrs
1.	Arithmetic	9
2.	Geometry	2
3.	Mensuration	2
4.	Puzzles	2
	Total	**15**

Soft skills

UNIT	UNIT/ Topics	Hrs
1.	**Vocabulary Builder**	4
2.	**Reading Comprehension**	4
3.	**Paragraph Jumbles**	3
4.	**General Usage**	4
	Total	**15**

19EME321: MATERIAL TESTING & CHARACTERIZATION LAB

L	T	P	C
0	0	3	1.5

Course objectives:

- To find the deflections of different beams
- To study the stress strain behavior of metals.
- To find the hardness of different materials.
- To study the microstructure of different materials.

LIST OF EXPERIMENTS

1. To study the Stress Strain Characteristics (Tension & Compression) of Metals by using UTM.
2. Determination of hardness using different hardness testing Machines- Brinnels, Vickers, and Rockwell's.
3. Impact Test by using Izod and Charpy Methods.
4. Deflection test on Beams using UTM.
5. Torsion Test on Circular Shafts.
6. Metallographic preparation practice.
7. Study of metallurgical microscope and study of macrostructure of standard rolled component using software.
8. Study of microstructure of steel, CI and non-ferrous alloys.
9. Effect of heat treatment on grain structure/ size.
10. Study of microstructure of weld joints in the heat affected zone.
11. Study of microstructure of annealed, normalized and tempered materials.

Course Outcomes:

After the completion of this course work the student will be able to

- Understand the stress strain behavior of different materials. L1
- Determine the hardness of any materials. L3
- Analyze the deflections of different beams. L4
- Understand the microstructure of different materials. L2

PROGRAM ELECTIVE – I
19EME341: TURBO MACHINERY

L	T	P	C
3	0	0	3

Turbo machines are basically rotodynamic machines which work on the principles of dynamic action. This course deals with the definition of a turbo machines, main parts, classification and its comparison with positive displacement machines. The first and second laws of thermodynamics, adiabatic efficiency, drawing of velocity triangles diagram, dimensionless parameters are the common factors for the calculation of power of the turbo machines.

Course Objectives:

- Calculate the main dimensions of hydro- and gas-turbines.
- Evaluate which turbine to be used in a Hydro Power Plant or a Gas Power Plant.
- Evaluate which pump or compressor to be used in a process-, gas- or a fluid-system.
- To have knowledge about Hydro turbines, Gas turbines, Pump turbines, Centrifugal pumps and Compressors.
- To introduce product planning and product development process.
- Use this knowledge in projects where these turbo machinery is a part of for example a process system or a power plant

UNIT I

Introduction: Definition of turbo machine, parts of turbo machines, Comparison with positive displacement machines, Classification of turbo machines, Dimensionless parameters and their significance, UNIT and specific quantities, model studies and its numerical.
Thermodynamics of fluid flow: Application of first and second law of thermodynamics to turbo machines, Efficiencies of turbo machines, Static and Stagnation states, overall isentropic efficiency, stage efficiency and polytropic efficiency for both compression and expansion processes. Reheat factor for expansion process.

Learning Outcomes:

- Able to identify the main parts of turbo machines, Classify turbo machines. and compare it with positive displacement machines (L1)
- Understand the effect of Reynolds number, specific speed & dimensionless parameters and their physical significance on turbo machines (L2)
- Know Compression process – Overall isentropic efficiency of compression; Stage efficiency, Polytropic efficiency and preheat factor (L3)
- Explore the principles of model studies and apply same to design of turbo machines (L3)

UNIT II

Energy transfer in Turbo machines: Euler's turbine equation, Alternate form of Euler's turbine equation, Velocity triangles for different values of degree of reaction, Components of energy transfer, Degree of Reaction, utilization factor, Relation between degree of reaction and Utilization factor.
General Analysis of Turbo machines: Radial flow compressors and pumps – general analysis, Expression for degree of reaction, velocity triangles, Effect of blade discharge angle on energy transfer and degree of reaction, Effect of blade discharge angle on performance. General analysis of axial flow pumps and compressors, degree of reaction, velocity triangles

Learning Outcomes:

- Derive the Euler's turbine equation and explain the significance of components of energy transfer(L3)
- Define and discuss the significance of degree of reaction & derive an expression between utilization factor and degree of reaction. (L2)
- Learn how to draw velocity triangles diagram for axial flow compressors and pumps for different values of degree of reaction. (L2)
- Explain the general analysis of a turbo machine – effect of blade discharge angle on energy transfer and degree of reaction. (L3)

UNIT III

Steam Turbines: Classification, Single stage impulse turbine, condition for maximum blade efficiency, stage efficiency, Need and methods of compounding, Multi-stage impulse turbine, expression for maximum utilization factor
Reaction turbine – Parsons's turbine, condition for maximum utilization factor, reaction staging.

Learning Outcomes:

- Explain the construction, working, types and classification of a steam turbine.(L2)
- Explain the condition for maximum blade efficiency, stage efficiency. (L2)
- Explain compounding - Need for compounding, Method of compounding.(L2)
- Explain impulse staging – Condition for maximum utilization factor for multi stage turbine with equiangular blades. L2)
- Explain Reaction turbine and Parson's reaction turbine, Discuss Condition for maximum blade efficiency, reaction staging.(L3)

UNIT IV

Hydraulic Turbines: Classification, various efficiencies.
Pelton Wheel – Principle of working, velocity triangles, design parameters, maximum efficiency
Francis turbine – Principle of working, velocity triangles, design parameters

Kaplan and Propeller turbines - Principle of working, velocity triangles and design parameters. Theory and types of Draft tubes.

Learning Outcomes:

- Explain the construction, working and classification of water turbine. (L2)
- Explain design parameters of Pelton wheel. (L3)
- Explain Francis turbine, its velocity triangles, runner shapes for different blade speed and its design. (L3)
- Explain draft tubes and its types.(L2)
- Explain Kaplan and propeller turbines, its design parameters and velocity triangles.(L3)

UNIT V

Centrifugal Pumps: Classification and parts of centrifugal pump, different heads and efficiencies of centrifugal pump, Theoretical head – capacity relationship, Minimum speed for starting the flow, Maximum suction lift, Net positive suction head, Cavitation, Need for priming, Pumps in series and parallel.

Centrifugal Compressors: Stage velocity triangles, slip factor, power input factor, Stage work, Pressure developed, stage efficiency and surging

Axial Flow Compressors: Expression for pressure ratio developed in a stage – work done factor, efficiencies and stalling.

Learning Outcomes:

- Explain the construction, working and classification of Centrifugal pump. (L3)
- Explain suction, delivery and manometric heads, pressure rise in the impeller, and various efficiency terms like manometric efficiency, hydraulic efficiency, volumetric efficiency and overall efficiency.(L3)
- Explain multistage centrifugal pumps, minimum starting speed, slip, priming, cavitations (L3)
- Explain the construction and working of Centrifugal and an axial flow compressors.(L2)
- Analyze blade angles at impeller eye root and eye tip; slip factor and power input factor, width of the impeller channel.(L4)

Course Outcomes:

After learning the course the students should be able to:

1. Understand the basics of turbo machines including dimensional analysis (L1)
2. To understand the principles and energy transfer process in turbo machines. (L2)
3. To understand the structural and functional aspects of major components of turbo machines. (L3)
4. Analyse the turbo machines to improve and optimize its performance (L4)
5. To understand control and maintenance aspects of turbo machines (L4)

Text book(s)

1. Turbo Machines B.U.Pai Wiley India Pvt, Ltd 1st Edition
2. An Introduction to Energy Conversion, Volume III, Turbo machinery V. Kadambi and Manohar Prasad New Age International Publishers reprint 2008
3. Turbo machines M. S. Govindegowda and A. M. Nagaraj M. M. Publications 7Th Ed, 2012
4. Fundamentals of Turbo Machinery B.K Venkanna PHI Publishers

Reference Book(s)

1. Fluid Mechanics & Thermodynamics of Turbo machines S. L. Dixon Elsevier 2005
2. Turbines, Compressors & Fans S. M. Yahya Tata McGraw Hill Co. Ltd 2nd edition, 2002
3. Principals of Turbo machines D. G. Shepherd The Macmillan Company 1964

19EME343: POWER PLANT ENGINEERING
(Elective)

L	T	P	C
3	0	0	3

This course provides an introduction to the various layouts and working mechanisms of steam power plant, gas power plant, nuclear power plant, and hydroelectric power plant. Power Plant Economics concepts will also be dealt in this course. This course introduces the working concepts of power generating devices like turbines and their components. This course is having integrity with industrial problems as prime movers are main components of power plants. Thermodynamics and Applied Thermodynamics are prerequisite for this course

Course Objectives

- Understand the basic knowledge of different types of thermal power plants
- Design of chimney, cooling tower operation in thermal power plants
- Perform basic analyses associated with each subsystem
- Improving skills to adopt modern methods in mechanical engineering as continuous improvement.

UNIT I **9 L**

Steam Power Plants: General layout, power plant cycles, coal-handling, storing, preparation and supply. Boiler Mountings and accessories, Draft systems, Flue gas testing and indicators (mechanical, electrical and chemical).Condensers and cooling towers,

Learning outcomes:

After completion of this UNIT, students will be able to

- Study the general layout of the steam power plants. (L_1)
- Acquaint with boiler mountings and accessories. (L_2)
- Utilize the knowledge of condensers and cooling towers. (L_3)

UNIT II **8 L**

Gas Turbine Power Plants: Introduction, gas turbine plant- classification and comparison of different types of gas turbine power plants, components and different arrangements of the gas turbine plants, Indian gas turbine power plants, governing system of gas turbine plant.

Learning outcomes:

After completion of this UNIT, students will be able to

- Study the general layout of the gas turbine power plants. (L_1)
- Summarize about different types of gas turbines. (L_2)

- Design a gas turbine for Indian scenario. (L_4)

UNIT III **9 L**

Nuclear Power Plants: Classification of reactors, thermal utilisation, fuels, fuel moderator and coolant, control and safety rods, special properties of structural materials required, induced radio-activity, gas cooled reactors, radiation hazards and shielding, radioactive waste disposal.

Learning outcomes:

After completion of this UNIT, students will be able to

- Acquaint with various nuclear reactors. (L_2)
- Summarize about the special properties of structural materials used. (L_4)
- Train about radiation hazards and shielding. (L_3)

UNIT IV **8 L**

Hydro Electric Plants: Selection of site, hydrology, hydrometric survey rainfall, catchment, reservoir, run-off flow and fall, storage and pondage. Mass- duration and flood discharge. Losses due to percolation, evaporation and transpiration. General layout of the plant. Different types of plants: Low, medium and high head plants and pump storage plants. Head works, spillways, canals, tunnels, governing, lubrication, penstock, anchorages and relief valves. Different types of surge tanks, intakes, gates and valves.

Learning outcomes:

After completion of this UNIT, students will be able to

- Study about the site selection of setting up a hydro electric plant. (L_1)
- Outline about the losses due to percolation, evaporation and transpiration. (L_2)
- Acquaint with the layout of the plant. (L_1)
- Study about gates, valves, intakes and surge tanks which are necessary for a hydro electric plant. (L_1)

UNIT V **8 L**

Power Plant Economics: Capacity factor, Load factor, Diversity factor, Peak load consideration, Factors governing capacity of plants. Cost of power plant, Cost of erection. Operating and maintenance expenses, Cost of production, distribution of power and determination of rates.

Learning outcomes:

After completion of this UNIT, students will be able to

- Study about different factors associated with power plant economics. (L_1)
- Acquaint with factors governing plant capacity. (L_2)
- Summarize about cost associated with plant erection, operating and maintenance. (L_4)

Course Outcomes

After completion of the course, the student will be able to

- Study the working of typical systems subsystems of a steam power plants
- Acquaint with the knowledge about recent advances in gas turbine power plants and apply the knowledge in industries for enhancing productivity
- Outline the knowledge about nuclear power plants and radioactive waste disposal
- Choose appropriate site for plantand layout of hydroelectric power plant
- Experiment with multi-disciplinary goals in the power plants.
- Utilize the concepts of power plant economics and understand costs involved in power plants.

Text Book(s):

1. P.K.Nag, Power plant engineering, Tata McGraw-Hill publishing Co., 2014
2. S.C. Arora and Domkundwar, A course in power plant engineering, DhanpatRai and Co, 2001
3. R.K. Rajput, A Text Book of Power Plant Engineering, 4/e, Laxmi Pub., 2007.

References:

1. B.S.Magal, Solar Power Engineering, 1/e, Tata McGraw-Hill publishing Co., 1999.
2. Joel Weisman, Roy Eckart, Modern Power Plant Engineering, Prentice Hall of India, 1985.
3. D.K. Singhai, Fundamentals of Nuclear Power Engineering, 4/e, Khanna Publishers, 2001.
4. G.R.Nagpal, Power Plant Engineering, 14/e, Khanna Publishers, 1996.

19EME345: AUTOMOBILE ENGINEERING

L	T	P	C
3	0	0	3

Automobile engineering is the study of automotive mechanics and vehicle mobility systems that contribute the locomotion. This course deals with study of different power UNITs propelling the automobile as well as the transmission and steering systems and controls involved. This course also attempts to understand and analyse the vehicle dynamics and to learn about the vehicle structure and suspension system. Modern production and assembly methods are also discussed. The impact of artificial intelligence in automotive systems is discussed regarding the future scope of the course.

Course Objectives:

- Study about the various power UNITs propelling the automobile.
- Understand the transmission requirement and study various steering systems.
- Analyse vehicle dynamics and stability criterion of an automobile.
- To have knowledge about vehicle structure and suspension systems.
- To understand the modern production, assembly, and material logistics technologies in automobile sector.
- Identify and understand the scope of artificial intelligence in automotive systems.

UNIT - 1

Introduction: Study of power UNITs like Gasoline**,** diesel, biodiesel, electrical, hybrids, solar, wind, compressed air, fuel cell, hydrogen etc. that propels the automobile

Learning Outcomes:

- Study the various I C engines to power the automobile (L2)
- Understand the scope of biodiesel and hybrid fuels (L2)
- Learn and illustrate the importance of renewable energy in automotive sector. (L3)
- Understand the hybrid and electric vehicle technology (L2)

UNIT - 2

Transmission system: Transmission requirement, standard transmission system, fluid transmission system, automatic transmission, performance requirements and gear ratios, tractive resistance.
Steering System and Controls: Different types of steering systems, performance requirements, power steering. Controls of Clutch, gear, dashboard display, and automatic control

Learning Outcomes:

- Study and utilize the transmission requirements in an automobile. (L2)
- Understand the various transmission systems. (L2)

- Illustrate the performance requirements, gear ratios and tractive resistance. (L2)
- Study the different types of steering systems. (L2)
- Identify the performance requirement factors in steering system. (L3)
- Study and analyze the clutch control. (L4)
- Study various automatic control and dashboard display features. (L2)

UNIT – 3

Vehicle dynamics. Aerodynamics of vehicles, stability analysis of vehicle, stability on curved path

Learning Outcomes:

- Study and identify the aerodynamics of vehicles. (L2)
- Analyze the stability criterion of vehicle in static and dynamic conditions. (L4)
- Analyze the stability criterion of vehicle along curved path. (L4)

UNIT - 4

Vehicle structure and suspension - Loads on the frame, general consideration of strength and stiffness, engine mounting, chassis, monocoque, prestressed, sheet metal details & tooling. Various suspension systems including active suspension, shock absorbers.
Modern assembly (robotic) and finishing technologies. Metal fabrication (Press shop), metal surface engineering, paint shop , hard and soft trim process lines, final assembly and inspection; Material logistics.

Learning Outcomes:

- Study and analyze the loads on vehicle frame, strength and stiffness and engine mountings. (L4)
- Study different types of chassis frame, prestressed, sheet metal details & tooling (L2)
- Understand the various suspension systems and shock absorbers. (L2)
- Learn the different assembly techniques from press shop to final assembly and inspection of an automobile. (L2)
- Infer the various material logistics involved in manufacture of an automobile. (L2)

UNIT – 5

Artificial Intelligence in Automobile: Role in manufacturing domain as in design, supply chain, production, and post-production. In transportation domain as driver assistance and driver risk assessment systems for autonomous vehicle systems and aftermarket services such as predictive maintenance.

Learning Outcomes:

- Understand the role of artificial intelligence in the manufacturing of automobile. (L2)

- Study the scope of artificial intelligence in driver assistance and driver risk assessment systems for autonomous vehicle systems. (L2)
- Develop the ambit of artificial intelligence in automotive systems. (L4)

Course Outcomes:

After learning the course the students should be able to:

1. Understand the different power UNITs in an automobile. (L2)
2. To understand the different transmission systems and steering system and controls in an automobile. (L2)
3. To study and analyze the different aspects of vehicle dynamics. (L4)
4. To understand the vehicle structure and the suspension system and study the modern assembly methods (L2)
5. To understand and develop the scope of Artificial intelligence in automotive systems (L4)

Text book(s)

1. A Textbook of Automobile Engineering – R. K. Rajput, Laxmi Publ. (P) Ltd.
2. Automotive Mechanics – W. H. Crouse & D. Anglin, Tata McGraw Hill Publications 7Th Ed, 2012
3. Automotive Mechanics, Heitner, J 2nd Ed., East-West Press
4. Autonomous Vehicle, Driverless Self-Driving Cars and Artificial Intelligence: Practical Advances in AI and Machine Learning, Dr. Lance Eliot and Michel Eliot, Lbe Press Publishing; 1st edition (29 December 2017)

Reference Book(s)

1. Julian Happian-Smith; Transport Research Laboratory (TRL) Introduction to Modern Vehicle Design, Publisher: Elsevier, 2001
2. Brown J. C., Motor Vehicle Structure: Concepts and Fundamentals, Butterworth-Heinemann, 2002
3. Heinz Heisler; Advanced Vehicle Technology, Publisher: Butterworth-Heinemann, 2002

19EME347: ADVANCES IN WELDING TECHNOLOGY

L	T	P	C
3	0	0	3

Welding technology traces its history back to the Industrial Revolution in 1750 AD. In 1920, P.O. Nobel of the General Electric Company invented automatic welding which made use of bare electrode wire and direct current. Recent improvements in welding technology include friction, inertia, and laser welding. These recent technologies are now being taught in several institutes for advanced welding programs.

Course Educational Objectives

1. To impart knowledge on various advanced welding processes so that the students can apply them in engineering industry applications.
2. To understand the various parameters and requirements for welding processes.
3. To know the comparative merits and demerits of various welding processes.
4. To learn about the joint designs adopted in different types of welding techniques.
5. To develop the knowledge on the design of welded joints and the quality control of weldments.

UNIT I **9 L**

SOLID STATE WELDING PROCESSES
Fundamental principles, survey of the various pressure welding processes and their applications. Friction, friction stir, explosive, diffusion, and Ultrasonic welding – principles of operation, process characteristics and application.

Learning Outcomes:

Students will be able
1. To impart knowledge regarding various advanced welding practices in industries like pressure welding, friction stir, explosive, diffusion, and ultrasonic welding (L3).
2. Understand the comparative merits and demerits of the above welding processes (L1).

UNIT II **9 L**

ELECTRON AND LASER BEAM WELDING
Heat generation and regulation, equipment details in typical set-up, electron beam welding in different degrees of vacuum, advantages and disadvantages, applications. Laser Welding: Principles of operation, advantages, and limitations, applications.

Learning Outcomes:

Students will be able
1. To impart knowledge regarding various advanced welding practices in industries like Laser Beam Welding and electron beam welding (L3).

2. To understand the various parameters and requirements for welding processes (L2).
3. To know the comparative merits and demerits of the above welding processes (L1).

UNIT III **9L**

ELECTRO SLAG WELDING
Heat generation, principles of operations, wire and consumable guide techniques, selection of current, voltage and other process variables, nature of fluxes and their choice. Electro-gas welding: Principle and applications. Narrow gap welding, Under Water welding. Rapid Arc Welding, Welding Automation

Learning Outcomes:

Students will be able
1. To impart knowledge regarding various advanced welding practices in industries like Electro-gas welding, Narrow gap welding, Under Water welding, Rapid Arc Welding (L3).
2. To understand the various parameters and selection of current, voltage and other process variables (L2).
3. To know the comparative merits and demerits of the above welding processes (L1).

UNIT IV **9L**

PLASMA WELDING
Special features of plasma arc- transferred and non-transferred arc, key hole and puddle-in mode of operation, micro low and high current plasma arc welding and their applications, plasma cutting, surfacing and applications.

Learning Outcomes:

Students will be able
1. To impart knowledge regarding various advanced welding practices in industries like plasma arc transferred and non-transferred arc welding, micro low and high current plasma arc welding (L3).
2. To know the comparative merits and demerits of the above welding processes (L1).

UNIT V **9L**

TESTING AND DESIGN OF WELDMENT
Design and quality control of welds. Edge preparation types of joints, welding symbols. Stresses in butt and fillet welds – weld size calculations. Testing – tensile, bend hardness. Impact, notch and fatigue tests. Life assessment of weldments.

Learning Outcomes:

Students will be able

1. To impart knowledge regarding of design and quality control of welds (L3)
2. To understand the right kind of welding technique suitable for various joints (L2).
3. To learn about the joint designs adopted in different types of welding techniques**,** stresses in butt and fillet welds – weld size calculations and Life assessment of weldments (L4).

Course Outcomes

1. Apply the knowledge of solid state welding process for engineering applications (L3).
2. Understand the principles of Heat generation of metal joining process (L2).
3. Understand the fundamental principles of special arc welding process (L2).
4. Understand the knowledge of plasma arc in metal joining and Laser cutting process (L2).
5. Understand the knowledge of design principles in weld joints. Apply the concept of quality control and testing of weldments in industrial environment (L4).

Text Book.

1. Nadkarni S.V., "Modern Arc Welding Technology", Oxford IBH Publishers, 1996. 9.

References

1. Schwartz M.M, "Metals Joining Manual", McGraw Hill Book(s), 2001.
2. Tylecote R.F, "The Solid Phase Welding of Metals", Edward Arnold Publishers Ltd, London, 2000.
3. Parmer R.S., "Welding Engineering and Technology", Khanna Publishers, 2002.
4. Carrry B., "Modern Welding Technology", Prentice Hall Pvt Ltd., 2002.
5. Nadkarni S.V., "Modern Arc Welding Technology", Oxford IBH Publishers, 1996.
6. Schwariz, M.M., "Source book on innovative welding processes", American Society for Metals (OHIO), 2004.
7. Christopher Davis, "Laser Welding- Practical Guide". Jaico Publishing House, 2002.

19EME351 : MECHANICAL BEHAVIOUR OF MATERIAL

L	T	P	C
3	**0**	**0**	**3**

This is a fundamental course that provides basic knowledge to the students on material response upon subjected to different loading conditions. It is prerequisite for higher level course such as fatigue, creep and fracture. As a Mechanical Engineer it is suggested to opt for this course for a brief understanding computational method in Mechanical system from a Material Property Point of view.

Course objective:

- Explains the structural effect of material that affects mechanical properties.
- Comprehension of the defects inside the structure and their effects on the mechanical properties
- Understanding of failure mechanisms in ductile and brittle material
- Basics of elastic and Plastic deformation of material under uniaxial loading conditions
- A brief idea about cyclic loading and cause of fatigue failure

UNIT I **8 L**

Introduction to deformation behaviour: Concept of stresses and strains, engineering stresses and strains, **Elasticity Theory**: The State of Stress and strain, stress and strain tensor, tensor transformation, principal stress and strain, elastic stress-strain relation, anisotropy, elastic behaviour of metals, ceramics and polymers.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- understand the concept of stress and strain in Brittle and Ductile materials [**L-1**]
- recognize the stress tensors [**L-1**]
- understand the material behavior in Metals, Ceramics and Polymers [**L-1**]

UNIT II **8 L**

Yielding and Plastic Deformation: Hydrostatic and Deviatoric stress, Octahedral stress, yield criteria and yield surface, texture and distortion of yield surface, Limitation of engineering strain at large deformation, true stress and true strain, effective stress, effective strain, flow rules, strain hardening, Ramberg- Osgood equation, stress - strain relation in plasticity, plastic deformation of metals and polymers.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- Recognize the concepts of plastic deformation in materials [**L-3**]
- Understand the stress-strain curve for brittle and ductile material [**L-1**]
- Expose the strain hardening and study of plasticity [**L-3**]

UNIT III **8 L**

Different types of loading and temperature encountered in applications, Tensile Test - stress – strain response for metal, ceramic and polymer, elastic region, yield point, plastic deformation, necking and fracture. Effect of strain rate on flow properties, Effect of Temperature on flow properties. Engineering stress-strain curve, True stress-true strain curve. Hardness/Indentation test- Types of indenter, hardness test, Knoop, Vickers, Brinell, Rockwell, Load~displacement curve obtained during instrumented indentation and their analysis.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- recognize the process of Tensile testing (Metals and Alloys), effect of tensile parameters [**L-1**]
- understand the basics of failure and fracture in materials [**L-2**]
- understand the concepts of Indentation technique to evaluate hardness [**L-2**]

UNIT IV **8 L**

Microscopic view of plastic deformation: crystals and defects, classification of defects, thermodynamics of defects, geometry of dislocations, slip and glide, dislocation generation - Frank Read and grain boundary sources, stress and strain field around dislocations, force on dislocation - self-stress, dislocation interactions, partial dislocations, twinning, dislocation movement and strain rate, deformation behavior of single crystal, critical resolved shear stress (CRSS), deformation of poly-crystals - Hall-Petch and other hardening mechanisms, grain size effect - source limited plasticity, Hall- Petch breakdown.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- Recognizes the effect of crystal defects on mechanical behavior of materials [**L-1**]
- Basic understandings of interaction of dislocation with planes [**L-1**]
- Analysis of Hall-Petch equation with respect to grain size [**L-2**]

UNIT V **8 L**

Fracture: fracture in ceramics, polymers and metals, different types of fractures in metals, fracture mechanics – Linear fracture mechanics –K_{IC}, **Deformation under cyclic load - Fatigue**: S-N curves, Low and high cycle fatigue, Life cycle prediction, Fatigue in metals, ceramics and polymers. **Deformation at High temperature**: Time dependent deformation - creep, different stages of creep, creep and stress rupture, creep mechanisms and creep mechanism maps.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- Basic understandings of fatigue (Methods, Sample Preparation and Analysis) [**L-2**]
- Determination of Fracture toughness and evaluation methods [**L-2**]
- Basic understandings of creep and time dependent loading [**L-3**]

Course Outcomes

- Students will demonstrate and understanding of the mechanical properties and behaviour of materials. (L2)
- In the concept of linear elastic fracture mechanics and estimate the effects of cracks in material and structure. (L4)
- Students will demonstrate the ability to identify engineering problem in using plastic deformation, fatigue, fracture and creep(L3)
- Assess and describe the mechanism loading to failure when provided with a failure example. (L2)

Text Book(s):

1. G.E. Dieter, "Mechanical Metallurgy", McGraw-Hill, 1986.
2. R.W. Hertzberg, "Deformation and Fracture Mechanics of Engineering Materials", John Wiley and Sons, 1976.

References:

1. Hayden, H. W. W. G. G. Moffatt, J. Moffatt and J. Wulff, The Structure and Properties of Materials, Vol.III, Mechanical Behavior, John Wiley & Sons, New York, 1965.
2. Wulff, The Structure and Properties of Materials, Vol. III “Mechanical Behavior of Materials”, John Wiley and Sons, New York, USA, 1983.
3. Honey combe R. W. K., “Plastic Deformation of Materials”, Edward Arnold Publishers, 1984.

19EME353: ADVANCED STRENGTH OF MATERIALS

L	T	P	C
3	0	0	3

This course helps in understanding the strength of solid structures based on material and geometrical behavior in depth. This course teaches the concepts with emphasis on mathematical formulation for defining material behavior of structures such as pressure vessels, columns & struts and springs. This is a higher level course which requires basic knowledge gained from the basic strength of material course and apply it to the study and design of advanced structures.

COURSE OBJECTIVES:

1). To enrich the student on the concept of Strain Energy due to different types of loading and to have good hold on the concepts of Mechanical Springs.
2). To enable students to gain good Knowledge on the stress analysis of Thick cylinders, Thin cylinders and Spherical Shells.
3). To make the student understand the concept of vertical compression loading on an engineering Column with different end conditions, analyzing and evaluating the critical loading condition.
4). To make the student understand the concept of stress analysis on circular rotating discs.
5). To enable the student understand the concept of curved beams having different cross Sections.

UNIT 1 **9 L**

Strain Energy: Introduction, strain energy in a body when the load applied gradually, load applied suddenly, load applied with impact, strain energy due to shear.
Springs: Deflection of closed coil helical springs under axial pull and Leaf springs

Learning Outcomes:

(a).Student is capable of determining strain energy value for mechanical members under gradually applied load. (L4)
(b).Student is capable of determining strain energy value for members under Suddenly applied load. (L3)
(c).Student is capable of determining strain energy value for members under load with an impact. (L3)
(d).Student can suggest suitable coiled spring for specific application based on the resilience analysis. (L3)
(e). Student can do deflection and stiffness analysis of the existing Leaf springs. (L3)

UNIT 2

Thin Cylinders and Spherical Shells: Stresses and strains (principal stress, principal strain, shear stress, shear strain and volumetric strain) in thin cylinders, thin spherical shell,wire wound cylinders.
Thick cylinders: Thick cylinders coursed to internal and external pressure and compound cylinders; different stresses induced; Lames equation, stresses due to shrink fit.

Learning Outcomes :

(a).Student can analyze Hoop and longitudinal stresses in thin cylinder under pressure.(L4)
(b). Student can analyze Hoop and longitudinal stresses in Spherical shell under pressure.(L4)
(c).Student is capable of determining the stresses in wire wounded cylinder under different pressure conditions.(L3)
(d).Student can analyze different stresses in Thick cylinder under various pressure conditions.(L4)
(e). Student is capable of determining the stresses in Compound cylinder under different pressure conditions and by taking shrink fit in to account.(L3)

UNIT 3
Columns and struts: Columns with one end free and the other fixed, Both ends fixed, one end fixed and other hinged, Limitation of Euler's formula, Column with initial curvature, Column carrying eccentric load, Laterally loaded columns, Empirical formulae.

Learning Outcomes:
(a).Student can find critical load for any column under compression load for various end conditions.(L4)
(b).Student can do the stress analysis of any column with initial curvature.(L3)
(c).Student can determine the safe working condition for column with eccentric loading.(L3)
(d).Laterally loaded column can be analysed for safe working conditions.(L4)
(e).Emperical formulae for column can be best utilized for the safe design of a column.(L3)

UNIT 4
Stresses due to rotation: Introduction, stresses in a rotating thin disc, disc of uniform thickness, disc of uniform strength, long cylinders.

Learning Outcomes :
(a).Student can do the stress analysis on a rotating disc.(L4)
(b). Disc for uniform strength can be designed.(L3)
(c). Student can do the analysis for a disc for uniform thickness.(L4)
(d).Student can analyse the wheel rim for different stresses.(L4)
(e).Can design a long cylinder based on the stress analysis.(L4)

UNIT 5
Bending of Curved Bars: Stresses in bars of circular, rectangular and trapezoidal sections.

Learning Outcomes:
(a).Stress analysis for curved bars can be carried out for different cross sections.(L3)
(b).Student can determine the critical loading condition based on the maximum bending condition.(L3)
(c). Student is capable of applying the concept in various applications like, Crane hooks etc.,(L3,L4)

Course outcomes:
1). The student is capable of determining the strain energy in various mechanical members, and can utilize the concept in analyzing the mechanical springs.(L3,L4)
2). The student is capable of calculating the radial and circumferential stresses for both Cylinders and Spherical shells under different pressurized conditions.(L3)

3). The student is capable of evaluating any engineering column or strut under different end conditions in various applications.(L3)
4). The student is capable of doing stress analysis of rotating discs under various conditions and can suggest the best for specific application.(L4,L6)
5).The student is capable of evaluating curved beams of different cross sections and can be able to evaluate the stresses across the cross-sections of the curved beam.(L3)

Text Book(s)

1.Strength of Materials by Dr. Sadhu Singh, Khanna Publishers, New Delhi.

References

1. Strength of Materials by Timoshenko, Part-I &II , 3rd edition, CBS Publishers & Distributors, New Delhi.
2. Mechanics of Solids by Popov, 2nd Edition, Pearson Education, 2003, New Delhi.
3. Mechanics of Materials by F.P.Beer, E.R. Johnston, Jr& John.T..Dewolf, 3rd edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.
4. Strength of Materials by Dr.R.K.Rajput, First multi colour Revised Edition 2006, S.Chand& Company Limited, New Delhi.
5. Mechanics of solids by Crandal, Dahl and Lardner.

19EME355: PRODUCT DESIGN

L	T	P	C
3	0	0	3

Product design describes the process of imagining, creating, and iterating products that solve users' problems or address specific needs in each market. The key to successful product design is an understanding of the end-user customer, the person for whom the product is being created. Product designers attempt to solve real problems for real people by using both empathy and knowledge of their prospective customers' habits, behaviours, frustrations, needs, and wants.

Course objectives:

The aim of the Product Design course is to focus on consolidation of core industrial design capabilities central to creative professional practice. This is achieved through project-based learning that supports the following design skills:

- Effective use of modelling/prototyping techniques (2D and 3D) in the generation, manipulation, and presentation of design ideas.
- Identification of market opportUNITy, user needs and use context.
- Creative solution ideation (through conceptual design strategies).
- Time management and effective working practice.

UNIT I **9 L**

Introduction: Design methodology and philosophy, types of design, design models, development product life cycle. Product development process, reverse engineering and redesign of product development process, theory, and methodology in design.

Learning Outcomes:

- Able to define the design methodology and find the product development process (L1)
- Understand the philosophy, classify the types of design, and demonstrate the design models (L2)
- Build the development product life cycle and understand reverse engineering (L3)
- Analyze the redesign of product development process and examine the methodology in design (L4)

UNIT II **9 L**

Design Process: Need, analysis, scope of the product, mission statement, customer study, Kano-diagram. Establishing product function, functional decompositions, FAST and SOP, functions structures. Building up a design team. Designing quality into product, product discovery.

Learning Outcomes:

- Define the need and scope of the product (L1)

- Understand the mission statement, kano-diagram & FAST and SOP functions structure (L2)
- Identify the customer study, make use of establishing product function and organize the product discovery (L3)
- Examine the building up design team and designing quality into product (L4)

UNIT III **8 L**

Plan for Design: Product teardown, planning for deliverables, building a plan, product specifications-QFD, contradiction to generate ideas, theory of inventive machines-TRIZ, Decision matrix.

Learning Outcomes:

- Able to define the product teardown and choose the Decision matrix (L1)
- Develop the planning for deliverables and building a plan & product specification (L3)
- Take part of contradiction to generate ideas and discover the theory of inventive machines (L4)

UNIT IV **8 L**

Embodiment Design: Product architecture, configuration, parametric design, systems approach, and other consideration of embodiment design.

Learning Outcomes:

- Understand the product architecture, explain the configuration and parametric design (L2)
- Build the system approach and organize the other consideration of embodiment design (L3)

UNIT V **8 L**

Industrial Design: Human factor in design, design for easy operations, serviceability, aesthetics, and environment. Value Engineering: Cost evaluation, categories of cost, overhead cost, methods of development cost estimate, manufacturing cost, value analysis costing.

Learning Outcomes:

- Understand the human factor in design, Serviceability, aesthetics, and environment (L2)
- Choose the design for easy operations and select the cost evaluation & categories of cost (L3)
- Analyze the value engineering, compare the methods of development cost and manufacturing cost, simply the value analysis costing (L4)

Coarse Outcomes:

Students will

- Use the Product Design and Development Process, to manage the development of an idea from concept through to production.

- Employ research and analysis methodologies as it pertains to the product design process, meaning, and user experience.
- Apply creative process techniques in synthesizing information, problem-solving and critical thinking.
- Demonstrate and employ hand drawing and drafting principles to convey concepts.
- Use basic fabrication methods to build prototype models for hard-goods and soft-goods and packaging.
- Demonstrate, apply, explain, and recognize basic engineering, mechanical, and technical principles.
- Demonstrate, apply, explain, and recognize basic family of materials used in soft-goods and hard-goods, including sustainable materials and manufacturing processes.

Textbook (s)

1. Kevin Otto and Kristin Wood, Product Design, Pearson, 2004.
2. Karl T. Ulrich and Steven D. Eppinger, Production Design and Development, Tata McGraw Hill, 2007.

References

1. David G. Ullman, The Mechanical Design Process, McGraw Hill, 2003.
2. George E. Dieter, Engineering Design, McGraw Hill, 2000.

19EME359: MATERIAL MANAGEMENT

L	T	P	C
3	0	0	3

Materials Management covers all the basics of supply chain management, manufacturing planning and control systems, purchasing, and physical distribution. The material, examples, questions, and problems lead the student logically through the text. Material management is the coordinated function, responsible for planning, acquiring, stocking, moving, and controlling the appropriate material of right quality, right quantity at right place in right time to optimise the usage of facilities and capital funds to provide customer patient service. It is only possible by efficient materials management.

Course objectives:

To introduce the student to the concept, functions, objectives, and importance of material management function in an organization. Also, to give him an elementary idea of material management linkages with other areas of management, supply chain management and production processes.

- To understand how the knowledge of materials management can be an advantage to logistics and supply chain operations.
- To sensitize the students on the materials management functions – Planning, Purchase, Controlling, Storing, Handling, Packaging, Shipping and Distributing, and Standardizing.
- To realize the importance of materials both in product and service.
- Use of MRP, ERP and PLM in managing materials.

UNIT I **9 L**

Introduction to Materials Management: Meaning, definition, scope and functions of Materials Management, Objectives and Advantages of Materials Management. Interfaces of Materials Management: Internal and external interfaces. Organisation for Material Management.

Learning Outcomes:

- Able to define the materials management, relate the scope and functions of materials management (L1)
- Illustrate the objectives and advantages of materials management (L2)
- Choose the interfaces of material management and develop the organisation for material management (L3)

UNIT II **8 L**

Supply Chain Management: Concept, objectives of supply – production and distribution system, Role and Management of flow of material in supply chain management.

Learning Outcomes:

- Understand the concept of supply chain management (L2)
- Identify the objectives of supply chain, organize the production system and distribution system (L3)
- Categorize the flow of material in supply chain management (L4)

UNIT III **9 L**

Material Management Linkages: Linkages with other functional areas of Management i.e. Production, Accounting and Finance, Marketing, HRM, IT, TQM. A Brief discussion on the functions of each functional area of Management.

Learning Outcomes:

- Demonstrate the linkages with other functional areas of management in Material management linkages (L2)
- Build the linkages between production, accounting, and finance analyze HRM IT and TQM (L3)
- Compare the functions of each functional area of management (L4)

UNIT IV **8 L**

Elements of Production Processes: Familiarity with broad categories of production processes used in industries. Commonly used machines and tools in industries.

Learning Outcomes:

- Classify the elements of production process (L2)
- Distinguish between the familiarities with broad categories of production process which are used in industries (L4)
- Choose the commonly used machines and tools in industry (L5)

UNIT V **8 L**

Cost Involved in material management: General discussion on concept of costs and cost classification, specific costs associated with Material Management.

Learning Outcomes:

- Identify the cost involved in the material management (L3)
- Classify the concept of costs and specific costs associated with material management (L4)

Coarse outcomes:

On completion of this course, the students will be able to meet:

• Identifying the scope for integrating materials management function over the logistics and supply chain operations.
• Integrate the organization wide materials requirement to develop an overall plan (MRP).
• Identify, study, compare, and evaluate alternatives, select and relate with a good supplier.
• Apply various purchasing method and inventory controlling techniques into practice.
• Analysing the materials in storage, handling, packaging, shipping distributing and standardizing.
• Integrate important materials functions to both products and services & use MRP, ERP, & PLM managing materials

Textbook(s):

1. Dutta A.K., Materials Management: Procedures, Text and cases, Prentice Hall of India Pvt. Ltd., New Delhi.
2. Gopalakrishnan, P. and Sundareson, M., Materials Management: An Integrated Approach, Prentice Hall of India Pvt. Ltd., New Delhi.
3. Sharma S.C., Material Management and Materials Handling, Khanna Publishers, New Delhi.

References:

1. Varma, M.M., Essentials of Storekeeping and Purchasing, Sultan Chand and Sons, New Delhi.
2. Shah N.M. An Integrated concept of Materials Management, Indian Institute of Materials Management, Baroda Branch, Baroda.
3. Arnold, Champman and Ramakrishnan, Introduction to Materials Management 5th ed., 2007 Pearson Education, Inc.
4. Pooler Victor H. Purchasing and Supply Management, Creating the Vision, New York, Chapman & Hall, 1997.

19EME361: ADDITIVE MANUFACTURING

L T P C
3 0 0 3

The course is to acquaint students with the concept of 3D-printing / Additive Manufacturing (AM), various 3D-printing / AM technologies, selection of materials for 3D-printing / AM, modeling of 3D-printing / AM processes, and their applications in various fields. Applications for 3D printing are rapidly expanding in a broad set of industries and the technology is being used as a complementary tool in many professions. 3D printing being not only a field of learning itself but being used to enhance other fields of study by generating student engagement and drawing concepts and digital literacy elements into the broader curriculum.

COURSE OBJECTIVES

The student will be able to

1. To gain knowledge and skills related to 3D printing technologies.
2. To learn the selection of material, equipment and development of a product for Industry 4.0 environment.
3. To understand the various software tools, process and techniques for digital manufacturing.
4. To apply these techniques into various applications.

UNIT I 10 L

Introduction to Additive Manufacturing (3D Printing): Introduction to AM, AM evolution, Distinction between AM & CNC machining, Steps in AM, Classification of AM processes, Advantages of AM and Types of materials for AM, Applications.

Learning Outcomes:

- Able to describe additive manufacturing and explain its advantages and disadvantages(L5).
- Can explain the processes used in additive manufacturing for a range of materials and applications (L3).

UNIT II 10 L

Vat Photopolymerization AM Processes: Stereolithography (SL), Materials, Process Modeling, SL resin curing process, Process Benefits and Drawbacks, Applications of Vat Photopolymerization, Material Jetting and Binder Jetting AM Processes.

Learning Outcomes:

- Candidate will know the process of how Stereolithography (SL) works (L2) .
- Will know how to make a differentiation of material jetting and Binder jetting process (L1).

UNIT III **10 L**

Extrusion-Based AM Processes: Fused Deposition Modelling (FDM), Principles, Materials, Process Modelling, Contour Crafting, Process Benefits and Drawbacks, Applications of Extrusion-Based Processes.

Learning Outcomes:

- An ability to design and create own model using FDM process (L6).
- A knowledge on industry oriented applications used for the process (L1).

UNIT IV **5 L**

Sheet Lamination AM Processes: Bonding Mechanisms, Laminated Object Manufacturing (LOM), LOM Process Preparation, Advantages and Disadvantages of LOM, Applications of LOM Ultrasonic Consolidation (UC), UC applications.

Learning Outcomes:

- Candidate will know the modeling process of preparing geometric data LOM method (L3).
- Understand the role of bonding mechanisms in the design process (L2).

UNIT V **6 L**

Powder Bed Fusion AM Processes: Selective laser Sintering (SLS), Materials, Powder fusion mechanism and powder handling, Process Modelling, Process Benefits and Drawbacks, Applications of Powder Bed Fusion Processes.
Post Processing: Requirement and Techniques: Support Removal, Sanding, Acetone treatment, polishing,

Learning Outcomes:

- An ability to function on SLS method (L1).
- Able to conclude the best methods in 3D printing techniques (L3).

COURSE OUTCOMES

After completion of this course, the students will be able to:

1. Develop CAD models for 3D printing. (L2)
2. Import and Export CAD data and generate. stl file. (L4)
3. Select a specific material for the given application. (L2)
4. Select a 3D printing process for an application. (L2)
5. Produce a product using 3D Printing or Additive Manufacturing (AM). (L1)

LIST OF SUGGESTED BOOK(S)

1. Lan Gibson, David W. Rosen and Brent Stucker, “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010.
2. Andreas Gebhardt, “Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing”, Hanser Publisher, 2011.
3. D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer 2001.

19EME 363: INDUSTRIAL ENGINEERING AND MANAGEMENT

L T P C
3 0 0 3

The course is suitable to fit into all functional areas of business in different sections of the economy from manufacturing to the service sector and the process industry and fit into managerial positions in all organizations like Manufacturing, service, IT, Logistics & Apparels. It is helpful to train students to rigorously make use of quantitative techniques in analyzing and designing service operations and also to train students who will have the passion to engage in improving the service and its delivery. The individual should be creative, inquisitive, analytical, and detail-oriented, and able to work in a team and communicate well, both orally and in writing.

COURSE OBJECTIVES

1. Understand the basic concepts of management, planning, organizing and staffing.
2. Acquire the knowledge to become entrepreneur.
3. Comprehend the requirements towards the small-scale industries and project preparation.

UNIT I **10 L**

Definition of Industrial Engineering: Objectives, work study, method study, method study procedure - various charts, THERBLIGS, work measurement – various methods of work measurements. Factors affecting productivity, strategies for improving productivity.

Learning Outcomes: -

- An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics (L3).
- An ability to communicate effectively with a range of audiences (L5).

UNIT II **10 L**

Materials Management: Strategic importance of materials in manufacturing industries, inventory control models, inventory control systems, safety stock, selective Inventory control – ABC, FSN, and VED analysis.
Quality Management: Definition of quality, various approaches, concepts of quality assurance systems, statistical quality control, variables & attributes, charts, acceptance sampling, OC curve, introduction to TQM & ISO-9000.

Learning Outcomes:

- An ability to acquire and apply new knowledge as needed, using appropriate learning strategies (L4).
- Able to learn the difference between quality management and types (L2).

UNIT III **10 L**

Production Planning and Control: Objectives, types of productions, production cycle, product design and development, process planning, forecasting, functions of production control.
Plant Layout and Material Handling: Plant layout and location, types of layouts, principles, concept of UNIT load, selection of material handling equipment.

Learning Outcomes:

- Professional Responsibility - an understanding of professional and ethical responsibility by using the concept production planning and control (L3).
- Multidisciplinary Teamwork- an ability to function on multidisciplinary teams and learn the plant layout design (L2).

UNIT IV **6 L**

Industrial Management: Concepts, principles of management, growth of management thought, functions of management, principles of organization, types of organizations.

Learning Outcomes:

- An understanding of the need for and an ability to engage in self-directed continuing professional development in managing the organization (L2).
- An ability to function effectively as a member of a technical team (L2).

UNIT V **6 L**

Industrial Relations: Industrial disputes, settlement of industrial disputes, trade unions, industrial dispute act 1947 and factories act 1948. Conflict management in organizations.

Learning Outcomes:

- Describe and critique the concept of employee engagement (L4).
- Identify problems associated with both over-engagement and disengagement (L3).

COURSE OUTCOMES

1. Explain about the management and planning. (L2)
2. Apply the knowledge on planning, organizing, staffing, directing and controlling. (L3)
3. Describe the requirements towards the small-scale industries and project preparation. (L2)

Text Book(s)

1. ILO, Introduction to Work Study, 3/e, Oxford and IBH Publishing, 2008.
2. O.P. Khanna, Industrial Engineering and Management, 14/e, Dhanpat Rai Publications, 2011.

References

1. Chary, S. N., Production and Operations Management, 4/e, Tata McGraw Hill Publications, 2009.
2. M.T. Telsang, Industrial Engineering and Production Management, 2/e, S Chand and Co., 1999.

OPEN ELECTIVE -I
19EOE301: JAPANESE FOR BEGINNERS

L	T	P	C
3	0	0	3

UNIT I **9 L**

Introduction to Japanese language, simple explanation of writing and pronunciation systems, characteristics of Japanese, grammar, meeting people, introductions, exchanging business cards, identifying people and things, useful daily expressions.

UNIT II **8 L**

Asking about business L, shopping, time and numbers, large numbers, counters. Grammar: Pronouns and noun modifiers. Useful daily expressions.

UNIT III **8 L**

Getting around, confirming schedules (including going/coming), visiting another company (including month/week/day). Grammar: Motion verbs. Useful daily expressions.

UNIT IV **8 L**

Existence of people and things, asking/telling location, dining out, making plans for a weekend. Grammar: State of being/existence, basic verbs. Useful daily expressions.

UNIT V **9 L**

Giving and receiving, expressing gratitude, talking about plans (usage of Te-Form), Grammar: Adjectives, present form of i-adjective, present form of na-adjective, past forms of i-adjective and na-adjective, the Te-Form. Useful daily expressions.

References:

1. Ajalt, Japanese for Busy People: Romanized Version Volume 1, 2006.
*Study through Romanized Textbook - No reading/writing in Japanese letters 188

19EOE303: FRENCH FOR BEGINNERS

L	T	P	C
3	0	0	3

UNIT I **9 L**

Asking for and giving personal information, asking for and giving directions, gender and number. Grammar: Verbs "avoir" and "etre", present tense, questions, vocabulary: countries and nationalities, professions, family, food

UNIT II **8 L**

Asking and giving the time, asking when something is open or someone is available, asking for prices and describing what one wants. Grammar: Alphabet and numbers, possessive adjectives, negative sentences. Vocabulary: Days of the week, months, money.

UNIT III **8 L**

Asking for information related to travel and accommodation, expressing one's wants/needs. Grammar: Present tense for verbs in -er, -ir and -re, present tense of irregular verbs. Verbs: to be able to, to want, to know. Vocabulary: Food, shops, packaging and measures.

UNIT IV **8 L**

Talking about daily routine and the working day, describing things, expressing oneself when buying things. Grammar: Possessive pronouns, reflexive verbs. Vocabulary: Clothes, colours and shapes, weather.

UNIT V **9 L**

Describing places; visiting the doctor, reading short advertisements, describing places, feelings and symptoms. Grammar: Using avoir aller, etre faire, vouloir pouvoir. Vocabulary: Parts of the body, rooms and features of interior spaces.

Textbook (s):

1. Le Nouveau Sans Frontières - Workbook CD and selected passages/ exercises 189

References:

1. Le Nouveau Sans Frontières -

19EOE305: BIOTECHNOLOGY AND SOCIETY

L	T	P	C
3	0	0	3

UNIT I

History of Biotechnology, Genes (basic concepts) Genetic Engineering Inventions, Genetic engineering, Tools for manipulation of genes (introduction to recombinant DNA technology) Vectors and expression systems (introduction) Genomic engineering (concepts and potential applications)

UNIT II

Intellectual property rights (concepts related to drugs, genes and genomes) Recombinant DNA Debates, Biotechnology and Business, Patenting Life, Genetically Modified Foods: Risk, Regulation, and Our Food

UNIT III

Freezing, Banking, Crossing, Eugenics, The Human Genome Project, Genetic Testing, Disability, and Discrimination, Bioethics and Medicine, From the Pill to IVF, Cloning, Stem Cells.

UNIT IV

Drugs and Designer Bodies, Personal Genomics, Biotechnology and Race, Bioprospecting and Biocolonialism

UNIT-V

Vaccines, Gene therapy, Clinical trials, Synthetic Biology and Bioterrorism, Use of biofertilisers and biopesticides for organic forming

Text book:

1. Biotechnology and Society: An introduction. Hallam Stevens. University of Chicago Press. 2016. ISBN 022604615X, 9780226046150

References:

1. W. Godbey, An Introduction to Biotechnology, The Science, Technology and Medical Applications, 1/e, Woodhead Publishing, 2014.
2. J.M. Walker and R. Rapley, Molecular Biology and Biotechnology, 5/e, Royal
3. society of chemistry, 2009.
4. B.R.Glick, J.J.Pasternak, C.L.Patten. Molecular Biotechnology.ASM Press. 2009. ISBN-10: 1555814980, ISBN-13: 978-1555814984s

19EOE307: CONTEMPORARY RELEVANCE OF INDIAN EPICS

L	T	P	C
3	0	0	3

UNIT I **8 L**

Reading the Texts: Reading for gist, chapter summaries, plot, pair work and discussions in small groups.

UNIT II **8 L**

Understanding the Texts: Basic themes, characterization-major characters, watching short videos followed by discussion, analysis and writing short reviews.

UNIT III **8 L**

Story Retelling and Responsive Writing: Narrating short episodes, enacting select scenes, role play, writing short paragraphs and short essays based on basic themes, plot and major characters.

UNIT IV **9 L**

Exploring the Texts from Socio-cultural and Political Perspectives: Identifying examples of mutual co-existence, duties and responsibilities of individuals in the context of family and society, righteous action, conflict between good and evil, possibilities of redefining cultural and political systems, identifying spaces for reconciliation in conflict situations.

UNIT V **9 L**

Contemporary Relevance of the Epics: Human relations, team play, leadership lessons, resource management, core competencies and competitiveness.

References:

1. C. Rajagopalachari, Ramayana, 44/e, Bharatiya Vidya Bhavan, Mumbai, India, 1951.
2. C. Rajagopalachari, Mahabharata, 57/e, Bharatiya Vidya Bhavan, Mumbai, India, 2012.
3. R. K. Narayan, The Mahabharata: A Shortened Modern Prose Version of the Indian Epic, Penguin Group, 2009.
4. R. K. Narayan, The Ramayana: A Shortened Modern Prose Version of the Indian Epic, Penguin Classic, 2006. 190

19EOE309: INDIAN NATIONAL MOVEMENT

L	T	P	C
3	0	0	3

UNIT I **9 L**

Background: Early British colonialism in India, early rebellions-Pazhassi Raja (the cotiote war - Kerala, 18th century), Veerapandiyan Kattabomman (Tamilnadu/Madras Presidency - 18th century), Paik rebellion (Kalinga/ Odisha, early 19th century), Vellore mutiny (early 19th century); The Sepoy Mutiny of 1857 and its consequences.

UNIT II **8 L**

Contributory Factors: Socio-political consciousness, growth of Western education and its impact on socio-religious movement, British economic policies and their impact.

UNIT III **8 L**

Rise of Organized Movements: Emergence of Indian national congress, its policies and programmes, partition of Bengal, rise of radical nationalists, Bal-Lal-Pal, formation of the Muslim league; Minto-Morley reforms, the national movement during the first world war.

UNIT IV **9 L**

Gathering Momentum: Non-cooperation and civil disobedience, emergence of Gandhi, some prominent revolutionaries - Khudiram Bose, Prafulla Chaki, Bhupendra Nath Dutt, V.D. Savarkar, Sardar Ajit Singh, Lala Hardayal, Sardar Bhagat Singh, Raj Guru, Sukh Deo, Chandra Shekhar Azad, development of socialist ideas, communal divide.

UNIT V **8 L**

Towards Independence: Constitutional developments, provincial elections, quit India movement and after, participation of women, national movement during the second world war, Indian national army, naval mutiny of 1946, freedom and partition, impact on the world.

References:

1. K. Majumdar, Advent of Independence, Bhartiya Vidya Bhavan, Mumbai, 1969.
2. R. Desai, Social Background of Indian Nationalism, 5/e, Popular Prakashan, Mumbai, 1976.
3. Bandyopadhyay, Sekhar, Nationalist Movement in India: A Reader, Oxford University Press, 2008.
4. Chandra, Bipin, Nationalism and Colonialism in Modern India, Orient Longman Limited, New Delhi, 1979.

19EOE313: ENGINEERING FOR COMMUNITY SERVICE

L	T	P	C
3	0	0	3

UNIT I **8 L**

Assessment of Needs: How to assess the needs of an existing underprivileged commUNITy and create a check list of required support. Conceptualize the local / global issues like education, poverty, power, sanitation, health, etc. Need of global humanitarian engineer.
Deliverable: Assessment of need analysis and report on services required.

UNIT II **8 L**

Project Management: Understand project management structure and allocation of roles / responsibility to the team members. Develop review and monitoring mechanism. NGO and professional mentor assistance to manage the project.
Deliverable: Define team structure and associated processes

UNIT III **8 L**

Sustainability of Model: Define and understand sustainability models and identify a suitable model for the project undertaken keeping in mind relevant environmental issues, impart of climate change and availability of natural resources.
Deliverable: CommUNITy characteristics and sustainable models report with recommendation of a suitable model for the project.

UNIT IV **8 L**

Leadership issues: Leadership issues in the context of commUNITy projects, socio-political issues and other influencing factors for the project. Prepare a check list by visiting effected area.
Deliverable: Documenting understanding of the commUNITy's social and political structures; who are the key influencers and what is required to ensure their support.

UNIT V **8 L**

Implementation Process: Implementation and post implementation processes to ensure sustenance. Preparation of project to operation manual. Review mechanism for sustenance.
Deliverable: Operational manual and review mechanisms to ensure implementation and sustainability of the project.

19EOE313: PERSONALITY DEVELOPMENT

L	T	P	C
3	0	0	3

UNIT I **8 L**

Self Awareness: Know yourself, have a snapshot of yourself, assess your personal traits, discover natural potential. Activities and Tasks: Class discussion, questionnaires, Johari Window, SWOC analysis (strengths, weaknesses, opportUNITies and challenges).

UNIT II **8 L**

Self Discipline: Importance of self discipline, characteristics of a self disciplined achiever, self discipline in personal life and career. Activities and Tasks: Viewing short videos followed by discussion and analysis, brainstorming in small groups, creating an action plan to realize academic and career goals.

UNIT III **8 L**

Motivating Oneself: Self motivation, confidence building, goal setting, decision making. Activities and Tasks: Discussion and analysis of case studies, completing self-assessment questionnaires.

UNIT IV **9 L**

Managing Oneself: Handling emotions, time management, stress management, change management. Activities and Tasks: Discussion and analysis of case studies, completing self-assessment questionnaires.

UNIT V **9 L**

Interpersonal Behaviour: Attitude towards persons and situations, team work, leadership skills, problem solving skills, interpersonal adaptability, cultural adaptability. Activities and Tasks: Team-building games and activities.

References:

1. Hurlock Elizabeth B., Personality Development, McGraw Hill Education, India, 1979.
2. Covey, Stephen R., The 7 Habits of Highly Effective People: Powerful Lessons in Personal Change, Free Press, 2004.
3. Carnegie, Dale, Levine, Stuart. R., The Leader In You: How to Win Friends, Influence People and Succeed in a Changing World, Pocket Book(s), 1995.
4. Swami Vivekananda, Personality Development, Advaita Ashrama, 1993.

*This will be supplemented by materials and activities from internet-related sources.

19EOE315: TELECOMMUNICATIONS FOR SOCIETY

L	T	P	C
3	0	0	3

UNIT I **10 L**

Telecommunication Systems: Telephones, Telephone System, Facsimile, Internet Telephony.

UNIT II **10 L**

Cell Phone Technologies: Cellular Telephone Systems, A Cellular Industry Overview, 2G and 3G Digital Cell Phone Systems, Long Term Evolution and 4G Cellular Systems, Base Stations and Small Cells.

UNIT III **10 L**

Wireless Technologies: Wireless LAN, PANs and Bluetooth, ZigBee and Mesh Wireless Networks, WiMAX and Wireless Metropolitan-Area Networks, Infrared Wireless, Radio-Frequency Identification and Near-Field Communications, Ultra wideband Wireless, Additional Wireless Applications.

UNIT IV **10 L**

Optical Communication: Optical Principles, Optical Communication Systems, Fiber-Optic Cables, Optical Transmitters and Receivers, Wavelength-Division Multiplexing, Passive Optical Networks, 40/100-Gbps Networks and Beyond.

UNIT V **10 L**

Satellite Communication: Satellite Orbits, Satellite Communication Systems, Satellite Subsystems, Ground Stations, Satellite Applications, Global Navigation Satellite Systems

Text Book(s):

1. Louis E. Frenzel Jr., Principles of Electronic Communication Systems, 4/e, Mc Graw Hill Publications, McGraw-Hill Education, 2016.

References:

1. Wayne Tomasi, Electronic Communication Systems, 5/e, Pearson Education, 2009.
2. Wayne Tomasi, Advanced Electronic Communication Systems, 4/e, Pearson Education, 2013.
3. Dennis Roddy, Electronic Communications, 4/e, Pearson Education, 2003.

19EOE317: ELECTRICAL SAFETY

L	T	P	C
3	0	0	3

UNIT I **8 L**

Basic Concepts
Charge, current, Voltage and Power; Types of supply and applications; various circuit elements, Personal Protective Equipment (PPE), Material Safety Data Sheet (MSDS), HAZOP, VFD

UNIT II **8 L**

Electrical Hazards, Safety Measures and Symbols:
Primary and secondary hazards-shocks, burns, scalds, falls-human safety in the use of electricity- first aid-cardio pulmonary resuscitation (CPR).- Safety Measures for operating personal - Safety symbols used in Power control centers and motor control centers

UNIT III **8 L**

Earthing, Electrical Equipment and Cables:
Introduction, need for earthing, Static electricity, effects, types of earthing, specifications, earth resistance, earth pit maintenance, Motors-Transformers-Cables: types, color coding, applications.

UNIT IV **8 L**

Hazardous Zones:
Classification of hazardous zones-intrinsically safe and explosion proof electrical apparatus- safe equipment-their selection for different zones-temperature classification.

UNIT V **10 L**

Substation, Switch Gear, Supply Changeover, UPS:
Voltage levels for distribution and utilization-switchgear and symbols- need for supply changeover-types of changeover-procedure; basics of UPS, MCC (motor control centre), PCC (power control centre), CT, PT, basics of breaker.

Text Book(s):

1. W. Fordham Cooper, "Electrical Safety Engineering", second edition, Butterworth & Co., 1986.
2. Rao S, Electrical Safety, Fire Safety Engineering, Khanna Publications

References:

1. Massimo A.G. Mitolo, “Electrical Safety of Low-Voltage Systems”, Mc Graw Hill, 2009.
2. D.C. Winburn, "Practical Electrical Safety", Marcel Dekker Inc., 1988.
3. Handbook of International Electrical Safety Practices, Princeton energy Resources

19MOE301: BASICS OF FINANCE

L	T	P	C
3	0	0	3

Individuals are constantly under pressure to effectively and efficiently manage all components of working capital, realizing that cash is the lifeblood of any entity. This is by no means easy to achieve in a competitive and dynamic business world. It is therefore important that students who are dealing with finance to be equipped with effective management of available finance.

LEARNING OBJECTIVES

- To understand the concept of finance,
- To understand the basics of various investment opportUNITies

UNIT I

Financial Management: An Introduction - Meaning and Definition of financial Management, objectives of Financial Management, Finance Functions, Organization of finance function, functions of finance Manager - Interface between Finance and other business functions.

UNIT II

Sources of finance – classification of sources- security financing – kinds of ownership securities-debentures-bonds- types of bonds -internal financing– loan financing – innovative source of finance-venture capital-seed capital –private equity.

UNIT III

Time value of money – introduction – concept – techniques of time value of money –compounding technique- doubling period-compound value of annuity-discounting or present value of technique – present value of annuity.

UNIT IV

Financing Decisions: Cost of Capital - Cost of Debt, Cost of Preference Shares, Cost of Equity Shares, Cost of Retained Earnings, Weighted Average Cost of Capital.

UNIT V

Working capital management- meaning – concept – components of working capital -factors determining working capital management – operating cycle- determinants of working capital - estimation of working capital management.

Textbook:

1. Shashi K. Gupta & R.K. Sharma, "Financial Management –theory and practices" 8th revised edition, 2014, Kalyani Publishers.

References:

1. Pandey, I. M., "Financial Management", Vikas Publications Print, New Delh, 2012
2. Khan, M. Y., & Jain, P. K., "Financial Management", Tata McGraw Hill, New Delhi, 2012
3. Maheswari, S. N., "Financial Management", Sultan Publications, New Delhi, 2013

Journals:

1. Chartered Financial Analyst - ICFAI - Hyderabad
2. Journal of Accounting and Finance - Research Development Association, Jaipur
3. GITAM Journal of Management, GITAM Institute of Management, GITAM University, Visakhapatnam

19LOE301: FUNDAMENTALS OF CYBER LAW

L	T	P	C
3	0	0	3

Objectives*: The objective of this course is to make students familiar with the developments that are taking place in different areas of study with the help of Computer and Information Technology. The students will acquire knowledge in national and international legal order on the Fundamentals of Cyber Laws. The abuse of computers has also given birth to a gamut of new age crimes that are addressed by the Information Technology Act, 2008 (as amended). The chief aim of this course is to encourage inter-disciplinary studies*

UNIT I

Conceptual and theoretical perspectives of Cyber Law - Computer and Web Technology –Evolution of Cyber Law – National &International Perspectivesof Cyber Law - Legal Issues &Challenges in India, USA and EU - Data Protection - Cyber Security, etc.

UNIT II

International Perspectives - Budapest Convention on Cybercrimes - ICANN's core principles and the domain names disputes - Net neutrality - EU electronic communications regulatory framework - Web Content Accessibility Guidelines (WCAG).

UNIT III

Information Technology Act, 2008 as amended - Overview of the Act - Jurisdiction -Electronic Governance - Electronic Evidence (Relevant portions of Indian Evidence Act) - Digital Signature Certificates (DSCs) - Duties of Subscribers of DSCs - Role of DSC Certifying Authorities - The Cyber Regulations Appellate Tribunal - Internet Service Providers and their Liability – Powers of Police - Impact of the Act on other Laws - Social Networking Sites vis-à-vis Human Rights.

UNIT IV

Cyber Laws vis-à-vis IPRs - Copyright in Information Technology - Software - Copyrights Vs Patents debate - Authorship and Assignment Issues - Copyright in Internet - Multimedia and Copyright issues - Software Piracy - Patents - European Position on Computer related Patents - Legal position of U.S and India on Computer related Patents - Trademarks in Internet - Domain name registration - Domain Name Disputes & World Intellectual Property Organization (WIPO) - Databases in Information Technology - Protection of database in USA, EU &India.

UNIT V

Mobile Technology- SIM (Subscriber Identity UNIT) cloning–Mobile frauds - Usage of mobile software - Special reference to the relevant provisions of IT ACT 2008, India Penal Code and Evidence Act.

Text book(s):

1. Yatindra Singh : Cyber Laws
2. Vakul Sharma, Handbook of Cyber Laws

References:

1. Linda Brennan and Victoria Johnson: Social, ethical and policy implication of Information Technology.
2. Kamath Nandan : Law relating to Computer, Internet and E-Commerce.
3. Mike Godwin: Cyber Rights Defencing free speech in the Digital Age.

19MOE319: INTRODUCTION TO MUSIC

L	T	P	C
3	0	0	3

UNIT I **8 L**

Introduction to Indian Classical Music: Heritage-Contribution of vari-ous races and tribes to the evolution of music in India, technical aspects of Indian classical music, influences Persian music especially on hindustani music, significance of music in bringing about social change.

UNIT II **9 L**

History of Indian Music: Origin-Vedas, scriptures and bharata'snatyasastra, traditions- hindustani and carnatic, basic elements, shruthi, swara, raaga and taala, similarities and variations in hindustani, carnatic and western classical music, octave, semitones, introduction to shruthi, swara, raaga and taala, fundamental ragas, importance of taala in indian music, introduction to pallavi, anupallavi and charana.

UNIT III **8 L**

Hindustani Music: Brief history of hindustani music, concepts of raagaand taala, introduction to various gharanas, classification of music (folk, semi-classical, bhajans, light), appreciation of music.

UNIT IV **8 L**

Carnatic Music: History of carnatic music, traditions, the musical trinity,Syama Sastri, Thyagaraja, Muthuswami Dikshitar, introduction to tech-nical terms in carnatic music, compositional forms/strategies.

UNIT V **9 L**

Connections-Music, Art and Culture: Musical oral tradition as a trans-mitter of culture, music as an expression of societal change, music as a means of communication across cultures.

References:

1. Rangaramanuja Iyengar R., History of South Indian Carnatic Music: From Vedic Times To The Present, Wilco Publishing House, 1972.
2. Beni Madhab Barua, Swami Prajnanananda, The Historical Development of Indian Music: A Critical Study, Buddh Gaya, India, 1973.
3. G.H. Ranade, Hindustani Music, Popular Prakashan, 1971.

19GOE301: GANDHIAN PHILOSOPHY

L	T	P	C
3	0	0	3

UNIT I **8 L**

Gandhi -The Man and His Times: Early life and education, lessons learntfrom his wife, in South Africa, influence of Thoreau, Tolstoy and other thinkers, return to India, Sabarmati ashram, role in the Indian national movement, his impact during his life time.

UNIT II **8 L**

Interpretation and Pursuit of Truth: Learning through trial and error; power of introspection, truth in thought, speech and action, pursuit of truth as true devotion to god, truth leads to courage and victory.

UNIT III **8 L**

Peace and Conflict Resolution: Ahimsa as practical idealism - the meansto the goal of truth, non-violent civil resistance, living faith in the power of nonviolence, prerequisites for practice, faith, courage and humility, prevention of structural violence, two pronged approach - conflict reso-lution and establishing peace, examples of methods and practices.

UNIT IV **8 L**

Transformation of the Individual: Liberating the mind from dogmatism,control of the senses, thoughts and actions, respect for all faiths and universalism, a few strategies- Anasakta Karma, non-discrimination, simple living and self-sufficiency.

UNIT V **10 L**

Contemporary Relevance: Gandhi's social, political and economic thought,sarva dharma sambhava - tolerance, respect towards all religions, educational reform - basic education and adult education, social equality-sarvodaya, removal of untouchability, communal UNITy, women empowerment, prohibition, service of backward classes, village sanitation, political solutions-swaraj, decentralization of power, democracy of enlightened majority, economic solutions -swadeshi, trusteeship, khadi and village industries, decentralization of wealth, sustainable development and equal opportUNITy, youth as agents of change.

References:

1. Gandhi M.K., Mahadev H. Desai, Gandhi An Autobiography: The Story of My Experiments With Truth, Beacon Press, 1993.
2. Fischer, Louis, The Essential Gandhi: An Anthology of His Writings on His Life, Work, and Ideas. Vintage Book(s), 1983.
3. http://www.mkgandhi.org/main.htm
   Comprehensive Website by Gandhian Institutions - Bombay Sarvodaya Mandal and Gandhi Research Foundation

19EOE321: ENVIRONMENT AND ECOLOGY

L	T	P	C
3	0	0	3

UNIT I **8 L**

Basic Concepts: Environment types, features of environment, structure of atmosphere, earth's four spheres, ecology, ecological principles, photosynthesis, components of ecosystem, carbon and oxygen cycles, nitro-gen, hydrological, sedimentary, phosphorous and energy cycles.

UNIT II **8 L**

Biomes: Terrestrial biomes, Aphine Tundra biomes, extinction of species. Bio-diversity: Biodiversity in American contents, Europe, central Asia and Africa. Categorization of species, bio geographic zones of India, biodiversity conservation, strategies, biodiversity conservation in India.

UNIT III **8 L**

Environmental Degradation and Management: Greenhouse effect and global warming, acidification, world distribution of acid rain, impact of acid of precipitation, ozone depletion, Antarctic ozone hole, some basic facts about ozone depletion, salinisation, desertification or desertisation, soil erosion, types of soil erosion, soil conservation, deforestation, waste disposal, sustainable development.

UNIT IV **8 L**

Natural Hazards and Disaster Management: Disaster, natural hazards, earthquakes in India, seismic zones of India, earthquake prediction, tsu-nami, landslides, types of landslides, avalanches, cyclones, thunderstorms, tornadoes, surge, sea-surge or storm surge. Floods: floods in India, flood disaster management. Drought hazards: causes of droughts, consequences of droughts, biological hazards and disasters, famines, wildfire (forest fire), forest fires in India.

UNIT V **8 L**

Climate Change: Evidence of global warming, consequences of climatic change, consequences of climate change in India. Biodiversity and Legislation: Earth summit, the five earth summit agreements, the Montréal protocol, Kyoto protocol on climatic change.

Text Book(s):

1. Majid Husain, Environment and Ecology, 2/e, Access Publishing, New Delhi, 2014.

References:

1. S. V. S. Rana, Essentials of Ecology and Environmental Science, Prentice Hall India, New Delhi, 2011.

19EOE323: INDIAN HISTORY

L	T	P	C
3	0	0	3

UNIT I **10 L**

Ancient Indian History and Culture (Earliest Times to 700 AD): Indus valley civilisation, origin, significance. art and architecture, aryans and vedic period, expansions of Aryans in India, significance of the vedic age, evolution of monarchy and varna system, political conditions and admin-istration under Mauryas, Guptas, social and economic conditions in an-cient India, philosophy and religions in ancient India.

UNIT II **8 L**

Medieval Indian History and Culture: Delhi sultanate, great mughals, bahumanis, rise of south supremacy and conflicts, Pallava, Chalukya, Chola and Rasthrakutas.

UNIT III **8 L**

Modern Indian History and Culture: European penetration into India, the Portuguese and the Dutch, the English and the French east India com-panies, their struggle for supremacy, the battle of Plassey and its signifi-cance, consolidation of British rule in India.

UNIT IV **8 L**

Impact of British Colonial Rule: Economic: Commercialization of agriculture, dislocation of traditional trade and commerce, de-industrialisation, decline of traditional crafts, drain of wealth, famine and poverty in the rural interior. Social and Cultural Developments: The state of indigenous education and its dislocation, orientalist, anglicist controversy, introduction of western education in India, the rise of print media, literature and public opinion, the rise of modern vernacular literature, progress of science, rail and road connectivity.

UNIT V **8 L**

The Rise of Indian National Movement: Indian response to British rule, the great revolt of 1857, the peasant movements of the 1920s and 1930s, the foundation of the Indian national congress, the moderates and extrem-ists, the partition of Bengal (1905), the swadeshi movement in Bengal, the economic and political aspects of swadeshi movement. Gandhian nationalism: Gandhi's popular appeal, Rowlett Act, satyagraha, the Khilafat movement, the non-cooperation movement, civil disobedience movement, Simon commission, the peasant and working class movements, Cripps mission, the quit India movement, declaration of independence.

Text Book(s):

1. Romila Thapar, A History of India, Vol. I, Penguin Book(s), 2013.
2. R.C. Majumdar, The History and Culture of the Indian People: Volume 1, The Vedic Age,

Bharatiya Vidya Bhavan, 2010.

3. B. L. Grover, Modern Indian History: From 1707 to the Modern Times, S. Chand, 1998.
4. R.C. Majumdar, History of the Freedom Movement in India, South Asia Book(s), 1988.

References:

1. D. N. Jha, Ancient India in Historical Outline, Manohar Publishers and Distributors, 2001.
2. G. S. Chabra, Advanced Study in the History of Modern India, Lotus Press, 2007.
3. M.K. Gandhi, Hind Swaraj: Indian Home Rule, Sarva Seva Sangh Prakashan, Varanasi, 2014.
4. W. W. Hunter, History of British India, Read Book(s) Design, India, 2010.
5. A. R. Desai, Social Background of Indian Nationalism, 6/e, Popular Prakashan, 2005.

19EOE325: PHILOSOPHICAL FOUNDATIONS OF EDUCATION

L	T	P	C
3	0	0	3

UNIT I **8 L**

Introduction: Philosophy's relevance to education; Philosophical roots of education, education as transmission of knowledge, education as the fostering of inquiry or reasoning skills, education as an agent of social change or personal liberation, liberal education and vocational education.

UNIT II **9 L**

Philosophical Concepts Related to Education: Indian: from the vedicto the modern - an overview; Western: an overview - metaphysics - naturalism or supernaturalism; Epistemology - reason or faith; Human nature - dualism, reductive materialism or integrationism; Ethics - egoism, predation or altruism; Idealism, Realism, Pragmatism, Behaviorism, Existentialism.

UNIT III **9 L**

Knowledge and Wisdom: Interrelation between education, science, technology, society and environment, Galileo to today-an overview.

UNIT IV **8 L**

Purposes of Education: Personal growth or self-improvement, intellectual purposes, political purposes, economic purposes such as job preparation, social purposes such as the development of social and moral responsibility.

UNIT V **8 L**

A Few Thinkers on Education and their Impact on Education: Easternand western-Confucius, Socrates, Plato, Aristotle, Michel Foucault, Bertrand Russel, Rabindranath Tagore, Sri Aurobindo, Swami Vivekananda, J. Krishnamurti, S. Radhakrishnan, M.K. Gandhi.

References:

1. Sharma, A.P., Indian and Western Educational Philosophy, Pustak Mahal, 2010.
2. Ozmon, Howard, Philosophical Foundations of Education, Prentice-Hall, 2011.
3. Palmer Joy, Bresler Liora, Cooper David, Fifty Major Thinkers on Education: From Confucius to Dewey, Routledge, 2001.
4. Noddings N., Philosophy of Education, Boulder, CO, Westview Press, 1995.
5. Gailbraith D., Analyzing Issues: Science, Technology and Society, Trifolium Book(s). Inc., Toronto, 1997.

19EOE327: PROFESSIONAL COMMUNICATION

L	T	P	C
3	0	0	3

UNIT I **8 L**

Internal Communication: Memo-structure, layout and style, e-mail-structure, style, content and etiquette, notice-structure, content and layout, conducting a meeting, purpose and preparation, drafting agenda and minutes, conducting effective meetings, meeting etiquette.

UNIT II **9 L**

Making a Business Presentation: Planning-define the purpose, analyze audience and occasion, preparation-developing central idea, main ideas, gathering supporting materials, audio-visual aids, organization-introduction, body and conclusion, delivery-addressing the audience, body language, eye contact, use of appropriate language, style and tone.

UNIT III **8 L**

Business Letters: Form and structure, style and tone, letters of enquiry, letters placing orders/ giving instructions/urging action, letters of complaint and adjustment.

UNIT IV **9 L**

Proposals and Reports: Proposals, types, structure, prefatory parts, body of the proposal, supplementary parts, reports, types, informative, analytical, formal/informal, oral/written, individual/group, format and structure.

UNIT V **8 L**

Resume, Cover Letter, Interview and Telephone Etiquette: Resume, design and structure, cover letter, cover letters, accompanying resumes, opening, body, closing; Interview, planning, purpose, pre-interview preparation, conversation, two-way interaction, projecting a positive image, telephone etiquette-guidelines for telephone conversations in a professional context.

References:

1. Seely, John, Oxford Guide to Effective Writing and Speaking, Oxford University Press, India, 2013.
2. Olsen Leslie, Huckin Thomas, Technical Writing and Professional Communication for Non-Native Speakers, McGraw Hill, 1991.
3. Rizvi, M. Ashraf, Effective Technical Communication, Tata McGraw Hill, 2005. 193

INTER DISCIPLINARY ELECTIVE-I

19EEC371: FUNDAMENTALS OF COMMUNICATION SYSTEMS

L	T	P	C
2	**0**	**2**	**3**

This course covers fundamental concepts of communication systems, which are essential for the understanding of advanced communication systems. Beginning with the basic communication system, the need for modulation, various analog and digital modulation techniques are covered. Further, this course will also focus on the basic concepts of various antenna and Radar systems, their working principles and applications.

Course Objectives:

- To familiarize with the need of modulation, AM, DSBSC and its applications.
- To explain the concept of angle modulation techniques and its practical applications.
- To demonstrate various pulse coding and the generation of digital modulation techniques.
- To explain the basics of antenna and its applications in HF/UHF/MW frequencies.
- To describe the working principles and applications of various RADAR Systems.

UNIT I **9L**

Introduction to Communication Systems: Introduction to communication, elements of communication system, need of modulation, electromagnetic spectrum and typical applications. amplitude modulation techniques: elements of analog communication, theory of amplitude modulation (AM) technique, double sideband suppressed carrier (DSBSC) technique, generation of amplitude modulated Signal: generation of AM Signal, generation of DSBSC Signal.

Learning Outcomes:

After completion of this UNIT, the student will be able to
- describe the elements of communication system (L1).
- explain the need of modulation, electromagnetic spectrum and applications (L2).
- analyze the generation of amplitude modulated signal and DSBSC signals (L5).

UNIT II **8L**

Angle Modulation Techniques: Theory of angle modulation technique: frequency modulation, phase modulation, frequency spectrum of the FM wave, narrow band and wide band FM, stereophonic FM multiplex system, comparison of FM and AM.

Learning Outcomes:

After completion of this UNIT, the student will be able to
- describe the theory of angle modulation technique (L1).
- compare frequency modulation, amplitude modulation and phase modulation (L2).

- differentiate narrow band and wide band FM (L4).
- analyze the stereophonic FM multiplex system (L4),

UNIT III **8L**

Digital Pulse Modulation Techniques: pulse code modulation, delta modulation, digital modulation techniques: introduction, basic digital modulation schemes: amplitude shift keying (ASK), frequency shift keying (FSK) and phase shift keying (PSK).

Learning Outcomes:
After completion of this UNIT, the student will be able to
- explain the digital pulse modulation techniques like pulse code modulation and delta modulation (L2).
- classify the basic digital modulation schemes (L3).
- demonstrate the generation of ASK, PSK, FSK signals (L3).

UNIT IV **9L**

Antennas: Basic considerations, wire radiator in space, terms and definitions, directional high-frequency antennas: dipole arrays, folded dipole and applications UHF and microwave antennas: parabolic reflector antenna, horn antenna.

Learning Outcomes:

After completion of this UNIT, the student will be able to
- explain the basic concepts of antenna fundamentals (L1).
- define the terms and definitions of antenna parameters (L1).
- illustrate the characteristics and applications of directional high-frequency antennas (L3).
- demonstrate the characteristics and applications of UHF and microwave antennas (L3).

UNIT V **8L**

Radar Systems: Fundamentals, radar performance factors, basic pulsed radar systems, moving-target indication (MTI), CW doppler radar, frequency modulated CW radar.

Learning Outcomes:

After completion of this UNIT the student will be able to
- explain the fundamentals and performance factors of radar (L1).
- describe the principles of pulsed radar systems and moving- target indication (MTI) (L1).
- distinguish between CW Doppler radar and frequency modulated CW radar (L4).

Text Book:

1. George Kennedy, Bernard Davis and S R M Prasanna, Electronic Communication Systems, 5 Ed Mc Graw Hill Education (India) Private Limited, 2014.

References:

1. Taub H. and Schilling D., Principles of Communication Systems, Tata McGraw Hill, 2010.
2. Simon Haykins, Michel Mohar, Introduction to Analog and Digital Modulation, second edition, Wiley India, 2014.
3. P. Rama Krishna Rao, Analog Communications 1 Ed, Tata McGraw Hill, 2011.
4. Gottapu Sasibhushana Rao, Microwave and Radar Engineering, 1 Ed, Pearson Education, 2014.

Course Outcomes:

After successful completion of the course, the student will be able to

- summarize the need of modulation, AM, DSBSC and its applications (L2).
- describe the concept of angle modulation techniques and its practical applications(L1).
- demonstrate various pulse coding and the generation digital modulation techniques(L3).
- explain the basics of antenna and its applications in HF/UHF/MW frequencies(L2).
- describe the working principles and applications of various RADAR Systems(L2).

19EEC373: FUNDAMENTALS OF GLOBAL POSITIONING SYSTEM

L	T	P	C
2	0	2	3

The course is structured to introduce students to the basic principles of positioning features. This course deals with topics on satellite constellation, data formats, positioning solution algorithm, different sources of errors and their mitigation techniques. Further this course exposes the student to other Global navigation systems such as Galileo and GLONASS. Application of GPS for different fields of Engineering is also introduced.

Course Objectives:

- To introduce the basic principles of Global Positioning System and other constellations.
- To make the student familiar with different error sources that affects the positioning accuracy.
- To familiarize about different reference frames and coordinate systems of positioning systems.
- To get acquainted about the GPS orbits and the satellite and Receiver position algorithm
- To explore about different applications of GPS in engineering.

UNIT I **8L**

Overview of GPS and other constellations: Basic concept, system architecture, space segment, user segment, GPS aided Geo-augmented navigation (GAGAN) architecture. GPS Signals and other constellations: signal structure, Galileo and GLONASS.

Learning Outcomes:

After completion of this UNIT, the student will be able to
- understand basic concept of Global Positioning and System architecture(L1).
- distinguish between the different segments of the architecture (L2).
- identify the necessity of augmented systems like GAGAN(L1).
- understand about the Galileo and GLONASS constellation (L2).

UNIT II **8L**

GPS Errors: GPS error sources – clock error, ionospheric error, tropospheric error, multipath, ionospheric error estimation using dual frequency GPS receiver, anti- spoofing (AS), selective availability(SA).

Learning Outcomes:

After completion of this UNIT, the student will be able to
- understand the different types of error sources (L2).
- estimate the ionospheric and troposheric error using real time data (L2).
- understand about anti- spoofing and selective availability(L2).

UNIT III **8L**

GPS Coordinate Frames and Time References: Geodetic and geo centric coordinate systems, ECEF coordinate world geodetic 1984 (WGS 84), GPS time.

Learning Outcomes:

After completion of this UNIT, the student will be able to
- describe different reference frames (L2).
- differentiate the different coordinate systems of GPS(L4).
- Interpret the GPS Time(L2).

UNIT IV **8L**

GPS Orbits and Satellite Position Determination: GPS orbital parameters, description of receiver independent exchange format (RINEX), observation data and navigation message data parameters, GPS position determination.

Learning Outcomes:

After completion of this UNIT, the student will be able to
- understand the satellite orbital parameters (L2).
- interpret the RINEX format (L2).
- identify orbital parameters from navigation message and observation data formats(L4).
- interpret the GPS position determination algorithm (L2).

UNIT V **8L**

GIS and GPS Applications: Introduction to GIS, geodetic control surveys, engineering and monitoring, vehicle tracking, traffic control and road condition monitoring.

Learning Outcomes:

After completion of this UNIT, the student will be able to
- explain the significance of GPS as a surveying tool (L2).
- discuss the usage of GPS in engineering and monitoring(L2).
- review the role of GPS in Traffic Control and road condition monitoring(L2).

Text Book(s):

1. B. Hoffman – Wellenhof, H. Liehtenegger, J. Collins, GPS: Theory and Practice, Springer – Wien, 2001.
2. Gottapu Sasibhushana Rao, Global Navigation Satellite Systems, Tata McGraw Hill Education, 2010.

3. Burrough.P.A, Principle of Geographical Information Systems for Land resources Assesment, OUP, Oxford, 1986.

References:

1. Parkinson. B, Spilker. J, Jr., GPS: Theory and Applications, Vol.II, AIAA, 1996.
2. James Ba, Yen Tsui, Fundamentals of GPS Receivers: A Software Approach, John Wiley and Sons, 2001.

Course outcomes:

After completion of this course, the student will be able to

- understand the basic principles of GPS and other constellations (L1).
- determine at least one /two errors with real time data (L3).
- explain the need of reference frames and coordinate systems in positioning systems(L3).
- describe the significance of orbital parameters in satellite systems (L2).
- interpret at least one engineering applications of GPS(L3).

19EEI477: INDUSTRIAL AUTOMATION

L	T	P	C
2	0	2	3

To provide students with required knowledge in the field of automation and to introduce the advanced automation techniques like PLC, SCADA and DCS systems and Instrument protocols which are presently used in different Industries for Automation.

Course Objectives:

- To familiarize the role of automation in industries
- To explain the architecture and applications of PLC, SCADA and DCS
- To provide an understanding of instrumentation standard protocols
- To describe the concept and applications of DCS.
- To explore the importance and applications of automation in various modern industries.

UNIT I **8L**

Control Systems and Automation Principles: Evolution of instrumentation and control, role of automation in industries, benefits of automation, introduction to automation tools PLC, DCS, SCADA, hybrid DCS/PLC, automation strategy evolution, control system audit, performance criteria and safety systems.

Learning Outcomes:

After completion of this UNIT, the student will be able to

- summarize the importance of instrumentation and control in industry (L2).
- describe various automation tools (L4).
- analyze the performance criteria of the system (L4).

UNIT II **9L**

Programmable logic Controllers (PLC): Introduction, architecture, definition of discrete state process control, PLC Vs PC, PLC Vs DCS, relay diagram, ladder diagram, PLC design, advanced applications of PLC and SCADA**:** PLC programming methods, PLC applications for batch process using SFC, analog control using PLC, PLC interface to SCADA/DCS using communication links (RS232, RS485) and protocols (Mod bus ASCII/RTU).

Learning Outcomes:

After completion of this UNIT, the student will be able to

- explain the architecture of PLC and assemble it with SCADA/DCS (L2).
- distinguish between PLC & PC and PLC & DCS (L2).
- construct the ladder diagrams of PLC(L3).
- identify the advanced applications of PLC and SCADA(L1).

- list out PLC programming methods (L1).

UNIT III **8L**

Instrumentation Protocols: HART protocol introduction, frame structure, programming, implementation examples, benefits, advantages and limitations. Foundation field bus H1 introduction, structure, programming, FDS configuration, implementation examples, benefits, advantages and limitations, comparison with other field bus standards including device net, Profibus, control net, CAN, industrial Ethernet etc.

Learning Outcomes:

After completion of this UNIT, the student will be able to

- explain the hart protocol and its programming (L2).
- list the advantages and limitations of HART protocol (L3).
- demonstrate the foundation field bus H1and its programming (L3).
- compare foundation field bus H1 with other field bus standards (L4).

UNIT IV **9L**

Distributed Digital Control Systems: DCS introduction, functions, advantages and limitations, DCS as an automation tool to support enterprise resources planning, DCS architecture of different makes, specifications, configuration and programming, functions including database management, reporting, alarm management, communication, third party interface, control, display etc. enhanced functions viz. advance process control, batch application, historical data management, OPC support, security and access control etc.

Learning Outcomes:

After completion of this UNIT, the student will be able to

- describe distributed control system (L2).
- list the advantages and limitations of DCS (L3).
- formulate DCS as an automation tool for various functions (L5).
- illustrate DCS architecture of different makes (L3).

UNIT- V **8L**

Industrial Applications for Automation:–Power, water treatment, food and beverages, dairy, cement, steel, pharmaceuticals, automobile and building automation.

Learning Outcomes:

After completion of this UNIT, the student will be able to

- analyze power plant industry (L4).
- develop water treatment and food &beverages plant using various automated tools (L3).

- explain the process of cement and steel plant automation (L3).
- adapt automated tools for automobile and building automation (L5).

Textbook(s):

1. Popovik, Bhatkar, Distributed Computer Control for Industrial Automation, Marcel Dekkar Publications, 1990.
2. Webb and Reis, Programmable Logic Controllers: Principles and Applications, PHI, 5th Edition.
3. S.K.Singh, Computer Aided Process Control, PHI, 2004.

References:

1. Gary Dunning, Introduction to Programmable Logic Controllers, Thomson Learning, 3rd Edition.
2. N.E.Battikha, The Management of Control System: Justification and Technical Auditing, ISA, 1992.
3. Krishna Kant, Computer Based Process Control, PHI, 2nd Edition.

Course Outcomes:

After completion of this course, the students will able to

- explain importance of automation in industries (L2).
- design and develop control systems for various real time industrial applications using PLC, SCADA and DCS (L5).
- apply different instrumentation protocols for industrial applications (L3).
- use DCS as an automation tool for various functions (L3).

design and develop advanced Instrumentation systems in Industrial & Automation field

19ECS371: INTRODUCTION TO DATABASE MANAGEMENT SYSTEMS

L	T	P	C
2	0	2	3

This course provides fundamental and practical knowledge on database concepts by means of organizing the information, storing and retrieve the information in an efficient and a flexible way when data is stored in a well-structured relational model. This course ensures that every student will gain experience in creating data models and database design.

COURSE OBJECTIVES

- Relate the role of a database management system in an organization.
- Demonstrate basic database concepts, including the structure and operation of the relational data model.
- Construct simple and moderately advanced database queries using Structured Query Language (SQL).
- Explain and successfully apply logical database design principles, including E-R diagrams and database normalization.
- Demonstrate the concept of a database transaction and related database facilities, including concurrency control, and data object locking and protocols.

UNIT-I 8 L

Introduction to DBMS: Overview, file system vs. DBMS, advantages of DBMS, storage data, queries, transaction management, DBMS Structure.

Learning outcomes

Students will be able to

- **Interpret** the basic terminology of DBMS like data, database, database management systems**(L2)**
- **Compare** DBMS over File Systems. **(L2)**
- **Define** levels of abstraction with three tier architecture.**(L1)**

UNIT-II 8 L

Entity Relationship Model: E-R model entities, attributes and entity sets, relationship and relationship sets, features of E-R model, conceptual database design with E-R model

Learning outcomes

Students will be able to

- **Match** the integrity constraints from ER model to relational model. **(L1)**
- **Translate** an ER Model to Relational Model and vice versa. **(L2)**
- **Compare** the difference between views and physical tables and working with views.**(L2)**
- **Construct** the given Query in Relational Algebra and Relational Calculus. **(L3)**

UNIT-III **8 L**

Relational Model: Integrity constraints over relations and enforcement, querying relational data, logical database design, views, destroying/altering tables and views, relational algebra and calculus. Relational algebra and calculus

Learning outcomes

Students will be able to

- **Create** and modify database using SQL query.**(L5)**
- **Illustrate** different types of query forms (simple queries, nested queries, and aggregated queries) in SQL.**(L2)**

UNIT-IV **8 L**

Structure Query Language: Basic SQL, query, union, interest, except, nested queries, aggregated operation, null values, embedded SQL, cursors, ODBC and JDBC, triggers and active database..

Learning outcomes

Students will be able to

- **Make use of** about schema refinement process.**(L3)**
- **Illustrates** knowledge about different types of normal forms and the importance of normalization. **(L2)**

UNIT-V **8 L**

Transaction Management, Concurrency Control and Crash Recovery: Transaction concept, transactions and schedules, concurrent execution of transactions, lock based concurrency control, crash recovery.

Learning outcomes

Students will be able to

- **Interpret** the overview of transaction management in DBMS. **(L2)**
- **Explain** the importance of concurrency and concurrency control mechanisms.**(L2)**
- **Develop** knowledge about concurrency control with and without locks.**(L3)**
- **Identify** knowledge about different types of crashes in DBMS.**(L3)**
- **Apply** crash recovery techniques to recover from DBMS crashes. **(L3)**

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

- design a data base for a system Using E-R data model and Relational Data model
- design logical database with all integrity constraints over relations.
- construct all types of SQL, relational algebra, relational calculus queries over relations and he/she can be able to create views on the existing relations.
- extend the characteristics of database transactions and how they affect database integrity and consistency.

- demonstrate the concurrency control mechanisms and crash recovery algorithms

Text Book(s):

1. Database Management Systems, Raghu Ramakrishnan and Johannes Gehrke McGraw-Hill, 3rd Edition, 2014

Reference Book(s):

1. Database System Concepts, H.F.Korth and A.silberschatz McGraw-Hill, 6e, 2011
2. Fundamentals of Database Systems, Ramez Elmasri, Shamkant B. Navathe, Pearson Education, 7e, 2016
3. Fundamentals of Database Systems, Elmasri, Navathe, Somayajulu, Gupta, Pearson Education, 6e, 2010

19ECS373: OBJECT ORIENTED PROGRAMMING WITH C++

L	T	P	C
2	0	2	3

C++ is one of the most popular languages, contains object-orientation, a new programming concept , is used to create an object, in code, that has certain properties and methods or UNITs, the implementation of the UNITs helps to see the whole world in the form of objects. This course also helps in developing high quality software like system application software, drivers, client-server applications and embedded firmware.

Course Objectives:

- To understand the difference between procedure oriented programming and object oriented programming.
- To learn the basic concept, applications of OOPS and practice of object oriented analysis and design in the construction of robust, maintainable programs which satisfy their requirements;
- To identify and practice the object-oriented programming concepts and techniques, practice the use of C++ classes and class libraries, modify existing C++ classes, develop C++ classes for simple applications
- Ability to implement features of object oriented programming to solve real world problems using Inheritance, data abstraction, encapsulation and Polymorphism.
- To understand the concept of file and handling function to perform file operations like accessing the data from file and store the data into file.

UNIT I **10 L**

Introduction to OOP: Procedure oriented programming, object-oriented programming, basic concepts of OOP, simple C++ program, namespace scope, structure of C++ Program, creating, compiling and linking a file.
Tokens: Keywords, identifiers, constants, basic data types, user defined data types, derived data types, dynamic initialization of variables, reference variables, operators in C++, scope resolution operator, member dereferencing operators, memory management operators.

Learning Outcomes:

By the end of this UNIT, the student will be able to

- list the difference between procedure and object-oriented programming, applications of OOP. (L1)
- tell the basic concepts of object-oriented programming. (L1)
- create, compile and run the C++ programs. (L3)
- choose appropriate datatype and operators in programs. (L3)
- extend the concepts of C++ in developing efficient programs. (L2)

UNIT II **9 L**

Control Structures: Classes and Objects-Specifying a class, defining member functions, C++program with class, private member functions, arrays within class, memory allocation for objects, static data members, static member functions, arrays of objects.
Functions in C++: Main function, function prototyping, inline functions, default arguments.

Learning Outcomes

By the end of this UNIT, the student will be able to

- compare and contrast parameter passing techniques of C and C++. (L2)
- illustrate the concept of classes and objects. (L2)
- develop real world applications by using appropriate concepts. (L3)
- make use of static members in programming. (L3)
- compare and contrast inline functions with macros. (L2)

UNIT III **9 L**

More about Functions: Function overloading, friendly functions: friend function, objects as function arguments.
Constructors & Destructors: Constructors, parameterized constructors, multiple constructors in a class, copy constructors, dynamic constructors, destructors.

Learning Outcomes

By the end of this UNIT, the student will be able to

- apply function overloading concept whenever required.(L3)
- explain the need of friend function.(L2)
- extend the concept of parameter passing techniques with objects.(L2)
- outline the different types of Constructors.(L2)
- make use of constructor and destructor in programming.(L3)

UNIT IV **10 L**

Inheritance: Introduction to inheritance, single inheritance, making a private member inheritable (protected member), multi-level inheritance, multiple inheritance, hierarchical inheritance, hybrid inheritance.
Operator Overloading: Rules for overloading operators, overloading unary operators, overloading binary operators.
Pointers: Introduction to pointers, declaring and initializing pointers ,pointers with arrays, arrays of pointers, 'this' pointer.

Learning Outcomes

By the end of this UNIT, the student will be able to

- explain the need of reusability concept with inheritance.(L2)
- summarize different types of inheritance.(L2)
- extend the overloading concept on operators.(L2)
- recall the basics of pointers from C language and extend to objects.(L1)
- tell the need of this pointer.(L1)

UNIT V **9 L**

Polymorphism and Virtual Functions: Compile-time polymorphism, run-time polymorphism, virtual functions.
Templates: Introduction, function templates, class templates.
Exception Handling: Introduction, exception handling mechanism, throwing mechanism, catching mechanism.

Learning Outcomes

By the end of this UNIT, the student will be able to

- compare and contrast compile time and run time polymorphism. (L2)
- make use of virtual functions. (L3)
- classify the various input and output operators into formatted and unformatted. (L2)
- apply the concept of templates for generic programming. (L3)
- demonstrate the handling of run time errors. (L2)

Course Outcomes:

After completion of this course, the student will be able to

- differentiate between procedure-oriented programming and object-oriented programming with emphasis on special features of C++ language.(L2)
- examine the working of Control structures in C++ programs.(L4)
- develop applications with the help of classes, objects,functions, constructors and destructors.(L3)
- understand various Inheritance mechanisms, operator overloading ,polymorphism and apply in applications.(L2)
- learn the concepts of Polymorphism, Virtual functions and Exception handling and be able to develop applications with them.(L3)
- construct applications using generic programming concepts (templates).(L3)

Text Book(s)

1. Balagurusamy, Object Oriented Programming with C++, 6/e, McGraw Hill, 2013.

References

1. SouravSahay, Object Oriented Programming with C++, 2/e, Oxford University Press, 2012.
2. Behrouz A. Forouzan and Richard F. Gilberg, Computer Science : A Structured Approach Using C++, 2/e, Cengage Learning, 2003.
3. Ashok N. Kamthane, Object Oriented Programming with ANSI and Turbo C++, 1/e, Pearson Education, 2006.

19ECS375: INTRODUCTION TO PROGRAMMING WITH JAVA

L	T	P	C
2	0	2	3

Java's unique architecture enables programmers to develop a single application that can run across multiple platforms seamlessly and reliably. In this hands-on course, students gain extensive experience with Java and its object-oriented features. Students learn to create robust console and GUI applications and store and retrieve data from relational databases.

Course objectives

- To make it understand the difference between programming languages C,C++ and Java.
- Learn various types of Inheritance mechanisms.
- Give exposure over various software packagesapplicability and usage of multithreading concepts.
- Applet creation and its graphical effects.
- Learn different components required for forms designing in AWT.

UNIT I **10 L**

Java Evolution and Overview of java Language: Fundamentals of OOP, Java evolution, overview of java language, java history, features of java, how java differs from C and C++, java and World Wide Web, web browser. Java Environment: Java Development kit (JDK), Application Programming Interface (API), java programming structure, java tokens, constants, variables, expressions, decision making statements and looping, java statements, overview of arrays and strings, machine neutral, Java Virtual Machine (JVM), Command Line Arguments. Arrays and Strings: One-dimensional arrays, creating an array, declaration of arrays, initialization of arrays, two-dimensional arrays, string arrays, string methods, string buffer class, vectors, wrapper classes. Basic I/O Streams: Scanner, buffered reader.

Learning Outcomes:

After completion of UNIT I, Student will be able to

- Identify the difference between C++ and Java
- Identify the Environment that allows to write platform independent programs
- Apply the methods of Strings to solve the string-oriented problems.
- Analyze the uses of wrapper classes in the design of solutions.
- Contrast the difference between the usage of I/O Streams

UNIT II **11 L**

Classes, Objects and Methods: Introduction, defining a class, creating objects, accessing class members, constructors, methods overloading, static members. Inheritance: Defining a sub class, sub class constructor, multilevel variables, final classes, and finalize methods, abstract methods and classes, visibility control. Managing Errors and Exceptions: Introduction, types of errors: compile time and run time errors, exceptions, types of exceptions, syntax of exception handling code, multiple catch statements, using finally statement, throwing our own exceptions.

Learning Outcomes

After completion of UNIT II, Student will be able to

- Define the user defined classes of the given problem to be solved.
- Explain the behavior of each object in its scope.
- Apply the concepts finalize, abstract and final over the methods and classes.
- Analyze the exception handling mechanisms.
- Develop a code with try and catch blocks.

UNIT III **9 L**

Interfaces, Package & Multithreaded Programming: Introduction, defining interfaces, extending interfaces, implementing interfaces. Package: Creation, importing a package and user defined package. Threads: Introduction to threads, creating threads, extending the thread class, implementing the 'runnable' interface, life cycle of a thread, priority of a thread, synchronization, and deadlock.

Learning Outcomes

After completion of UNIT III, Student will be able to

- Recall the concepts of Inheritance for implementing new classes.
- Extends the new classes from one or more classes.
- Define the interfaces and packages.
- Develop new packages for solving complex problems.
- Survey the flow of execution by decomposing into two or more.

UNIT IV **9 L**

Applet Programming: Introduction, how applets differ from applications, building applet code, applet life cycle, about HTML, designing a web page, passing parameters to applets, getting input from the user.

Learning Outcomes

After completion of UNIT IV, Student will be able to

- Defining the new concept applet on internet programming.
- Compare applet with application programs
- Apply applet life cycle to the real problem to solve.
- Examine the behavior of applet using HTML code
- Test the parameterized applet.

UNIT V **8 L**

Graphics Programming: Introduction, abstract window toolkit class hierarchy, frames, event-driven programming, layout managers, panels, canvases, drawing geometric figures. Introduction to Swings: Introduction to swings, overview of swing components-Jbutton, JCheckBox, JRadioButton, JLabel, JTextField, JTextArea, JList.Introduction to Networking: InetAddress class, socket class, URL class.

Learning Outcomes

After completion of UNIT V, Student will be able to

- Choose awt to create GUI
- Classify the various layouts
- Develop the very user friendly GUIs
- Contrast the between applet and Swings
- Build an Internet based application using networking concepts in java

Course Outcomes

- Ability to differentiate Java and C,C++ and basic environment required for implementing Java program.
- Introduce the concept of class and object and Ability to apply inheritance concepts
- Illustrate concept of user defined exceptions
- Demonstrate usage of a package and thread implementation in application development
- Develop applets with various graphical aspects and Develop GUI forms using different AWT Components

Text Book(s)

1. Herbert Scheldt, The Java complete References, 9/e, TMH Publications,2014.

References

1. Balagurusamy, Programming with JAVA, 2/e, TMH Publications,2014.
2. Y.DanielLiang, An Introduction to JAVA Programming, TMH Publications, 2009.
3. Kathy Sierra, Head First Java, 2/e, Shroff Publishers, 2012.

19EHS375: BUSINESS ETHICS AND CORPORATE GOVERNANCE

L	T	P	C
3	0	0	3

Ethics and responsibility in Business has received critical focus in the wake of the various corporate scams rocking the global economy. It is believed by many that in the own interest of business, importance be given to ethical functioning. Business decisions often concern complicated situations that are neither totally ethical nor totally unethical. The need for imparting sound ethics and a responsible mindset in the future leaders is considered as one of the important aspects of higher education. Decision making, when facing ethical dilemmas that arise in a wide range of contemporary business practices, is crucial, and is enabled through moral reasoning and understanding ethical norms of individual and organisation.

Course Objectives:

- To be able to rasp the various issues in the professional field from an ethical view point
- To stimulate thoughts on ethical issues, and professional challenges encountered in business
- To create consciousness of the value system and its importance in business
- To enable students to recognize and manage ethical issues and to formulate their own standards of integrity and professionalism
- Would enable the student to take future decisions, in personal and professional life, with a clear understanding about the ethical implication of this on him, his firm, and the society at large.

UNIT I: **7 L**

Ethics and Values: Understanding of ethics and values and their formation; personal and professional ethics; moral overconfidence; moral disengagement – a basis for unethical behavior

Learning Outcomes:

At the end of this UNIT, the student will be able to

- Understand the basis for different ethical thinking (L2)
- Interpret different ethical behaviors (L3)
- Analyse behavior critically from the perspective of morality (L4)

UNIT II: **9 L**

UNIT II: Corporate Culture and Ethics: Building an ethical corporate culture – the impact of business environment, Leadership, code of ethics, globalization; Ethical dilemmas, conflict of interest and resolutions; ethical decision making

Learning Outcomes:

At the end of this UNIT, the student will be able to

- Analyse the impact of various factors on corporate culture (L4)
- Identify ethical dilemmas (L2)
- Construct an argument for an ethical decision making (L5)

UNIT III: **8 L**

Fairness in the workplace: Discrimination; harassment; working conditions - HSE, privacy, work-life balance; whistle blowing.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- Identify various ethical issues relating to employee-employer (L2)
- Debate on the rights and duties of an employee and employer (L4)
- Justify his argument regarding workplace ethics (L6)

UNIT IV: **8 L**

Marketing and Ethics: Unethical issues in product, pricing and advertising; issues due to globalization.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- Identify ethical issues in business and customer relationship (L2)
- Analyse the impact of unethicality in marketing (L4)
- Evaluate the marketing strategies from an ethical point of view (L6)

UNIT V: **8 L**

Corporate Governance: Stakeholder theory; role of Board; Conflict of Interest, Insider Trading; Corporate Lobbying.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- Understand the role of corporate governance in trust building of an organization (L2)
- Identify various issues ethical issues an organization is susceptible to at the hands of the top management (L2)
- Analyse the impact of conflict of interest on human behavior

Course Outcomes:

At the end of the course, the student will be able to

- Identify various issues relating to ethics to ethics and (L3)
- Analyse situations of ethical dilemmas and arrive at the right decision making (L4)
- Distinguish between ethical and unethical actions in the professional life (L4)
- Choose the right path by evaluating the various choices available (L6)

Text Book(s):

3. Richard T. DeGeorge, "Business Ethics", 7th Ed., Pearson, New Delhi, 2011
4. Andrew Crane and Dirk Matten., Business Ethics. Oxford Publication, New Delhi: 2007.

References:

4. M.G. Velasquez, Business Ethics, Prentice Hall India Limited, New Delhi: 2007.
5. R.C. Sekhar., Ethical Choices in Business, Response Book(s), New Delhi: 2007.
6. Manikutty, S., "Being Ethical – Ethics as the foundation of Business", Random House India, Noida, 2011

SEMESTER VI

19EME332: HEAT AND MASS TRANSFER

L	T	P	C
3	**1**	**3**	**5.5**

This course focuses on the fundamental concepts and techniques of heat and mass transfer and emphasizes application of mathematical principles in heat transfer. The knowledge of Thermodynamics and Fluid mechanics are prerequisite in understanding the concepts fluid kinematics & boundary layer concepts with respect to heat and mass transfer. Further, this course gives good understanding of industrial related problems as phase change heat transfer and heat exchangers.

Course Objectives

- To impart the basic laws of conduction, convection and radiation heat transfer and their applications
- To familiarize the convective heat transfer concepts
- To explain basics of radiation heat transfer
- To make conversant with the heat transfer analysis related to thermal systems like heat exchangers, evaporator, and condenser.

UNIT I **9 L**

Introduction: Basic modes of heat transfer- rate equations- generalized heat conduction equation - steady state heat conduction solution for plain and composite slabs - cylinders - critical thickness of insulation-

Learning outcomes:

After completion of this UNIT, students will be able to
- identify the phenomenon related to different modes of heat transfer (L2)
- compare different types of conduction heat transfer(L2)
- apply concept of thermal resistance and its importance in practical problems(L3)

UNIT II **9 L**

Fins: Heat conduction through fins of uniform cross section- fin effectiveness and efficiency.
Unsteady State Heat Transfer - Transient heat conduction- lumped system analysis and use of Heisler charts.

Learning outcomes:

After completion of this UNIT, students will be able to
- compare different types of Fins(L2)
- apply concept transient heat conduction in practical problems(L3)

UNIT III **10 L**

Convection: Basic concepts of convection–heat transfer coefficient - types of convection –forced convection and free convection. Dimensional analysis in convection
External Flow: Concepts of hydrodynamic and thermal boundary layer- use of empirical correlations for flow over plates and cylinders. Fluid friction – heat transfer analogy
Internal Flow: Use of empirical relations for convective heat transfer in horizontal pipe flow.
Free Convection -development of hydrodynamic and thermal boundary layer along a vertical plate – use of empirical relations for convective heat transfer on plates and cylinders in horizontal and vertical orientation

Learning outcomes:

After completion of this UNIT, students will be able to

- Apply the physical phenomenon of convective heat transfer(L3)
- Calculate convective heat transfer using empirical relations for different cases (L4)
- Use analogy between fluid friction and heat transfer to solve engineering problems.(L4)

UNIT IV **9 L**

Boiling and Condensation: Different regimes of boiling- nucleate, transition and film boiling – condensation - filmwise and dropwise condensation.
Heat Exchangers: Types of heat exchangers- parallel flow- counter flow- cross flow heat exchangers- overall heat transfer coefficient- LMTD and NTU methods- fouling in heat exchangers

Learning outcomes:

After completion of this UNIT, students will be able to

- identify different regimes of boiling in design of boilers(L1)
- interpret the basic modes of condensation heat transfer (L2)
- explain the working of different types of heat exchangers (L1)
- calculatethe heat transfer in heat exchangers (L5)
- design a heat exchanger for a given application(L5)

UNIT V **9 L**

Radiation: Radiation heat transfer – thermal radiation – laws of radiation - Black and Gray bodies – shape factor-radiation exchange between surfaces - Radiation shields - Greenhouse effect.
Mass Transfer: Conservation laws and constitutive equations - Fick's law of diffusion, isothermal equi-mass - Equimolar diffusion- - diffusion of gases and liquids- mass transfer coefficient.

Learning outcomes:

After completion of this UNIT, students will be able to

- Apply the principles of radiation heat transfer(L3)
- Design a radiation shield for given conditions (L5)
- Examine the effect of greenhouse gases on atmosphere(L2)
- Explain the basic mechanism of mass transfer(L2)
- Differentiate between mass transfer due to convection and diffusion (L3)

Course Outcomes

At the end of the course, the student will be able to

- Apply the concepts of different modes of heat transfer. (L2)
- Apply knowledge of conduction heat transfer in the design of insulation of furnaces and pipes. (L3)
- Analyse free and forced convection phenomena in external and internal flows. (L2)
- Design of thermal shields using the concepts of black body and non-black body radiation. (L4)
- Apply the basics of mass transfer for applications in diffusion of gases.(L3)

Text Book(s):

1. P.K. Nag, Heat Transfer, 3/e, Tata McGraw-Hill, 2011.
2. F. P. Incropera and D.P. Dewitt, Fundamentals of Heat and Mass Transfer, 6/e, John Wiley, 2007.

References:

1. J.P.Holman, Heat Transfer, 9/e, Tata McGraw-Hill,2008.
2. Cengel. A.Yunus, Heat Transfer- A Practical Approach, 4/e, Tata McGraw-Hill, 2007.
3. S.P. Sukhatme, A Textbook of Heat Transfer, Universities Press, 2005
4. Lienhard and Lienhard, A Heat and Mass Transfer, Cambridge Press, 2011.
5. C.P. Kothandaraman and S. Subramanyan, Heat and Mass Transfer databook, New Age Publications, 2014

HEAT TRANSFER LAB

Course Objectives:

Students undergoing this course would

- Understand different modes of heat transfer
- Gain knowledge about natural and force convection phenomenon
- Estimate experimental uncertainty in measurements

LIST OF EXPERIMENTS

1. Determine the overall heat transfer coefficient across the width of composite wall
2. Determine the thermal conductivity of a metal rod
3. Determine the thermal conductivity of insulating powder material through concentric sphere apparatus
4. Determine the thermal conductivity of insulating material through lagged pipe apparatus
5. Determine the efficiency of a pin fin in natural and forced convection.
6. Determine the heat transfer coefficient for a vertical cylinder in naturalconvection
7. Determine the heat transfer coefficient in forced convection of airin a horizontal tube.
8. Determine the heat transfer coefficients on film and drop wisecondensation apparatus.
9. Determine the effectiveness of a parallel and counter flow heatexchanger.
10. Study the pool boiling phenomenon and different regimes of poolboiling.
11. Experiment on pool boiling
12. Determine the emissivity of the test plate surface.
13. Experiment on Stefan-Boltzmann apparatus
14. Determine the heat transfer rate coefficientin fluidized bed apparatus

Course Outcomes

Upon the successful completion of course, students will be able to

- Explain different modes of heat transfer L1
- identify parameters for measurement for calculating heat transfer L2
- determine effectiveness of heat exchanger L3
- design new equipment related to heat transfer L4
- apply principles of heat transfer in wide application in industries **L4**

19EME302: DESIGN OF MACHINE ELEMENTS

L	T	P	C
3	1	0	4

This course introduces the design procedurs for various mechanical elements. Concepts applied in this course are from previous courses such as Strength of materials and Dynamics of Machinery. The course aims to throw knowledge on design against static and fatigue loadings. The course addresses designing of fasteners, couplings, shafts and other machine components and limited to strength and regidtity based designs.

Course Objectives:

- To provides an introduction to design of machine elements.
- To familiarize with fundamental approaches to failure prevention for static and dynamic loading.
- To explain design procedures for different types of joints.
- To explain the working principle of clutches and brakes and their design procedures.
- To instruct different types of bearings and design procedures.

UNIT I **12 L**

Mechanical Engineering Design: Design process, design considerations, codes and standards of designation of materials, selection of materials.
Design for Static Loads: Modes of failure, design of components subjected to axial, bending, torsional and impact loads, Static theories of failures.
Design for Dynamic Loads: Endurance limit, fatigue strength under axial, bending and torsion, stress concentration, notch sensitivity. Types of fluctuating loads, fatigue design for infinite life. Fatigue theories of failure. Soderberg, Goodman and modified Goodman criterion for fatigue failure. Fatigue design under combined stresses.

Learning outcomes:

After completion of this UNIT, students will be able to

- **Select** materials for specific applications .(L1)
- **Understand the** standards in design. (L3)
- **Apply** failures theories in designing components subjected to static and dynamic loads. (L3)

UNIT II **10 L**

Bolted Joints: Threaded fastiness, preload of bolts, various stresses induced in the bolts. Torque requirement for bolt tightening, eccentrically loaded bolted joints, and gasketed joints.
Riveted Joints: Design of lap, butt and eccentrically loaded joints, failure and efficiency of riveted joints.

Welded Joints: Strength of lap and butt welds, eccentrically loaded welded joints. Joints subjected to bending and torsion.

Learning outcomes:

After completion of this UNIT, students will be able to

- **Understand the advantage and disadvantages of various joints**. (L1)
- **analyse the** stresses induced in joints subjected to different loads. (L4)
- **design** the different joints subjected to different loading conditions . (L5)

UNIT III **10 L**

Keys: Function, types, design of sunk, saddle, Kennedy and Woodruff keys.
Power Transmission Shafts: Design of shafts subjected to bending, torsion and axial loading. Shafts subjected to fluctuating loads using shock factors.
Couplings: Design of flange and bushed pin couplings, universal coupling.
Springs: Design of helical closely coiled compression, tension and torsional springs

Learning outcomes:

After completion of this UNIT, students will be able to

- **Understand the functions of** different keys. (L2)
- **Select** coupling for a given application and outline the design procedure. (L3)
- **design a** shaft subjected to different loading conditions. (L5)
- **Design** a helical springs subjected to compressive loads. Torsion . (L2)

UNIT IV **10 L**

Friction Clutches: Torque transmitting capacity of disc and centrifugal clutches. Uniform wear theory and uniform pressure theory.
Brakes: Different types of brakes. Concept of self-energizing and self-locking of brake. Band brake, block brakes and disc brakes.

Learning outcomes:

After completion of this UNIT, students will be able to

- **Understand the working principles of** different clutches and brakes.(L2)
- **Calculate** the power transmitting capacity of clutches using uniform wear theory and uniform wear theory.. (L3)
- **Compare** different types of brakes and their applications. (L2)
- **Compare** the concepts of self-energizing and self-locking brakes. (L2)
- Design different types of brakes. (L5)

UNIT V **12 L**

Design of Sliding Contact Bearings: Lubrication modes, bearing modulus, McKee's equations, design of journal bearing. Bearing Failures.
Design of Rolling Contact Bearings: Static and dynamic load capacity, Stribeck's Equation, equivalent bearing load, load-life relationships, load factor, selection of bearings from manufacturer's catalogue.
Design of Gears: Spur gears, beam strength, Lewis equation, design for dynamic and wear loads.

Learning outcomes:

After completion of this UNIT, students will be able to

- **Contrast** the difference between sliding and rolling contact bearings. (L2)
- **Explain** the mechanics of lubrication in sliding contact bearings. (L2)
- **Identify various** failures in bearings. (L3)
- **Evaluate** static and dynamic load capacity of rolling contact bearings. (L5)
- **Explain** the procedure to select bearings from manufacturer's catalogue. (L3)

Course Outcomes:

At the end of the course the students will be able to

- **Estimate** safety factors of machine members subjected to static and dynamic loads. (L3)
- **Design** different fasteners subjected to various loads. (L5)
- **Analyse the loads and design various machine components such as** keys, shafts, couplings, springs and bearings. (L5)

Text Book(s):

1. J.E. Shigley, Mechanical Engineering Design, 2/e, Tata McGraw Hill, 1986.
2. V.B.Bhandari, Design of Machine Elements, 3/e, Tata McGraw Hill, 2010.

References:

1. R.L. Norton, Machine Design an Integrated approach, 2/e, Pearson Education, 2004.
2. R.K. Jain, Machine Design, Khanna Publications, 1978.
3. M.F.Spotts and T.E.Shoup, Design of Machine Elements, 3/e, Prentice Hall (Pearson Education), 2013.

Note: PSG Design data book is permitted.

19EME392: COMPREHENSIVE SKILL DEVELOPMENT V

Course Objectives:

- To encourage the all-round development of students by focusing on soft skills, Coding & domain skills.
- To make the engineering students aware of the importance, the role and the content of soft skills, Coding and domain skills through instruction, knowledge acquisition, demonstration and practice.
- To develop and nurture the soft skills, coding and domain skills of the students through individual and group activities.
- To expose students to right attitudinal and behavioral aspects and to build the same through activities

Course Outcomes:

- On completion of the course, student will be able to– Effectively communicate through verbal/oral communication and improve the listening skills
- Write precise briefs or reports and technical documents, actively participate in group discussion / meetings / interviews and prepare & deliver presentations. Become more effective individual through goal/target setting, self motivation and practicing creative thinking.
- Student will be able to understand the problems and develop his competitive coding skills.
- Apply the skills in various domains and will be able to solve complex problems faced by the industry.
- Function effectively in multi-disciplinary and heterogeneous teams through the knowledge of team work, Inter-personal relationships, conflict management and leadership quality

Reasoning skills

UNIT	UNIT/ Topics	Hrs
1.	Combinatorics	4
2.	Cryptarithmetic & Modular Arithmetic	5
3.	Analogy & Classification of Numbers	3
4.	Puzzles	3
	Total	15

Verbal skills

UNIT	UNIT/ Topics	Hrs
1.	Grammar and Error Detection Exercises	6
2.	Structure and Sentence Correction/ Improvement Exercises	6
3.	Error Detection & Sentence Correction–FAQs with Solutions	2
4.	Fill-in-blanks and Cloze Passages	3
	Total	15

Domain skills

The student is required to get trained in one or more of the following areas of

Name of course	L
Simulation technologies and python programming	30
AI in mechanical Engineering	30
Robotics and Automation	30
Electrical Vehicle Design/ Batteries Technology.	30
3-D Printing in Mechanical Engineering	30
Industry 4.0	20
MATLAB Python and CFD using Solidworks for Mechanical Engineering Application	60
Introduction to Automotive Cyber security and Vehicle Networks	60
Introduction to Structural Analysis using ANSYS Workbench	60
Introduction to Automation using ANSYS Workbench and Python	60
Advanced CFD Meshing using ANSA	60
Automation Using TCL/TK for Hyper Mesh	60
Certification courses in Autonomous Vehicles.	60
Certification in Robotics.	60
SIEMENS SITRAIN Course Certificate	60
Renewable energy and sustainable environment – input from centre for green energy, Pondicherry University, Schneider Electric	60
Recycle and reuse – input from Tata & Sons, UN	60
Project Management and workstation planning – Input from Renault Nissan	60
Industrial IoT – input from Robert Bosch, Hirotech India	60

PROGRAM ELECTIVE-II

19EME340: HEATING VENTILATION AND AIR CONDITIONING

L	T	P	C
3	0	0	3

Students undergoing this course are expected to understand the air-conditioning systems used in automotive application and building applications. The concept of psychometric process will be applied to design HVAC systems and function to maintain the comfort and safety of the occupants in automobile and building applications. HVAC system controls the indoor climate and proper air flow, ensure that the human neither freeze nor sweat and several health benefits are probable with a well-maintained HVAC system.

Course Objectives

- To understand the fundamentals of heating, ventilation and air conditioning and prepares students to become industry ready by providing a foundation of knowledge.
- To become familiar with the codes and standards from ASHRAE handbook(s).
- To impart knowledge to design, install and troubleshoot residential and commercial HVAC systems.
- To study the science and technology of low temperatures and provides instruction in fundamental principles of refrigeration, developing these into tools that can be utilized in laboratory and industrial applications.
- To develop skills for designing components like compressors, evaporators, coolers in HVAC systems and gain the knowledge of instrumentation.

UNIT I **9 L**

Introduction: Purpose, applications, definition and components of air conditioning, need and methods of ventilation.

Psychrometry: Evolution of air properties and psychrometric chart, basic processes such as sensible heating/cooling, humidification/dehumidification and their combinations.

Learning outcomes

At the end of this UNIT, the student will be able to

- Know the need and application of air-conditioning.(L3)
- Know the use of psychometric charts and describe various psychometric processes involved.(L3)
- Explain how the temperature, humidity, and air motion affects human comfort. (L3)

UNIT II **9 L**

Summer and Winter A/c: Simple summer and winter A/c process, SHF (sensible heat factor), load concepts of RSHF (Room sensible heat factor), CSHF (Coil sensible heat factor),GSHF

(Gross sensible heat factor) - problems, concept of ESHF (Effective room sensible heat factor) and ADP temperature, cooling load calculations.
Human Comfort: Concept of human comfort, thermal response, comfort factors, environmental indices, indoor air quality.

Learning outcomes

At the conclusion of this UNIT, the student will be capable to
- Know the understanding of working summer and winter air conditioning systems. (L2)
- Know the necessity of SHF, RSHF, CSHF, GSHF, and ESHF for the calculation cooling loads. (L4)
- Explain the factors that influence the rate of heat loss and gain for a house. (L4)
- Be acquainted with the need of comfort factors of human related to air-conditioning. (L2)

UNIT III **9 L**

Air Conditioning Equipment: Types of filters: Dry, viscous, wet and electric filters, types of blowers: axial flow and centrifugal of parallel and series configurations, air washer, heated and cooled, cooling tower, noise control.
Air Distribution: Methods of ducting and its arrangements, air flow, friction chart, methods of sizing, air diffusion, throw, and drop.

Learning outcomes

At the end of this UNIT, the student will be able to
- Understand the description and working principles of various air conditioning components and use of various parts of A/C. L3
- Understand the air distribution methods, class of ducts for air distribution and conditioned air flow to the space to be cooled or heated. L3
- Describe what constitutes good airflow through a duct system. L2

UNIT IV **8 L**

Heating Systems: Warm air systems, hot water systems, steam heating systems, panel heating systems, central heating systems, heat pump circuit, heat sources for heat pump. Heating of high building with electric infrared systems.

Learning outcomes

At the end of this UNIT, the student will be able to
- Grasp the knowledge about working of heating system for the space to be conditioned. L2
- Describe the control sequence of operation for various heat pumps L2
- Perform precautionary maintenance on a variety of equipment used in the lab. L3

UNIT V **8 L**

Basics of Ventilation - Need, threshold limits of contaminants, estimation of ventilation rates, air flow round buildings.

Methods of Ventilation: Natural, wind effect, stack effect, combined effect- mechanical, forced, exhaust, combined - displacement ventilation. Industrial Ventilation: Steel plants, car parks and mines.

Learning outcomes

At the end of this UNIT, the student will be able to

- Identify components and discuss the different ventilation techniques. (L1)
- Explain the different industrial ventilation systems.(L1)
- Know the different effects of wind. (L2)

Course Outcomes

After successfully completion of the course, the student will be able to

- Understand the psychometric properties and processes, cooling and heating load calculations and recognize components and design principles used in air distribution systems. (L1)
- Articulate the purpose and operation of HVAC system components, the operation of HVAC systems, diagnose, repair faults and perform maintenance on HVAC systems. (L3)
- Identify and apply the principles and strategies necessary for hands-on installation, trouble-shooting of HVAC systems. (L3)
- Design the cooling and heating systems with proper ventilation methods. (L4)
- Be industry ready with the knowledge of the functions, working principles of insulations. (L3)

Text Book(s) :

1. Robert McDowall, Fundamentals of HVAC Systems, 2nd Edition, Elsevier, 2009.
2. S C Arora and S Domkundwar, A Course in Refrigeration and Air conditioning, Dhanpat Rai & Co, 2002.

References:

1. Faye C. McQuiston, Jerald D. Parker, Jeffrey D. Spitler,Heating, Ventilating and Air Conditioning: Analysis and Design, 6/e, Wiley India, 2011.
2. Stoecker, W.F., and Jones, J.W., Refrigeration and Air Conditioning, 2/e Edition, Tata McGraw Hill, 1982.
3. Arora, C.P., Refrigeration and Air Conditioning, 3/e, Tata-McGraw-Hill, 2008.

19EME342: RENEWABLE ENERGY TECHNOLOGY

L	T	P	C
3	0	0	3

The course provides an introduction to energy systems and renewable energy resources, with a scientific examination of the energy field and an emphasis on alternate energy sources and their technology and application. It helps in exploring society's present need and future energy demands, examine conventional energy sources and systems. The course will also help in assessing the procedures in terms of technical, financial and social, in the context of training as an Mechanical Engineer.

Course Objectives

- To understand the basic knowledge of conventional and non-conventional energy sources.
- To design and optimization of solar, wind, OTEC and Geo Thermal power plants,
- To perform basic analyses associated with each subsystem
- To apply the same in their project works as well as higher studies or in their job.

UNIT I **9 L**

Introduction: Role and potential of new and renewable sources.
Solar Energy: Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors. Solar energy storage- Different methods, sensible, latent heat and stratified storage, solar ponds. Solar applications, solar heating/ cooling techniques, solar distillation and drying, nano materials used in solar photovoltaic cells. Next generation photovoltaic systems- Solar Ink, photovoltaic energy conversion.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- acquaint basic knowledge of renewable sources. **[L1]**
- understand of different solar energy storage. **[L2]**
- acquire fundamental concepts of photovoltaic systems. **[L1]**

UNIT II **8 L**

Wind Energy: Sources and potentials, classification of wind mills, horizontal and vertical axis wind mills, effect of wind speed on power generation, site evaluation, wind turbine subsystems-rotors, drive trains, yaw control systems, electrical systems.
Bio Gas: Properties, principles of production, classification- fixed dome-floating type, comparison, site selection, water removing device, environmental effect. Plant models in India: floating gas holder-KVIC, fixed dome - janata type, pragati model, deenbandhu model, constraints for implementation.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- acquaint with sources and potentials of wind energy. **[L1]**
- understand the effect of wing speed on power generation. **[L2]**
- study the properties of bio gas. **[L2]**
- design the structure of Bio gas in India. **[L4]**

UNIT III **8 L**

Fuel cells: Principle of fuel cells, Faradays laws, thermodynamic aspects. Performance limiting factors of fuel cells-reactivity-invariance, electrode losses-chemical polarization-concentration polarization-resistance polarization, types of fuel cells-hydrogen-oxygen fuel cells-biochemical cells-regenerative cells

Learning Outcomes:

At the end of this UNIT, the student will be able to

- study the principle of fuel cell and laws governing it. **[L1]**
- acquaint with losses i fuel cells. **[L1]**
- summarize different fuel cells available. **[L2]**

UNIT IV **9 L**

Geothermal Energy: Resources, types of wells, methods of harnessing the energy, potential in India. OTEC: Principles, utilization, setting of OTEC plants, thermodynamic cycles.
Tidal and Wave Energy: Potential and conversion techniques, tidal barrage, modes of operation-ebb generation- flood generation-two way generation. Latest techniques used in TIDAL energy generation.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- understand the resources of geothermal energy. **[L1]**
- acquaint with the principles and utilization of otec. **[L2]**
- study about tidal and wave energy. **[L2]**
- outline modes of operation of ebb generation. **[L2]**
- choose the latest techniques in tidal energy generation. **[L3]**

UNIT V **8 L**

Direct Energy Conversion: Need for DEC, limitations, principles of DEC. Thermoelectric generators, seebeck, Peltier and Joule Thompson effects, figure of merit, materials, applications, MHD generators, principles, dissociation and ionization, hall effect, magnetic flux, MHD accelerator, MHD engine, power generation systems, electron gas dynamic conversion, economic aspects.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- understand and acquire the need for DEC.**[L1]**
- acquaint basic knowledge of thermoelectric generators. **[L1]**
- understand the performance of MHD generators. **[L2]**

Course Outcomes

At the end of the course, Students will be able to

- understand the different types of conventional and non-conventional energy sources, their parts, working, and will be able to sort out realistic application to society. (L2)
- analyse different set of operational parameters and constraints of solar energy systems for direct and indirect methods of usage, (L4)
- improve the efficiency of the wind and bio gas l energy systems. (L4)
- understand concepts of fuel cells. (L2)
- understand and analyze geothermal, tidal and wave energy conversion systems (L4)

Text Book(s):

1. G.D. Rai, Non-conventional Energy Sources, 6/e, Khanna Publishers, 2004.
2. R.K.Rajput, Non-Conventional Energy Sources and Utilization, 2/e, S. Chand Publishing, 2014.

References:

1. G.Boyle, Renewable Energy: Power for a Sustainable Future, 3/e, Oxford University Press India, 2012
2. D.P.Kothari, K.C.Singal, Ranjan Rakesh, Renewable Energy Sources and Emerging Technologies, 2/e, Prentice Hall India, 2011.
3. B.H.Khan, Non-Conventional Energy Resources, 2/e, McGraw Hill India, 2009.

19EME344: ELECTRIC AND HYBRID VEHICLES

L	T	P	C
3	0	0	3

This course introduces the fundamental concepts, principles, analysis and design of hybrid, electric and fuel cell vehicles. This course is an intended for learning the Fundamentals of Automobile Hybrid vehicles. This course is gives the brief ideas of Hybrid vehicles propulsion methods- Hybrid architecture Hybrid power plant specifications- Fuel cell technology - and Non electric Hybrid propulsion systems.

Pre-requisites: Thermodynamics, Basic Electrical and Electronics engineering

Course Objectives

- To introduce different configurations of electric vehicles
- To familiarize knowledge of hybrid electric vehicles
- To impart basic analyses associated with batteries and its types
- To enable hybrid vehicle configuration and its components, performance analysis
- To explain the concepts learnt for project work, higher studies and industry

UNIT I **8 L**

Introduction to Electric Vehicles: History of Modern Transportation, air pollution-NOx, CO, UHC other pollutants, global warming, Economic and Environmental Impact of Electric Hybrid Vehicle, India Dependence on Foreign Oil EV Market

Learning outcomes:

After completion of this UNIT, students will be able to

- acquaint knowledge of hybrid vehicles .(L2)
- study the costing of hybrid vehicle. (L4)
- outline the dependency of oil market (L3)

UNIT II **8 L**

Architecture of Hybrid and Electric Vehicles: Vehicle Power Plant and Transmission Characteristics, Basic Architecture of Hybrid Drive Trains and Analysis of Series and parallel Drive Train, Power Flow in HEVs, Basic Architecture of Electric Drive Trains, Advantages and Disadvantages of Series-Parallel Combination.

Learning outcomes:

After completion of this UNIT, students will be able to

- acquaint types of hybrid vehicles .(L2)
- select hybrid vehicles for practical applications. (L3)

- experiment in vehicles like all-terrain vehicles. (L3)

UNIT III **10 L**

Energy Source: Battery**-** Battery Basics, Lead-Acid Battery, Nickel-Cadmium Battery, Nickel-Metal-Hydride (NiMH) Battery, Li-Ion Battery, Li-Polymer Battery, Zinc-Air Battery, Battery Parameters, Battery Capacity.
Fuel Cells: Fuel Cell Characteristics, Fuel Cell Types- Alkaline Fuel Cell (AFC) Proton Exchange Membrane (PEM), Direct Methanol Fuel Cell (DMFC), Phosphoric Acid Fuel Cell (PAFC), Molten Carbonate Fuel Cell (MCFC), Solid Oxide Fuel Cell (SOFC, ITSOFC), Fuel Cell EV

Learning outcomes:

After completion of this UNIT, students will be able to
- outline different energy sources .(L2)
- design new systems in practical applications. (L5)
- utilize energy sources for proper application. (L3)

UNIT IV **8 L**

Electric Machines and their Controllers: DC-DC converters-Classification, DC-AC inverter-classification, Induction motors and Permanent Magnet Motors for HEV/EVs,

Learning outcomes:

After completion of this UNIT, students will be able to
- choose different controllers and drive train systems .(L2)
- utilize for new systems in practical applications. (L3)
- design vehicles like all-terrain vehicles. (L3)

UNIT V **8 L**

Design of Hybrid and Electric Vehicles: Hybridness: parallel hybrid, series, mixed and range extender (plug-in) hybrids, Range extender, Techniques to enhance hybrid performance, Mild or micro hybrid features, Plug-in hybrid, All-wheel drive hybrid, Sizing of Electric machine, Brake System of EVs and HEVs, case study of HEV.

Learning outcomes:

After completion of this UNIT, students will be able to
- outline different electric vehicles. (L2)
- develop new systems for practical applications. (L5)
- test on-road vehicles. (L3)

Course outcomes:

At the end of the course student able to

- explain the need and advantages of electric vehicles in present scenario (L2)
- compare hybrid vehicle with IC engines (L2)
- analyse the modern trends in identifying energy sources in the form of fuel cells (L4)
- interpret different types of controllers and drive train systems (L2)
- define various DC and AC electrical machines for vehicle applications (L2)

Textbook(s)

1. Mehrdad Ehsani, Yimin Gao, Ali Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, CRC Press, 2010.
2. E. Fuhs, *Hybrid Vehicles and the Future of Personal Transportation*, CRC Press, 2009

Reference Book(s):

1. James Larminie, Electric Vehicle Technology Explained, second editon, John Wiley & Sons, 2012.
2. Sandeep Dhameja, "Electric Vehicle Battery Systems", Newness, 2000 .
3. Iqbal Hussain, Electric & Hybrid Vehicles – Design Fundamentals, Second Edition, CRC Press, 2011

Web references:

1. https://nptel.ac.in/courses/108/103/108103009/

19EME348: ROBOTICS AND AUTOMATION
(Program Elective-II)

L	T	P	C
3	0	0	3

This course helps in understanding the basics of robotics such as origin of robotics, types of robotics and various generation of robots. This course teaches the fundamentals of robotics required to design the robot anatomy, kinematics of robots, robot dynamics, robot drive systems, robot programming and its applications. The Knowledge gained from this course is to apply the concepts in handling the automated systems like assembly systems, material handling systems, storage, and retrieval systems.

Course Objectives

- To familiarize the history and automation of robot and its applications.
- To enhance the students' knowledge about robot end effectors, sensors, and their design as well as their applications.
- To impart computational skills related to kinematics and dynamics of robots.
- To acquire knowledge about Robot Programming methods & Languages of robot.
- To develop the ability to analyze and design the Automated systems and their applications.

Course Outcomes

At the end of the course work, the students will be able to

1. Understand the basic components of robots and the types of robots and robot grippers.
2. Comprehend and interpret various aspects relating to the designing of end effectors.
3. Analyze and demonstrate knowledge of the relationship between mechanical structures of industrial robots and their operational work-space characteristics
4. Interpret basic safety guidelines for robotic applications.
5. Describe and judge the use of Automated systems in industrial applications.

UNIT I **8 L**

Fundamentals of Robotics:
Introduction to robot, Definition need and scope of robots, robot anatomy, co-ordinate system, work envelop, robot classification, robot parts and functions, need of robot and its applications.

UNIT II **8 L**

Robot Drive systems and Control:
Design of drive systems, Mechanical, hydraulic, and pneumatic drives, electric drives, motors, designing of end effectors, mechanical, hydraulic, vacuum, and magnetic grippers.
Robot Sensors and Machine vision:
Need of sensors, position sensor, tactile sensor, proximity and range sensors, wrist-force sensing, frame grabbers, robotic vision system.

UNIT III **10 L**

Robot Kinematics and Robot Programming:
Direct and inverse kinematics of manipulators, Homogeneous transformations, D-H parameter notation, Jacobian, trajectory planning. Robot Programming Methods, and programming languages for robotics.

UNIT IV **8 L**

Robot Cell Design and Application:
Robot work cell design and control, safety in robotics, robot cell layouts, multiple robots and machine interference, robot cycle time analysis. Industrial application of robots.

UNIT V **8 L**

Automation:
Types of automation, analysis of automated assembly systems, line balancing problems, analysis of automated material handling systems, automated storage, and retrieval systems.

Text Book(s):

1. Robotics and Control / Mittal R K & Nagrath I J / TMH.
2. Automation, Production systems and Computer Integrated Manufacturing – M P Groover, Prentice Hall India.
3. S.R. Deb and Sankha Deb Tata, Robotics Technology and Flexible Automation, 2/e, McGraw Hill, 2009.

References:

1. K.S.Fu, R.C. Gonzalez and C.S.G. Lee, Robotics Control, Sensing, Vision and Intelligence, 2/e, McGraw Hill, 1987.
2. Yoram Koren, Robotics for Engineers, McGraw Hill, 1987.
3. Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey, Industrial Robotics Technology, Programming and Applications, 1/e, McGraw Hill, 1986
4. Robotics: Control, sensing, vision and intelligence, Fu, K., Gonzalez, R. and Lee, C. S. G McGraw Hill.
5. Robotic Engineering / Richard D. Klafter,
6. Introduction to Robotics / John J Craig / Pearson Edu. Prentice Hall
7. Robot Dynamics & Control – Mark W. Spong and M. Vidyasagar / John Wiley & Sons (ASIA) Pte Ltd.

19EME350: MATERIAL CHARACTERIZATION

L	T	P	C
3	0	0	3

This course provides basic understanding of Material Characterization such as crystal structure determination, Microstructural studies and Phase transformation etc. This is an important course with respect to Material Science point of view and very helpful for those who want to excel in research. This is a prerequisite course for some advanced courses such as Advanced Phase Transformation, X-ray and Electron Diffraction techniques and Advanced Thermodynamics in Materials etc.

Course objectives:

- To teach basic principles of optical microscope in understanding materials characterization.
- To impart basic understanding of the electron microscopy and its techniques.
- To teach various diffraction methods and their application in material characterization.
- To explain the basics of thermal analysis.
- To impart basic knowledge of corrosion, its types and methods to measure corrosion.

UNIT I **8 L**

Introduction: Need of materials characterization and various characterization techniques available. **Optical microscope -** Basic principles and components, Different examination modes (Bright field illumination, Oblique illumination, Dark field illumination, Phase contrast, Polarized light, Hot stage, Interference techniques), Stereomicroscopy, Photo-microscopy, Color metallographic, Specimen preparation, Applications.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- Understand the significance of Optical microscopy in Material Characterization. [**L-1**]
- Understand the working principle of Microscopes. [**L-1**]
- Learn the procedure of Metallography: Sample preparation, Polishing, Etching etc. [**L-2**]
- Learn to use an optical microscope to study the microstructure of given metal/alloy. [**L-3**]

UNIT II **8 L**

Electron Microscopy: Interaction of electrons with solids, Scanning electron microscopy Transmission electron microscopy and specimen preparation techniques, Scanning transmission electron microscopy, Energy dispersive spectroscopy, Wavelength dispersive spectroscopy.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- Have a basic understanding of interaction of electron with atoms and electrons. [**L-1**]

- Learn the fundamentals of SEM and TEM. [**L-3**]
- Learn the specimen preparation techniques for TEM and SEM analysis. [**L-2**]

UNIT III **8 L**

Diffraction Methods: Fundamental crystallography, Generation and detection of X-rays, Diffraction of X-rays, X-ray diffraction techniques, Residual stress measurement.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- Learn the basic concept of X-ray generation and interaction with atoms. [**L-1**]
- Determine the crystal structure of crystalline solids. [**L-2**]
- Analyze XRD Peaks for Phase identification. [**L-2**]
- Have basic understanding of Residual stress analysis from XRD-Peaks. [**L-3**]

UNIT IV **8 L**

Thermal Analysis: Thermo gravimetric analysis, Differential thermal analysis, Differential Scanning calorimetry, Thermo mechanical analysis and dilatometry.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- Analyze phase transformations and phase transition in materials. [**L-2**]
- Identify crystallinity and non-crystallinity of materials. [**L-2**]

UNIT V **8 L**

Electrochemical characterization techniques: Introduction to corrosion, types of corrosion. DC Polarization, linear polarization method, AC Impedance. Taffel analysis, Electrochemical impedance spectroscopy, potentiodynamic polarization techniques.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- Understand the concept of corrosion and its types [**L-1**]
- Understand of corrosion measurement methods [**L-1**]
- Understand corrosion analysis techniques. **[L-1]**

Course Outcome:

By the end of the course, the learners will be able to:

- Explain the principles of optical microscope in understanding materials characterization. **[L-2]**

- Apply appropriate characterization technique for microstructure examination at different magnification level and use them to understand the microstructure and phases of various materials. **[L-4]**
- Explain various diffraction methods and their application in material characterization. **[L-2]**
- Apply thermal analysis techniques to determine thermal stability of and thermodynamic transitions of the specimen. **[L-4]**
- Explain the concept of corrosion, its types and methods to measure corrosion.**[L-2]**

Text Book(s):

1. B.D.Cullity and S.R.Stock, "Elements of X-Ray Diffraction" Third edition, Prentice Hall, NJ , 2001.
2. David B. Williams, C. Barry Carter, " Transmission Electron Microscopy: A Textbook for Materials Science", Springer, pub. 2009.

References:

1. Brown, Michael Ewart, "Introduction to Thermal Analysis", Second edition, Springer, pub. 2001,
2. Zaki Ahmad, Principles of Corrosion Engineering and Corrosion Control, Butterworth-Heinemann, 2006.
3. Christopher Hammond, The Basics of Crystallography and Diffraction, Oxford University Press, 2015.

19EME352 - FINITE ELEMENT ANALYSIS (Elective)

L	T	P	C
3	**0**	**0**	**3**

Pre-requisites: *Engineering Mathematics, Strength of Materials, Dynamics of Machinery*
This course exposes the students to deal with various modeling techniques and uses different numerical methods for solving a system of governing equations over the domain of a continuous physical system, which is discredited into simple geometric shapes called finite element. This course also capitalizes on knowledge of mechanics and solves problems that can only be tackled numerically on the computer.

Course Objectives

1. Introduce the basic principles of finite element analysis.
2. Teach the theory and characteristics of finite elements that represent engineering structures.
3. Discuss the finite element solutions to static and dynamic structural problems.
4. Demonstrate the methodology to model and to solve complex problems in engineering
5. Familiarize the students with the knowledge and skills needed to effectively use commercial finite element software.
6. Impart Advanced FEA knowledge and techniques for solving complex problems in engineering.

UNIT I **8L**

Introduction: General description of the FEM, comparison of FEM and other methods and engineering applications of FEM. **Fundamental Concepts:** Stresses and Equilibrium, Boundary conditions, Strain-Displacement relations, Stress-Strain relations, Plane stress, Plane strain, Temperature effects, Potential energy and Equilibrium. Raleigh-Ritz method, Galerkin's method, Saint Venant‟s principle.

Learning Outcomes:

At the end of this UNIT, the student will be able to

Understand the significance of FEM (L1)
Comprehend the concept of plane stress and strain (L3)
Utilize the concept of energy methods (L3)

UNIT II **10 L**

One-dimensional Problems: Finite element modeling coordinates and Shape functions. Potential energy approach. Galerkin approach, Assembly of the global stiffness matrix- mass matrix and load vector, Treatment of boundary conditions, Quadratic shape functions, Temperature effects. Analysis of Plane trusses.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- Comprehend the concept Finite element modelling (L2)
- Utilize the concept of energy methods (L3)
- Analyze the bars and trusses by treatment of boundary conditions. (L4)

UNIT III **8 L**

Two-dimensional Problems Using Constant Strain Triangles: Finite element modeling, Constant strain triangle, in plane and Bending, problem modeling and boundary conditions. **Axisymmetric Solids subjected to Axisymmetric Loading:** Axisymmetric formulation, Finite element modeling - triangular element, Problem modeling and boundary conditions.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- Comprehend the concept of two dimension elements (L2)
- Analyze the CST and Axisymmetric Solids by problem modeling and boundary conditions. (L4)

UNIT IV **8 L**

Two-dimensional Isoparametric Elements and Numerical Integration: Four-node quadrilateral, Numerical integration, Higher-order elements. **Beams:** Finite element formulation, Load vector, Boundary considerations, Shear force and bending moment, Beams on elastic supports.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- Comprehend the concept Higher order elements (L2)
- Aquaint with concept of numerical integration (L2)
- Analyze and the beams and frames and to evaluate shear force and bending moment of the given continum. (L4 & L5)

UNIT V **8 L**

Dynamic considerations: formulation, element mass matrices, consistent and lumped mass matrices, free vibration analysis and evaluation of Eigen values and Eigen vectors., **Scalar field problems:** Basic equations of heat transfer, Steady state heat transfer and straight uniform fin analysis.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- Comprehend the concept of Dynamics and Heat transfer in FEM (L2)

- Develop the Consistent and lumped mass matrices(L3)
- Evaluate the Eigen values and Eigen vectors. (L5)

Course Outcomes

Upon successful completion of the course, the students will be able to

1 Gain knowledge to have a clear understanding of how to solve basic real-world problems (L1)
2 Comprehend the solution path to engineering problems. (L2)
3 Apply the theoretical FEA concepts in solving simple to complex multi-physics FEA problems using advanced softwares. (L3)
4 Infer and analyze the results obtained from finite element analysis software.(L4)
5 Make transparent judgments` with regards to the design or issues related to engineering problems.(L5)

Text Book(s):

1. Tirupathi.R.Chandrupatla, Ashok.D.Belegundu "Introduction to Finite Elements in Engineering", Pearson Education Limited, fourth edition ,2015
2. Oc Zienkiewicz, Rl Taylor, Jz Zhu," Finite Element Method Its Basis & Fundamentals" Reed Elsevier India Pvt.Ltd, 2015 edition.

References:

1. S.S.Rao, "Finite element method in engineering", Elsevier Butterworth-Heinmenn publications, fourth edition, 2011.
2. JN Reddy, "An Introduction to the Finite Element Method" McGraw-Hill, 3rd edition, 2006.
3. P.Seshu ,"Finite element Analysis", PHI Learning Pvt. Ltd, first edition, 2003.

19EME354: DESIGN OF POWER TRANSMISSION SYSTEMS

L	T	P	C
3	0	0	3

This course provides design of various transmission devices which aid in effective working of mechanical systems. It introduces concepts associated with devices such as design of belt drives, chain drives, gear drives and gearboxes. It also introduces the functional and strength design principles of important transmission systems like gears and flexible drives.

Course Objectives:

- To introduce the principles and procedure for the design of power transmission components.
- To explain various forces acting on the elements of a transmission system.
- To impart knowledge on the usage of standard data and catalogues.
- To familiarize various elements involved in a transmission system.
- To design power transmission systems based on the input and the output parameters.

UNIT I **12 L**

Design of Flexible Elements: Belts and their construction. Flat belts versus V- belts. Open and cross belt arrangements. Ratio of tensions, centrifugal tension, effect of centrifugal tension. Design of belts. Chain Drives: Roller chains, geometric relationships, polygonal effect of chain, power rating and design of chain drives.

Learning Outcomes: Student will be able to
- understand different belts, chain drives and their applications.(L3)
- design and select the suitable belts, pulleys and chain drives (L4)

UNIT II **12 L**

Spur Gears and Helical Gears: Gear Terminology-force analysis -tooth stresses - dynamic effects - fatigue strength - Factor of safety - Gear materials – UNIT and Face width-power rating calculations based on strength and wear considerations - Helical Gears – Pressure angle in the normal and transverse plane Equivalent number of teeth-forces and stresses. Estimating the size of the spur and helical gears.

Learning Outcomes:

Student will be able to
- calculate the stresses induced in gears (L3)
- design and select the suitable gears for required application (L4)
- analyze the forces on gear tooth. (L3)

UNIT III **12 L**

Bevel and Worm Gears: Straight bevel gear - tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: terminology, Merits and demerits. Design procedure and problems based on strength and wear considerations.

Learning Outcomes:

Student will be able to

- calculate the stress induced in bevel and worm gears (L3)
- design and select bevel and worm gears for required application (L5)
- estimate the forces on gear tooth.(L3)

UNIT IV **10 L**

Gearbox: Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gearbox - Design of multi speed gearbox for machine tool applications - Constant mesh gearbox - Speed reducer UNIT. – Variable speed gearbox,

Learning Outcomes:

Student will be able to

- understand the significance of gearbox for different applications. (L2)
- design and develop a multi speed gearbox for industrial applications. (L4)
- evaluate torque conversion in automotive applications (L4)

UNIT V **10 L**

Automatic Transmission System: Semi-automatic and automatic transmission system Requirements, types, Torque converter, Hydrostatic and hydrodynamic transmission, continuously variable transmission.

Learning Outcomes:

Student will be able to

- understand different types of automatic transmission systems (L2)
- develop the knowledge on automatic transmission System (L1)

Course Outcomes

At the of the course Student will be able to

- Design pulleys, chain drives, rope drives and belt drives.(L4)
- Calculate various forces acting on spur, bevel, helical and worm gears. (L3)
- Design different types of gear boxes. (L4)
- Interpret the performance requirements in the selection of commercially available transmission drives. (L3)

Text Book(s) (s):

1. J.E.Shigley, Mechanical Engineering Design, 8/e, Tata McGraw-Hill, 2008.
2. Bhandari V, Design of Machine Elements, 3/e, Tata Mc Graw Hill, 2010.

References:

1. T.V. Sundararajamoorthy and N. Shanmugam, Machine Design, 1/e, Anuradha Publications, Chennai, 2018.
2.U.C.Jindal, Machine Design, 1/e, Pearson, 2010.
3. Aaron Kuchle and Harald Naunheimer, Automotive Transmissions: Fundamentals, Selection, Design and Application, 2/e, Springer.
Note :PSG Design data book is permitted

19EME346: CAD/CAM

L	T	P	C
3	0	0	3

The concept of CAD/CAM is a computer aided design and manufacturing approach of using computers to control the entire production process from the beginning. The integration of all elements of CAD/CAM environment allows individual processes to exchange information with each other and initiate actions. These activities encompass all functions necessary to translate customer needs into a final product. It includes computer aided design (CAD), computer aided manufacturing (CAM), computer aided process planning (CAPP), computer numerical control machine tools, robots, computer integrated production management system and a business system integrated by a common data base.

Course Objectives

- To understand principles of CAD/CAM, including engineering drawing, geometric and surface modeling and feature-based design.
- To apply engineering mathematics related to geometry to understand CAD/CAM concepts.
- To analyze computer aided manufacturing principles to perform manual and computer aided numerical control programming.
- To evaluate the CAD/CAM concepts and apply those in product design and manufacturing.
- To create new systems using concepts of Group Technology, FMS and CIM.

UNIT I **10 L**

Introduction: CAD/CAM/CIM, CAD/CAM input devices, CAD/CAM output devices, CAD/CAM software, Graphics standards and benefits of CAD. Transformations of geometry: Translation, scaling, rotation and mirroring. Homogeneous transformations, concatenation of transformations.

Learning outcomes

At the end of this UNIT, the student will be able to

- describe basic structure of CAD workstation, Memory types, input/output devices and display devices and computer graphics **(L2).**
- apply geometric transformations on the created wireframe, surface and solid models **(L3).**

UNIT II **8 L**

Geometric Modeling of Curves: Bezier and B-spline curves in two dimensions and three dimensions; Geometric Modeling of Surfaces: Basic surfaces entities, sweep surfaces, surface of revolution, blends, intersections; Geometric Modeling of Solids: Solid entities, Boolean operations, B-rep of Solid Modeling, CSG approach of solid modeling.

Learning outcomes

At the end of this UNIT, the student will be able to

- use parametric 3D CAD software tools in the correct manner for making geometric part models, assemblies and automated drawings of mechanical components and assemblies **(L3).**
- acquire the knowledge of geometric modeling and Execute the steps required in CAD software for developing 2D and 3D models and perform transformations **(L2).**

UNIT III **8 L**

Computer Aided Manufacturing (CAM): Introduction to Computer Numerical Control (CNC) and direct numerical control (DNC), structure of NC machine tools, designation of axes, drives and actuation systems, feedback devices, CNC tooling, automatic tool changers and work holding devices, Functions of CNC and DNC systems.

Learning outcomes

At the end of this UNIT, the student will be able to

- apply the concepts of machining for the purpose of selection of appropriate machining centers, machining parameters, select appropriate cutting tools for CNC milling and turning equipment, set-up, program and operate CNC milling and CNC drilling **(L3).**
- create and validate NC part program data using manual data input (MDI) and automatically using standard commercial CAM package for manufacturing of required component using CNC milling or turning applications **(L4).**

UNIT IV **8 L**

Robotics: Anatomy and configuration of robot, characteristics of robots, grippers, application of robots in manufacturing, robot programming languages.

Learning outcomes

At the end of this UNIT, the student will be able to

- understand robot configuration, structures, basic components, workspace and generations of robots**(L2).**
- understand the present and future applications of a robot **(L1).**

UNIT V **8 L**

Group Technology: Introduction to group technology, part classification and coding systems: OPITZ, MICLASS. Computer aided process planning (CAPP): Introduction to CAPP, variant and generative methods of CAPP, advantages of CAPP, computer integrated manufacturing (CIM): Elements of CIM, CIM case studies.

Learning outcomes

At the end of this UNIT, the student will be able to

- examine the importance of Group Technology, CAPP and CIM concepts**(L4).**

Course Outcomes

After completing the course, the student will be able to

- apply engineering knowledge, techniques, skills and modern tools to analyze problems in both design and manufacturing **(L3).**
- apply geometric transformation techniques in CAD **(L4).**
- develop mathematical models to represent curves, surfaces and solids **(L4).**
- develop manual and APT part programs for 2D complex profiles and test the programs through simulation **(L3).**
- demonstrate knowledge of industrial robots, CAPP, GIT and CIM systems **(L2).**

Text Book (s)

1. Mikell P. Groover and Emory W. Zimmers Jr, CAD/CAM: Computer-Aided Design and Manufacturing, Pearson Education Inc., 1984.
2. P. N. Rao, CAD / CAM Principles and Applications, 3/e, Tata McGraw Hill, 2014.

References

1. Ibrahim Zeid and Sivasubramanian, R., CAD/CAM Theory and Practice, 2/e, Tata McGraw Hill, 2009.
2. M. M. M. Sarcar, K. Mallikarjuna Rao, K. Lalit Narayan, Computer Aided Design and Manufacturing, 2/e, Printice Hall of India, 2012.

19EME356: ENTERPRISE RESOURCE PLANNING

L	T	P	C
3	0	0	3

This course exposes the students with content that contains business process reengineering, ERP life cycle and ERP related Technologies. This course will also offer the technologies involved in business UNITs in ERP packages. It also covers the emerging trends in ERP case studies.

Course Objectives

- To explain the technical aspects and life cycle of ERP systems.
- To expose the steps and activities in ERP.
- To explain, identify and describe different types of ERP system.
- To analyze the ERP Packages in manufacturing, textile, and e-commerce.
- To expose the concepts, tools and methodology used for designing ERP for an Enterprise.

UNIT I **8 L**

Introduction: Concept of Enterprise, ERP Overview, Integrated information system, The role of Enterprise, Business Modeling, Myths about ERP, Basic ERP Concepts, Intangible benefits of ERP, Justifying ERP investment, Risks of ERP, Benefits of ERP

Learning Outcomes:

At the end of this UNIT, the student will be able to

- understand the concept of enterprise resource planning. [**L2**]
- apply and interpret basic summary and modelling techniques of business modelling in ERP. [**L3**]
- recognize the myths, risks and benefits of ERP. [**L2**]
- knowledge in the areas where ERP has significance. [**L1**]

UNIT II **8 L**

Implementation: Life Cycle, Methodologies, Strategy, Business Case and Return on Investment Analysis for ERP, Selecting Consulting Partner, ERP Package Selection, ERP Project Team and Project Organization Structure, ERP Project Management, Managing Requirements, Business Process Re-engineering, Business Process Modeling and Business Modeling.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- understand the concept of life cycle and strategies involved in ERP. [**L2**]
- compile the ideas of any project team and develop modelling techniques in the structure of ERP.[**L5**]
- identify the process of selecting consulting partner and package selection. [**L1**]

- analyze wide knowledge in business process re-engineering. [**L4**]

UNIT III **8 L**

Post ERP Implementation: Post-Implementation Review of ERP Systems, Post-Implementation Support, Maintenance and Security of ERP, Gaps Identification and Strategies to Bridge the Gap, Configuring and Testing of the Solution, Data Migration, Cutover Planning and Go Live Preparation, Training, Change Management, Success or Failure of ERP Implementation.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- identify the gaps in the maintenance and security of ERP systems. [**L1**]
- test the solutions in data migration. [**L3**]
- extend wide knowledge in the success and failure of ERP. [**L3]**

UNIT IV **8 L**

ERP Functional UNITs: Human Capital Management, Financial Management Procurement, Inventory Management through ERP, Supplier Relationship Management, Production Planning, Execution, Supply Chain Planning, Sales and Service, Logistics Execution, Warehouse and Transport Management, Customer Relationship Management, Quality Management, Maintenance Management, Enterprise Asset Management, Product Lifecycle Management.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- understand the concept and distinguish the features between capital management, financial management and inventory management. [**L2**]
- recognize the execution of logistics, warehouse and transport management. [**L1**]
- Interpret the difference between customer relationship management, quality management and enterprise management. [**L1**]
- identify the features of product life cycle management. [**L1**]

UNIT V **8 L**

ERP Applications: Portal, Content Management, Knowledge Management, Data Warehousing, Data Mining, Business Intelligence and Analytics, ERP and Enterprise Applications, Emerging Trends, ERP for Industries- ERPs for Different Manufacturing Industries, ERPs for Different Service Industries, Case Studies.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- identify the gaps in the maintenance and security of ERP systems. [**L1**]

- configure and test the solutions in data migration. [**L2**]
- obtain the process of cutover planning, preparation, and training. [**L1**]
- enhance wide knowledge in the success and failure of ERP. [**L2**]

Course Outcomes:

Upon successful completion of the course, the students will be able to

- obtain a basic understanding of the concept of ERP. **[L1]**
- comprehend the significance of the ERP implementation Procedure. **[L2]**
- apply design principles for various business UNITs in ERP. **[L4]**
- learn various ERP UNITs and software's related to ERP. **[L3]**
- analyze security issues in ERP. **[L4]**
- compare ERP UNITs for Industries and Service org. **[L2]**

Text Book(s):

1. Rajesh Ray, Enterprise Resource Planning, 1stEdition, McGraw Hill Education, 2010.
2. Robert D.Hisrich, Michael P.Peters, Mathew J. Manimala and Dean A. Shepherd, Entrepreneurship, 9thEdition, McGraw Hill Education, 2010.

References:

1. D. P. Goyal, Enterprise Resource Planning a Managerial Perspective, 1stEdition, McGraw Hill Education, 2011.
2. L.Wagner, Concepts in Enterprise Resource Planning, 4th Edition, engage Learning India Pvt. Ltd, 2014.
3. A. leon, Enterprise Resource Planning, 3rdEdition, McGraw Hill Education, 2014.
4. P. C. Reddy,Enterprise Resource Planning, 1stEdition, S. K. Katarina& Sons, 201

19EME358: STATISTICAL QUALITY CONTROL

L	T	P	C
3	0	0	3

Quality control is a process by which entities review the quality of all factors involved in the production. Quality control emphasizes testing of products to uncover defects and reporting to management to enable them to decide to allow or deny the release. Quality assurance attempts to improve and stabilize production, and associated processes, to avoid, or at least minimize, issues that led to the defects. This course introduces the various statistical tools which aid in the process of quality control.

Course Objectives:

- To recognize the purpose of various tools used in quality control.
- To determine costs associated with quality.
- To familiarize students with various control charts for attributes and variables.
- To investigate the process capability and methods to improve the capability.
- To understand the acceptance sampling plans.

UNIT I **8 L**

Quality Basics and History: Meaning of quality, Factors affecting quality, Quality Principles, Quality function, Quality control, Aims and objectives of quality control, Characteristics, Cost of Quality, Value of quality, Seven QC tools, Need of management of product quality, Historical perspective of quality control.

Learning Outcomes:

After completing this UNIT, the student will be able to

- define quality and familiarize terms**[L1]**
- list factors effecting quality**[L1]**
- summarize objective of quality**[L2]**
- list quality tools. **[L1]**

UNIT II **10 L**

Modeling Process Quality: Variation: Stem-leaf Plot, Frequency distribution Histogram, Box Plot, Discrete Distributions Hyper geometric Distribution, Binomial distribution, Poison Distribution, Continuous Distributions- Normal, Gamma, Exponential and Weibull’s distribution.

Learning Outcomes:

After completing this UNIT, the student will be able to

- distinguish various distributions continous and discrete distributions**[L4]**
- generalize and analyze the the distributions **[L4]**

- analyze the distribution **[L4]**

UNIT III **8 L**

Statistical Quality Control: Introduction, Concept of variability , Common vs. Special Causes, Types of Control charts, Measurement of control limits, Control charts for variables -large sample data, Warning limits, Revised control limits, Group control chart, Control chart with line trend.

Learning Outcomes:

After completing this UNIT, the student will be able to

- define variability **[L1]**
- list common and special causes of variability **[L1]**
- apply control c hart technique to solve problem**[L3]**
- analyze the causes for variations for variable chart**[L4]**

UNIT IV **10 L**

Control Charts for Attributes: Control charts for non-confirming Models, control charts for fraction non- conforming.
Process and Measurement System Capability Analysis: Using Probability plot, process capability ratios, specification limits and Tolerances.

Learning Outcomes:

After completing this UNIT, the student will be able to

- apply control Chart technique to solve problem for attributes**[L3]**
- analyze the causes for variations **[L4]**
- estimate the process capability ratio**[L2]**
- calculate the limits and Tolerances**[L3]**

UNIT V **8 L**

Acceptance Sampling: Introduction, Advantages and Disadvantages of Sampling methods, Sampling techniques, Sampling Risks and indices, Operating characteristic curves, Average outgoing quality Limit. Sampling plans Single, Double, Multiple and Sequential Sampling Plans Tightened Inspection, Dodge-Rooming system, Sequential plans.

Learning Outcomes:

After completing this UNIT, the student will be able to

- List advantages and disadvantages of sampling methods**[L1]**
- Selection of sampling plans for given situation **[L2]**
- Apply sampling plan **[L3]**

COURSE OUTCOMES:

- assess and estimate costs of quality. **[L5]**
- use tools of quality to quantify quality costs. **[L3]**
- graph control chart and control limits and revise the limits. **[L3]**
- estimate the capability of a process. **[L2]**
- state a sampling plan for a given scenario. **[L1]**

Text Book(s):

1. E. L. Grant Richard, R.S. Leavenworth, Design Statistical Quality Control, 7th Edition, McGraw-Hill Pvt Ltd New Delhi, 2011.
2. D. C. Montgomery, Statistical Quality Control,7th Edition, John Wiley Sons, 2012.

References:

1. M. Mahajan, Statistical Quality Control, Revised Edition, Dhanapat Rai & Co, 2007.
2. W.W.Hines, D. C.Montgomery, Probability and Statistics in Engineering and Management Science, John Wiley and Sons, New York, 1990.

PROGRAM ELECTIVE-III
19EME360: FUEL CELL AND HYDROGEN STORAGE

L	T	P	C
3	0	0	3

This course introduces the alternative energy source to fossil fuels in the form of Hydrogen, through fuel cell technology. As the global energy consumption increasing year-by-year causing threats like greenhouse effects, global warming there is a need of reducing consumption of fossil fuel. This fuel cell technology using in automobile sector may reduce this grave consequences. Basic concepts of electrochemical energy conversion, technology behind the production and storage of Hydrogen are discussed in this course.

Course Objectives:

- To introduce the basic concepts of fuel cell, and electrochemical energy conversion
- Familiarize regarding various cell types and advantages
- Explain the performance and design characteristics and operating issues for various Fuel cells.
- Enable the student regarding the working of fuel cell and its economics
- Create awareness about the applications of fuel cell in automobiles

UNIT I **9 L**

Introduction: Fundamentals of electrochemical energy conversion, Basic operation principles and Overview. Advantages and applications, Fuel cell thermodynamics; open circuit voltage; efficiency. Heat released, reasons for losses in voltage, Electrode kinetics, porous electrodes, characteristics, fabrication of electrodes, assembly of fuel cells, testing, Classification of fuel cells based on nature of electrolyte, operating temperature etc.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- acquaint fundamental knowledge about electrochemical energy conversion[L1]
- study the fuel cell thermodynamics[L2]
- develop knowledge in fuel cell construction and assembly[L2]
- study the electrolytes in fuel cell[L3]

UNIT II **8 L**

Fuel cell types: Alkaline Fuel cells (AFC), Phosphoric Acid Fuel cells (PAFC), Polymer Electrolyte Membrane Fuel cells (PEMFC), Direct Methanol Fuel cells (DMFC), Molten Carbonate Fuelcells(DMFC), Solid Oxide Fuel cells (SOFC), Regenerative Fuel Cells (RFC), Specificcharacteristics, advantages and applications.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- explain about various types of fuel cells[L1]
- impart knowledge about advantages of fuel cells[L1]
- expose the applications of fuel cells [L2]
- familiarise the characteristics of fuel cells[L3]

UNIT III **8 L**

Applications: Automotive applications & issues – Micro fuel cells & Portable power – Distributed & Stationary power

Learning Outcomes:

At the end of this UNIT, the student will be able to

- expose the application of fuel cell in automobiles[L3]
- enable to know about the issues in fuels cells in automobiles[L4]
- create the design of micro fuel cells[L6]
- demonstrate the application of fuel cells in micro power generation[L2]

UNIT IV **9 L**

Hydrogen production technologies: Hydrogen as a future energy carrier, Properties, Chemical production of hydrogen, steam reforming of methanol, natural gas, coal gas etc, shift conversion and thermal decomposition, purification (removal of CO and CO_2), desulphurization, Electrolytic hydrogen production, Electrolyser Configurations.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- aware of hydrogen as future fuel [L1]
- explain the physic-chemical characteristics of hydrogen [L1]
- acquire knowledge about hydrogen production and purification [L3]
- demonstrate the configuration of electrolyser in hydrogen production [L4]

UNIT V **8 L**

Hydrogen storage technologies: Basic principles, compressed gas storage, Cryogenic liquid storage, Solid state Storage, Adsorption in compounds and metal hydrides, hydride heat pumps and compressors.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- impart basic knowledge of cryogenic fuels and their storage[L1]
- create awareness of metal hydrides and their use in hydrogen storage[L2]
- explain the prime movers role in hydrogen storage [L3].

Course outcomes:

The student will be able to

- Acquaint knowledge of fuels cells regarding their construction, performance and operational issues [L1]
- Study the operating characteristics of fuel cell [L2]
- Train the students to apply fundamental knowledge of thermodynamics, fluid mechanics and heat transfer in design, construction of fuel cell [L3]
- Develop the application of fuel cell in automobiles [L3]
- Acquaint knowledge in hydrogen production procedures [L2]
- Carryout experiments on metal hydrides for hydrogen storage [L5].

Text Book(s)

1. B.Viswanathan and AuliceScibioh, Fuel Cells Principles and Applications,
Universities Press, Hyderabad, 2006.
2. J. Larminie& A. Dicks, Fuel Cell Systems Explained, Wiley, ISBN#0-471-49026-1, 2003.

References:

1.Fuel Cell Handbook, 7th Edition, US Department of Energy, 2004.
2. M. M. Mench, Fuel Cell Engines, Wiley, (ISBN: 978-0-471-68958-4), 2008
3. X. Li, Principles of Fuel Cells, Taylor & Francis, 2005.
4. GregorHoogers, Fuel Cell Technology Handbook (FCTH), CRC Press, Current
Edition.ISBN # 0-8493-0877-1, 2003.
5. N. Sammes, Fuel Cell Technology - Reaching Towards Commercialization,
ISBN-10: 1852339748-Springer, 2006.
6. S. Srinivasan, Fuel Cells: From Fundamentals and Applications, Springer, 2006.
7. James Larminie and Andrew Dicks (2000)Fuel Cell Systems Explained, , 2nd Edition, John Wiley
&Sons Inc.,.
8. FranoBarbir (2005) PEM Fuel Cells Theory and Practice, , Elsevier Academic Press,

19EME362: SOLAR ENEGY

L	T	P	C
3	0	0	3

To understand the fundamentals of solar energy and its conversion techniques for both thermal and electrical energy applications. Solar energy is the most secure of all energy sources. It is abundantly available. Renewable Power generation including Solar Photovoltaic (PV) and Solar Thermal (ST) power / steam / hot water generation offer an environmentally safe and sustainable alternative.

Course Objectives:

- Summarize the basic fundamental concepts of the solar radiation and analyze the future scope of solar energy and their utilization
- Explain the working principle of solar cells and their modern manufacturing techniques
- Elaborate the students with various solar Thermal systems and their utilization
- Demonstrate the workings of various solar photovoltaic systems
- Appraise the knowledge related to latest life cycle analysis of solar Energy Systems

UNIT I **9 L**

Introduction: Basic Heat Transfer Principles- Availability of Solar Energy- Nature of Solar Energy- Solar Energy & Environment- Sun as the source of radiation- Solar radiation- Measurement of solar radiation Irradiance- Solar constant- Insolation- Radiosity- Emissive power- Earth"s equator- Meridian Longitude- Sun earth angles- Sunrise, sun set and day length- Solar time- Equation of time Various Methods of using solar energy- Photo thermal, Photovoltaic, Photosynthesis, Present & Future Scope of Solar energy.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- summarize the availability of Solar Energy and nature of Solar Energy [L2]
- demonstrate the basic measurement of solar radiation [L2]
- illustrate the different methods of using solar energy [L2]

UNIT II **10 L**

Solar cells :Various generations- Semiconductor materials- Doping- Fermi level- PN junction and characteristics- Photovoltaic effect- Photovoltaic material- Parameters of solar cells- Effects of cell temperature on cell efficiency- Types of solar cells- Solar UNITs and arrays- Advantages and limitations of solar energy system- Solar cell power plant- Silicon, thin film and polymer processing- Silicon wafer based solar cells.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- summarize various solar cell characteristics and their materials.[L2]
- analyze different types of solar cells and their UNITs and arrays.[L4]
- assess solar power plant with silicon, thin film and polymer processing. [L4]

UNIT III **10 L**

Solar Thermal Energy: Stationary collectors- FPC- CPC- ETC- Sun tracking concentrating collectors- PTC- PDR- HFC Fresnel collectors- Solar thermal power plants- Solar chimney power plant- Solar pond- Solar water heater- Solar cooker- Types- SODIS- Thermal energy storage- Solar cooling- Limitations of solar thermal energy.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- summarize the principles underlying in working different types stationary collectors [L2]
- analyze working principle of solar thermal power plants [L4]
- analyze the limitations of thermal energy storage in solar system. [L4]

UNIT IV **9 L**

Solar Photovoltaics: Photovoltaic cell function- Types of PV system- Design of PV system- Grid connected PV system Stand alone PV system- Efficiency of PV UNIT- MPPT- Applications of PV system- SPV lighting system- Solar water pumping system- Solar vehicles- Solar dryer- BIPV- Features of SPV system Case study- Solar water pumping system in Punjab- Performance study on solar drying system in Nepal.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- interpret the photovoltaic cell function.[L2]
- design and study the different types of PV system[L5]
- develop the solar dryer, solar pump and solar vehicle.[L3]

UNIT V **7 L**

Economic analysis: Life cycle analysis of Solar Energy Systems – Time Value of Money – Evaluation of Carbon Credit of Solar Energy Systems.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- infer the need of life cycle analysis of solar energy system.[L1]

- develop economic analysis system for solar energy system.[L3]
- evaluate Carbon Credit of Solar Energy Systems.[L4]

Course Outcomes:

Upon successful completion of the course, the students will be able to

- summarize the basic concept of solar radiation calculations. [L2]
- demonstrate the working principle solar cells and their importance[L2]
- analyze the solar collectors and their limitations [L4]
- explain the function of solar photovoltaic and modern techniques of using solar energy in different application. [L2]
- analyze economic analysis and life cycle of solar thermal systems.[L4]

TEXTBOOK

1. Soteris A. Kalogirou,Solar Energy Engineering: Processes and Systems, 2/e, Academic Press, 2013
2. Tiwari G.N, Solar Energy – Fundamentals Design, Modelling and applications, Alpha Science, 2002

REFERENCES

1. John W. Twidell,Anthony D Weir,Renewable Energy Resources,Taylor&Francis,2005
2. John A. Duffie, William A. Beckman, Solar Energy: Thermal Processes, 4/e, John Wiley and Sons, 2013
3. S P Sukhatme, J K Nayak,Solar Energy, 4/e,McGraw-Hill Education, 2017.

19EME364: AUTOMOTIVE TRANSMISSION SYSTEMS

L	T	P	C
3	0	0	3

To acquire knowledge about the designing of automotive transmission system and to make the student understand the working of automotive transmission system, and emphasize the need for maintenance of transmission equipment.

Course Objectives

- To familiarize concepts of transmission system for power transfer from engine to wheels.
- To explain different mechanisms and working of transmission system.
- To teach the concepts of clutches and gears
- To introduce the concept of automatic transmission.
- To familiarize Special transmission systems.
- To provide fundamental concepts of driveline used in automobiles

UNIT 1 **8 L**

Clutch: Necessity of clutch in an automobile, different types of clutches, friction clutches namely Single plate clutch, multi plate clutch, cone clutch, centrifugal clutch, electromagnetic clutch, hydraulic clutches, Clutch - adjustment, Clutch troubles and their causes, requirements of a clutch , Clutch materials, clutch lining Vacuum operated clutch. Fluid coupling

Learning outcomes

At the end of this UNIT, the student will be able to

- identify different types of clutches. (L2)
- explain the different mechanisms and materials used for clutches . (L2)
- develop clutches for torque requirement problems. (L4)

UNIT II **8 L**

Gear box: Various Resistances to Motion of the Automobile, Traction, tractive effort Performance curves, acceleration grade ability, draw bar pull. The need for transmissions, Necessity of gear box, Desirable ratios of 3-speed & 4-speed gear boxes, Constructional details of sliding-mesh gear box, constant-mesh gear box, synchromesh gear box, automatic and semi-automatic transmission, overdrive.

Learning outcomes

At the end of this UNIT, the student will be able to

- apply various performance curves.(L3)
- explain the efficiency of different gear systems.(L2)
- enumerate the causes for poor performance transmission systems.(L3)

UNIT III **8 L**

Torque Converter and Automatic Transmission: Principal of torque conversion, single, multi stage and polyphase torque converters, performance characteristics, constructional and operational details of typical hydraulic transmission drives. Automatic transmission: relative merits and demerits when compared to conventional transmission epicyclic and hydromatic transmission continuously variable transmission.

Learning outcomes

At the end of this UNIT, the student will be able to

- apply principal of torque conservation for enhanced performance of systems. (L3)
- evaluate performance characteristics of automatic clutches.(L4)
- explain different unconventional transmission systems.(L3)

UNIT IV **8 L**

Special transmission systems: Hydrostatic drives: advantages and disadvantages, principles of hydrostatic drive systems, construction and working of typical hydrostatic drives, Janney Hydrostatic drive. Electrical drives: advantages and limitations, principles of Ward Leonard system of control Modern electric drive for buses and performance characteristics.

Learning outcomes

At the end of this UNIT, the student will be able to

- apply principals of hydrostatic systems .(L3)
- examine hydraulic and electrical drives.(L4)
- evaluate the performance of modern electric drives .(L4)

UNIT V **8 L**

Drive line: Effects of driving thrust and torque reaction. Hotchkiss drive. Torque tube drive, radius rods. Propeller shaft. Universal joints. Final drives – different types, double reaction final drive. Two speed rear axle. Rear axle construction – full floating, three quarter floating and semi-floating arrangements. Differential conventional type, no-slip type. Differential locks.

Learning outcomes

At the end of this UNIT, the student will be able to

- explain the driving thrust and torque reaction. (L3)
- relate different types of drives. (L3)
- examine different types of rear axle construction. (L4)

Course Outcomes

Upon successful completion of the course, the student will be able to

- select proper transmission system for a vehicle, L2
- identify and solve problems related to transmission system. L3
- Use of advanced technology in automobiles L3
- Choose a particular drive line for an application L4

Text Book:

1. Fischer and Pollack, “The automotive transmission book”, Springer, 2014

References :

1. Newton K and Steeds. W. “The Motor Vehicle”, Butter Worth’s & Co., Publishers Ltd, 2001
2. Automatic vehicle transmission, John Wiley Publications 1995
3. Crouse. W.H., Anglin. D.L., "Automotive Transmission and Power Trains construction ", McGraw-Hill 4 Heldt P.M - Torque converters- Chilton Book Co.-1992

19EME366: COMPUTER NUMERICAL CONTROL AND ADAPTIVE CONTROL

L	T	P	C
3	0	0	3

This course exposes the students to understand the standard terminologies, conventions, processes, operations, design and operational characteristics of key hardware components, programming techniques, applications, merits and demerits of computer numerical control (CNC) machines. This course helps the students to develop the programming skills, able to operate the CNC machines so that the need of automation in manufacturing industries can be satisfied.

Course objectives:

- To introduce the basic concepts in numerical control and CNC machine tools.
- To explain the basic standard terminologies/ conventions, hardware, applications, merits and demerits of general NC, CNC and DNC technology.
- To familiarize the knowledge regarding adaptive control of CNC machines.
- To expose the students to Automatic/ Computer Assisted NC tool path programming using G codes and M codes for complicated machining applications.
- To impart the knowledge regarding various CNC programming languages and learn about the automated part programming (APT).

UNIT I **10 L**

Introduction: NC, DNC, CNC, Programmed Automations, Machine control UNIT, Part program, NC tooling. NC machine tools: Nomenclature of NC machine axes, Types of NC machine tools, Machining centers, Automatic tool changes (ATC), Turning centers.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- recognize the need of automation in manufacturing industries. [**L1**]
- differentiate NC, CNC and DNC systems. [**L2**]
- understand the nomenclature of NC machine axis and types of NC machine tools. [**L2**]
- explain NC tooling, machining centers and turning centers used in CNC machine tools. [**L2**]

UNIT II **12 L**

Machine control UNIT & tooling: Functions of MCU, NC actuation systems, Part program to command signal, MCU organization, Computerized numerical control, Transducers for NC machine tools, Tooling for NC machining centers and NC turning machines, Tool presetting. Adaptive control of CNC machine tools – SMART manufacturing, Programmable logic controllers (PLC) – Hardware, ladder logic programming of PLCs using basic functions – timers and counters – Advanced programming with control and arithmetic instructions.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- acquaint knowledge regarding CNC machine hardware components like MCU, actuation systems and transducers. [**L1**]
- understand how the part program will be converted into command signal which is required to operate CNC machine. [**L2**]
- comprehend different concepts of adaptive control of CNC machine tools. [**L2**]

UNIT III **12 L**

Manual part programming: Part program instruction formats, Information codes: Preparatory function, Miscellaneous functions, Tool code and tool length offset, Interpolations, Canned cycles, Manual part programming for milling operations, turning operations, parametric subroutines.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- summarize the preparatory functions (G- Codes) and Miscellaneous functions (M- Codes). [**L2**]
- create the part drawings and prepare the manual part programs for different machining operations. [**L5**]
- identify the advanced part programming features like parametric subroutines.[**L2**]
- operate the CNC machines to manufacture the different complicated and complex profiles. [**L4**]

UNIT IV **12 L**

APT programming: APT language structure, APT geometry: Definition of point, time, vector, circle, plane, patterns and matrices. APT motion commands: setup commands, point-to-point motion commands, continuous path motion commands. Post processor commands, complication control commands, Macro subroutines, Part programming preparation for typical examples.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- differentiate between manual part programming and APT programming. [**L1**]
- comprehend the APT language structure, APT geometry and motion commands. [**L2**]
- develop the APT part programs for typical examples. [**L4**]

UNIT V **10 L**

Computer aided part programming: NC languages: APT, NELAPT, EXAPT, GNC, VNC, Preprocessor, Post processor.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- understand the need of computer assisted part programming. [**L2**]
- explore different types of NC languages to solve different complex issues in manufacturing industries. [**L2**]
- identify the need of Preprocessor and Post processor commands in computer assisted part programming. [**L2**]

Course Outcomes:

Upon successful completion of the course, the students will be able to

- Obtain the knowledge regarding need of automation and fundamentals of NC, CNC and DNC systems.[**L1**]
- Understand the design configurations, operational characteristics and control of CNC machine systems.[**L2**]
- Understand the significance of adaptive control of CNC machine tools. [**L2**]
- Compile and execute standard CNC programs for multi-axis machine tools in both high-level language and code format, including canned cycles and subroutines. [**L3**]
- Apply the knowledge for the purpose of selection, design and use of NC technology for manufacturing applications. [**L4**]

Text Book(s)

1. P.N. Rao, CAD/CAM, 3rd edition, Tata McGraw-Hill Company Limited, New Delhi, 2012.

References

1. S.K Sinha, CNC Programming using Fanuc Custom Macro B, McGraw Hill Education, 2010.
2. Mike Mattson, CNC Programming: Principles and Applications, 1st edition, Delmar publishers, 2013.
3. M.M.M. Sarcar, K. Mallikarjuna Rao, K. Lalit Narayan, Computer Aided Design and Manufacturing, 2nd Edition, Prentice Hall of India, 2012.
4. T.K.Kundra, P.N.Rao, N.K.Tewari, Numerical control and computer Aided Manufacturing, Tata McGrawhill Education, 2002.

19EME368: MANUFACTURING OF AUTOMOBILE COMPONENTS

L	T	P	C
3	0	0	3

This course provides an insight to the basic concepts and techniques of metal casting processes, joining & deformation processes and various types of plastic parts used as automotive components. The course aims at giving adequate exposure to select materials and manufacturing techniques for automotive component development that are used in real-life to realize successful products.

Course Objectives

- Understand the knowledge in various manufacturing methods in developing automotive components.
- Remember the underlying concepts and methods behind Automobile materials and manufacturing
- Apply a problem oriented in depth knowledge of Automobile materials and manufacturing.
- Analyze the suitability of different manufacturing methods.
- Create suitable materials for automobile components.

UNIT I **9 L**

Casted Engine Components - Introduction to manufacture of automobile components material selection and foundry pattern making. Production of Cylinder block, Cylinder head, wet and dry liners, engine head, oil pan, carburetors, piston and piston rings and testing. Thermal barrier coating of Engine head and valves.

Learning outcomes

At the end of this UNIT, the student will be able to

- understand the suitable materials for casting of automobile components (L2).
- able to define the sequence of operations for production of automobile components (L2).
- apply the required pattern allowances as per components requirements (L3).

UNIT II **8 L**

Forged Engine Components: Material selection and manufacturing methods of automobile components using forging and metal working process. Different process of steels making and machine forging. Production of Crank shaft, Connecting rod, Cam shaft, valve, Piston pin, Push rod, Rocker arm, tappets, spark plug.

Learning outcomes

At the end of this UNIT, the student will be able to

- understand the suitable materials for forging of engine components (L2).

- apply different processes of steel making used in manufacture of automotive components (L3).
- apply the machine forging methods for production of specific parts (L3).

UNIT III **10 L**

Transmission System - Material selection and Manufacturing methods for Clutch – Clutch lining – Gear Box – Gear – Propeller Shaft – Differential – Axle Shaft – Bearing – fasteners – Wheel drum. Methods of Gear manufacture – Gear hobbing and gear shaping machines – gear generation – gear finishing and shaving – Grinding and lapping of hobs and shaping cutters – gear honing – gear broaching.

Learning outcomes

At the end of this UNIT, the student will be able to

- Understand the suitable materials for elements of transmission system (L2).
- Create models for Clutch – Clutch lining – Gear Box – Gear – Propeller Shaft – Differential – Axle Shaft – Bearing – fasteners – Wheel drum to select appropriate manufacturing methods (L6).

UNIT IV **8 L**

Vehicle Chassis - Material selection and manufacturing methods for chassis, dead axle, leaf spring, coil spring and shock absorbers – wheel housing – steering system, Brake shoes, wheel rim, Tyres. Heat treatment procedures.

Learning outcomes

At the end of this UNIT, the student will be able to

- understand vehicle chassis configuration, structures, basic components, materials and manufacturing methods (L2).
- apply and demonstrate the need for heat treatment procedures in production of chassis (L3).

UNIT V **10 L**

Recent Developments - Surface treatment – Plastics – Plastics in Automobile vehicles – Processing of plastics – Emission control system – catalytic converter – Hydro forming of exhaust manifold and lamp housing – stretch forming of Auto body panels – MMC liners –Selection of materials for Auto components. Use of Robots in Body weldment.

Learning outcomes

At the end of this UNIT, the student will be able to

- analyze the importance of Surface treatment (L4).
- evaluate the usage of Emission control system (L5).

Course Outcomes

After completing the course for a given automotive components Student will be able to

- remember the concepts and methods for manufacturing automobile materials and components. L1.
- understand the proper sequence of manufacturing process and produce them.L2
- apply the basic principle and production methods of automotive components. L3
- analyze different areas of automobile materials and manufacturing. L4
- Evaluate the suitability of manufacturing materials for automobile components. L5
- Create applications of all the areas in day to day life.L6

Text Book(s):

1. Heldt.P.M, “High speed combustion engines”, Oxford publishing Co., New York, 1990.
2. SeropeKalpakjian and Steven R. Schmid, “Manufacturing Processes for Engineering Materials”, Fourth Edition, Pearson Education publications – 2003

References:

1. Kirpal Singh, ‘Automobile Engineering”, Vol. I & II, Standard Publishers, New Delhi, 1997.
Newton and steels, the motor vehicle, ELBS, 1990
1. Gupta K.M. “Automobile Engineering” Vol.I& II, Umesh Publishers, 2000.

19EME370: NON-DESTRUCTIVE TESTING

L	T	P	C
3	0	0	3

This course is very helpful for real time evaluation of both surface and volume defects generated in materials either during manufacturing process or while in service life. A student can get acquainted or trained on certain set of NDT testing Principle and Method those are popularly being practiced by Production Industry. In addition to some basic techniques on NDT, advanced technology in this field can be practiced by the student.

Course Objective:

- Explains the concept of detecting defects in material without damaging the structure.
- Understanding special techniques to detect micro-cracks responsible for fatigue failure.
- Learning of detecting volumetric defects within materials by using magnetic and ultrasonic method.
- Understanding certain advanced NDT technique using concept of Eddy current, Thermal Infrared and Acoustic techniques.

UNIT I **8 L**

Introduction to NDT: Introduction, non-destructive versus destructive tests, conditions for effective non-destructive testing, personnel consideration, certification summary
Discontinuities Origins and Classification: Primary production of metals, castings, cracks, welding discontinuities, discontinuities from plastic deformation, corrosion – induced discontinuities, operationally induced discontinuities, fatigue cracking, creep, brittle fracture, geometric discontinuities

Learning Outcomes:
- Understands the technique of Destructive and Non-destructive technique.**[L-1]**
- Recognizes the conditions for NDT testing. **[L-2]**
- Learns the technique of finding surface defect during welding, casting and corrosion etc. **[L-1]**

UNIT II **9 L**

Penetrant Testing and Magnetic Particle Testing: Penetrant testing: Introduction, theory and principles, penetrant equipment and materials, penetrant procedures, penetrant procedures, techniques and variables, evaluation and disposition, penetrant testing applications. Magnetic Particle Testing: Introduction, theory and principles, equipment and accessories, techniques, variables, evaluation of test results and reporting, applications.

Learning Outcomes:
- Understanding of theory of penetrating test. **[L-1]**
- Uses of Equipment related to penetration test. **[L-2]**

- Learns the concept of Magnetic Particle testing. **[L-3]**

UNIT III **9 L**

Radiography Testing and Radiation Safety: Introduction, theory and principles, geometric exposure principles, shadow formation, shadow sharpness, radiographic equipment and accessories, variables, techniques and procedures, radiographic evaluation, applications, compendium of radiographs.
Radiation Safety: Special and SI UNITs of radiation, principles of radiation detectors – ionization chamber, proportional counter, G.M. counters, scintillation counters, solid state detectors, biological effect of ionizing radiation, operational limits of exposures, radiation hazards evaluation and control, design of radiography installation and shielding calculations.

Learning Outcomes:

- Explains the concept of Radiography technique. **[L-1]**
- Understand the experimental use of Radiography Testing. **[L-2]**
- Learns the Safety aspect of Radiation safety. **[L-3]**

UNIT IV **8 L**

Ultrasonic Testing: Introduction, theory and principles, equipment for ultrasonic applications, techniques, variables, evaluation of test results, applications, basic instrument calibration, calibration blocks (IIW block, ASTM blocks, distance amplitude block, area amplitude block), cables, 157 connectors, test specimens. Reference reflectors for calibration (side drilled holes, notches, etc.,), inspection calibration, comparison with reference blocks, reference for planned tests (straight beams, angle beam), transmission factors – factors affecting the performance of ultrasonic test.

Learning Outcomes:

- Understanding the concepts of Ultrasonic methods in testing. **[L-1]**
- Explains the calibration technique of equipment related to Ultrasonic testing. **[L-1]**
- Assessing factors responsible for the performance of Ultrasonic test. **[L-3]**

UNIT V **8 L**

Other NDT Techniques: Eddy current testing; Introduction, theory and principles, alternating current principles, eddy current, test equipments, eddy current applications and signal display, advantages and limitations
Thermal Infrared Testing: Introduction, theory and principles, equipment and accessories, techniques, variables, data storage, applications, advantages and limitations, thermal chalks
Acoustic Emission Testing: Introduction, principles of acoustic emission testing, advantages and limitations of acoustic emission testing.

Learning Outcomes:

- Understands the concept of Eddy current technique for detecting defect. **[L-1]**
- Learns the theory of Thermal Infrared Testing. **[L-1]**
- Explains the concept of Acoustic Emission Testing. **[L-1]**

Text Book(s)

1. J. Prasad and C. G. K. Nair, Non-Destructive Test and Evaluation of Materials, 2/e, Tata McGraw Hill, 2011.

References

1. C. Hellier, Handbook of Non-Destructive Evaluation, 1/e, McGraw Hill Professional, 2001. 2. B. Raj, T. Jayakumar and M. Thavasimuthu, Practical Non Destructive Testing, 3/e, Alpha Science International, 2002.

2. Non-Destructive Examination and Quality Control, 9/e, ASM

19EME372: TRIBOLOGY

L	T	P	C
3	0	0	3

Tribology is an interdisciplinary subject which deals with the science of friction, wear and lubrication. This subject focuses on the interaction of moving surfaces, with emphasis on every aspect related to friction, wear and wear mechanisms, lubrication and lubricants, and adhesion etc. This course aims to provide the student with the fundamentals, ***the applications in modern machinery for designing, manufacturing and exploration for new and better products.***

Course Objectives:

- To introduce basics of tribology and wear.
- To explain the importance of lubrication.
- To describe various wear mechanisms.
- To introduce the Reynolds equation with compressible & incompressible lubricants
- To familiarize different applications of tribology.

UNIT-I **8 L**

Introduction to tribology, history of tribology, friction- causes of friction, adhesion theory, abrasive theory, junction growth theory, laws of rolling friction, friction instability.

Learning outcomes:

After completion of this UNIT, students will be able to

- **Introduce the students to the field of tribology (L1)**
- understand the importance of tribology in engineering applications. **(L1)**
- identify causes of friction **and explain laws of friction (L2)**

UNIT-II **8 L**

Wear- Wear Mechanisms, adhesive wear, abrasive wear, corrosive wear, fretting wear, wear analysis.

Learning outcomes:

After completion of this UNIT, students will be able to

- **learn basic understanding of wear processes (L2)**
- explain different wear mechanisms **(L2)**
- analyze the type of wear **(L3)**

UNIT-III **8 L**

Lubrication and Lubricants- **-** Importance of lubrication, boundary lubrication, mixed lubrication, Hydrodynamic Lubrication.

Learning outcomes:

After completion of this UNIT, students will be able to

- contrast between thick & thin lubrications **(L2)**
- understand the importance of lubrication **(L2)**
- explain mixed and hydrodynamic lubrication **(L2)**

UNIT-IV **8 L**

Fluid film lubrication- Fluid mechanics concepts, equation of continuity & motion, generalized Reynolds equation with compressible & incompressible lubricants

Learning outcomes:

After completion of this UNIT, students will be able to

- identify different fluid film lubrication **(L2)**
- explain fluid film lubrication between two plates **(L1)**

UNIT-V **8 L**

Application of tribology- Introduction, rolling contact bearings, gears, journal bearings - Finite bearings.

Learning outcomes:

After completion of this UNIT, students will be able to

- explain rolling contact type motions with deformation at contact **(L2)**
- **Ability to analyze and design** journal bearings **(L3)**

Course Outcomes:

At the end of the course the students will be able to

- Understand the concept of friction, lubrication and wear. **(L2)**
- Understand the importance of lubrication for various applications. **(L2)**
- Identify different wear mechanisms**.(L2)**
- Analyze the various lubrication regimes of of tribology. **(L4)**

Text Book(s):

1. Stachowiak and Batchelor, Engineering Tribology, 4th edition, Butterworth – Heinimann, 2013
2. Kenneth C Ludema, Friction. Wear, Lubrication : A Text book in Tribology, 2nd edition, CRC Press, 2018.

References:

1. D. Dowson, History of Tribology, Wiley, 1998.
2. G.N. Stachowiak, A.W. Batchelor and G.B. Stachowick, Experimental methods in Tribology, Elsevier Science, 2004.
3. Michael M Khonsari, Applied Tribology (Bearing Design and Lubrication), John Wiley & Sons, 2001.
4. B.C. Majumdar, Introduction to Tribology of Bearings, Kindle Edition, S. Chand, 2010.
5. John Williams, Engineering Tribology, Cambridge University Press, 2005

19EME374: DESIGN FOR MANUFACTURING AND ASSEMBLY

L	T	P	C
3	0	0	3

This course deals with various types of materials, classification, suitable materials for product design, general design considerations and design recommendations for different casting, forging, machining processes, metal joining and assembles.

Course Objectives

- To explain the concept and applications of design for manufacturing and assemble and selection of processes, materials, developments in material.
- To familiarize the manufacturing processes characteristics and general design considerations.
- To expose general design considerations of sand casting and forging.
- To explain the design for machining, materials for machinability and design recommendations of round holes, broached parts.
- To impart knowledge on design guidelines for metal joining and compliance analysis and interference analysis for the design of assembly.

UNIT I **8 L**

Introduction of DFMA: History of DFMA, Steps for applying DFMA during product design, Advantages of applying DFMA during product design, Reasons for not implementing DFMA, General design rules for manufacturability.
Materials: Selection and criteria of materials for design – systematic selection of processes and materials, developments in material, process selection charts (SHBY charts).

Learning Outcomes:

At the end of this UNIT, the student will be able to

- understand the concepts of design for manufacturing and assemble and general design rules for manufacturability.(L1)
- comprehend the concept of selection of processes, materials and developments in material.(L2)

UNIT II **10 L**

Introduction to Manufacturing Process: Overview of manufacturing processes, general design rules for machining - dimensional tolerance and surface roughness – design for machining – ease – redesigning of components for machining ease with suitable examples, general design recommendations for machined parts.
General design considerations: Specific design recommendation, Injection moulding-Introduction, typical characteristics of injection molded parts, Effect of shrinkage, Suitable materials, Design recommendations for powder metal processing-Introduction, typical characteristics and applications, Limitations.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- understand the overview of manufacturing processes and general design rules for machining. (L1)
- analyze the design considerations and characteristics. (L4)

UNIT III **12 L**

Casting: Overview of various casting processes, selection of casting process, - general design considerations for casting – casting tolerances – use of solidification simulation in casting design.
Sand casting: Introduction to sand casting, Typical characteristics of a sand cast part, Design recommendation for sand casting, Investment casting: Introduction, Steps in investment casting, Design consideration of Investment casting, Typical characteristics and applications, Die casting: Introduction to die casting, Advantages of the die casting process, Disadvantages of the die casting process, Applications, Suitable material consideration.
Forging: Design factors for forging – closed die forging design, parting lines of dies, drop forging die design – general design recommendations.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- explain various casting, sand casting and forging processes. L2
- analyze the design recommendation for sand casting and special casting processes.(L4)
- analyze the design factors and general design recommendations for forging. (L4)

UNIT IV **10 L**

Design for machining: Introduction to machining, Recommended materials for machinability, Design recommendations, Design for tuning operation: Process description, Typical characteristics and applications, Suitable materials, Design recommendations,
Design for machining round holes: Introduction, Suitable materials, Design recommendations, Recommended tolerances, Parts produced by milling: Process description, Characteristics and applications of parts produced on milling machines, Design recommendations for milling, Dimensional factors and tolerances, Parts produced by planning, shaping and slotting: Process description, Design recommendation planning,
Design for broached parts: Process description, typical characteristics of broached parts, Suitable materials for broaching, Design recommendations.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- understand the concept of design for machining and materials for machinability (L2).
- comprehend the overview of materials and design recommendations for machining round holes and broached parts. (L2)

UNIT V **10 L**

Metal joining: Appraisal of various welding processes, factors in design of weldments – general design guidelines – pre and post treatment of welds – effects of thermal stresses in weld joints – design of brazed joints.
Assembly: Choice of Assembly method, Compliance analysis and interference analysis for the design of assembly – design and development of features for automatic assembly – liaison diagrams. Assembly process-characteristics and applications, Example of common assembly, Economic significance of assembly, General taxonomies of assembly operation and systems, Assembling a product, Design guidelines for Manual assembly and analysis of an assembly, classification system for manual handling, Manual insertion and Fastening.

Learning Outcomes:

At the end of this UNIT, the student will be able to
- understand the concept of various metal joining processes and general design guidelines. (L2)
- comprehend the choice of assembly method and design guidelines for manual assembly and analysis of an assembly. (L2)

Course Outcomes:

Upon successful completion of the course, the students will be able to:
- Outline the appropriate design for manufacturing concept for effective product development and select the materials. (L2)
- Apply a systematic understanding of knowledge in the field of casting and forging. (L4)
- Select between various machining and formulate appropriate design rules in machining (L2).
- Integrate the knowledge of compliance analysis and interference analysis for assembly and propose manual and automated assembly sequences using appropriate design rules. (L4)

Text Book(s):

1. A K Chitale and R C Gupta, Product Design and Manufacturing, Prentice Hall of India, New Delhi, 2003.
2. Geoffrey Boothroyd, Dewhurst P and Knight W, Product design for manufacture and assembly, CRC press, 2002.

References

1. George E. Dieter, Engineering Design - A material processing approach, 5/e, McGraw Hill International, 2003.
2. ASM Handbook, Design for manufacture, 2000.
3. M F Ashby and K Johnson, Materials and Design - the art and science of material selection in product design, Butterworth-Heinemann, 2003.
4. K G Swift and J D Booker, Process selection: from design to manufacture, London: Arnold, 1997.

19EME376: INVENTORY CONTROL

L	T	P	C
3	0	0	3

The course exposes the students to understand the concepts of Supply chain, manufacturing planning and Control systems. It mainly focuses on the inventory management very much essential for the students who work with the industries in the future and familiarizes the inventory management techniques.

Course Objectives:

- To explain the fundamental concepts of materials management.
- To familiarizes the basic inventory control systems.
- To compare different manufacturing operations in a firm
- To select the best combination of materials-handling and storage equipment.

UNIT- I **8 L**

Introduction: Operating Environment. Supply Chain Concept, Material Flow, Supply Chain Metrics.
Production Planning System: Manufacturing Planning and Control System. Sales and Operations Planning, Manufacturing Resource Planning. Enterprise Resource Planning. Making the Production Plan.

Learning Outcomes:

After completing this UNIT, the student will be able to

- apply logistics and purchasing concepts to improve supply chain operations**[L3]**
- evaluate complex qualitative and quantitative data to support strategic and operational decisions.**[L4]**
- analyzesystematic planning of production activities to achieve the highest efficiency in production of goods/services**. [L4]**

UNIT II **8 L**

Inventory Fundamentals: Aggregate Inventory Management, Item Inventory Management, Inventory and Flow of Material, Supply and Demand Patterns, Functions of Inventories,Objectives of Inventory Management, Inventory Costs, Financial Statements and Inventory, ABC Inventory Control.
Order Quantities: Economic Order Quantity (EOQ), Variations of EOQ Model. QuantityDiscounts, Use of EOQ when Costs are not known, Period Order Quantity (POQ).

Learning Outcomes:

After completing this UNIT, the student will be able to

- identify the role of information technology in managing inventories. **[L2]**
- categorize the ABC analysis of inventory items**[L4]**
- describe the continuous or periodic review inventory-control system. **[L1]**

UNIT III **8 L**

Independent Demand Ordering Systems: Order Point System, Determining Safety Stock. Determining Service Levels, Different Forecast and Lead Time Intervals, Determining when Order Point is reached, Periodic Review System, Distribution Inventory.

Learning Outcomes:

After completing this UNIT, the student will be able to

- determine differentinventory performance measures and relevant costs **[L3]**
- analyze thewarehouse/Distribution Centre Management**[L4]**
- apply quality management tools for process improvement**[L3]**

UNIT IV **6 L**

Purchasing: Establishing Specifications, Functional Specification Description, Selecting Suppliers, Price Determination, Impact of MRP on Purchasing, Organizational Implications of SCM.

Learning Outcomes:

After completing this UNIT, the student will be able to

- apply the sales and operations planning, MRP and lean manufacturing concepts**[L3]**
- examine the methods used by organizations to obtain the right quantities of stock or inventory, **[L1]**

UNIT V **8 L**

Physical Inventory and Warehouse Management: Warehousing Management, Physical Control and Security, Inventory Record and Accuracy.
Physical Distribution: Physical Distribution System, Interfaces, Transportation. Legal Types of Carriage. Transportation Cost Elements, Warehousing, Packaging, Materials Handling. Multi-Warehouse Systems.

Learning Outcomes:

After completing this UNIT, the student will be able to

- familiarize themselves with inventory management practices. **[L2]**

- assess the different levels of transportation costs, warehouse utilization metrics and productivity improvement methods**[L4]**

Course Outcomes:

Upon successful completion of the course, the students will be able to

- analyze systematic planning of production activities to achieve the highest efficiency in production of goods/services. **[L4]**
- evaluate problems pertaining to inventory by choosing right models**.[L4]**
- identify different inventory models to reduce inventories costs in real life situations.**[L2]**
- compute the problems in price discounts and multi-level inventory also**[L3]**
- apply latest emerging concepts like ABC and MRP for business organizations.**[L4]**

Textbook:

1. Steve Chapman & Tony Arnold, Introduction to Materials Management, 7Th edition, Pearson,2016.
2. P Gopalakrishnan& M Sundaresan, Materials Management: An Integrated Approach,18th Printing, PHI, 2012.

References:

1. A K Dutta, Materials Management: Procedures, Text and Cases, 2nd edition, PHI, 2009.
2. S D Sharma, Operations Research, 4th edition, 2009.
3. KantiSwarup, PK Gupta & Man Mohan, Operations Research, S Chand, 2014.

19EME378: PLANT LAYOUT AND FACILITIES PLANNING

L	T	P	C
3	0	0	3

The workspace is one of the main resources to deliver products/services with the expected level of quality with minimum cost. To achieve the organizational effectiveness and efficiency proper utilization of the workspace has to be ensured. This course has been designed to highlight the basic issues, concepts and the techniques related to Plant layout and assembly lines.

Course Objectives:

- To impart knowledge on plant layout and plant location Theories.
- To understand and introduce SLP procedure for plant layout preparation.
- To learn the basics of material handling techniques.
- To understand the line balancing techniques and labour optimization in industry.

UNIT –I **8 L**

Plant Engineering: Plant Layout, Introduction, Types of Plant Layout, Phases of Layout Planning, Plant Location, Urban v/s Rural Location, Single facility location problems, Multi facility location Problems.

Learning Outcomes:
After completing this UNIT, the student will be able to
- familiarize the characteristics of product, process layouts. **[L1]**
- expose various factors those influence the location of a plant in urban vs rural area. **[L3]**
- know different phases of layout planning. **[L2]**
- study a facility location problem for single and multiple facilities. **[L2]**

UNIT-II **10 L**

Systematic Layout Planning: P-Q Analysis, Flow of Materials Analysis, Activity Relationship Analysis, Space Requirements & Availability, Modifying Considerations, Practical Limitations, Selection of Layout, Installation of Layout, CORELAP, CRAFT, ALDEP Algorithms Procedure and application, Problems.

Learning Outcomes:

After completing this UNIT, the student will be able to
- study the material flows in a manufacturing industry. **[L2]**
- adapt the knowledge in REL chart. **[L4]**
- employ various computer algorithms in designing a layout. **[L3]**
- teach the students for selecting a layout process**. [L3]**

UNIT–III **8 L**

Material Handling: Functions, Principles of Material Handling, MH Equipment-Conveyors, MH Equipment-Cranes, MH Equipment-Trucks, Systematic Handling Analysis, Classification of Materials.

Learning Outcomes:

After completing this UNIT, the student will be able to

- familiarize various functions and principles of material handling systems. **[L1]**
- introduce various MH equipment used in the manufacturing industry. **[L1]**
- expose various materials used in a manufacturing industry. **[L3]**
- enumerate some numerical problems for selection of MH equipment for a given material. **[L1]**

UNIT–IV **8 L**

Mass Production Management (Line Balancing): Basic idea of assembly line balancing, Optimization of number of stations with given production rate, Minimization of cycle time with fixed number of stations.

Learning Outcomes:

After completing this UNIT, the student will be able to

- learn the concept of line balancing in an assembling a product. **[L1]**
- acquaint knowledge in minimum number of work stations in a production line. **[L1]**
- solve numerical problems in calculating the minimum cycle time of an assembly line**.[L3]**
- Recognize the importance of assembly line balancing through a case study. **[L1]**

UNIT –V **8 L**

Line Balancing Algorithms: Kilbridge and Wester, Rank Positional Weight method, COMSOAL, Moodie and Young method.

Learning Outcomes:

After completing this UNIT, the student will be able to

- evaluate algorithmic approach to balance the assembly line. **[L5]**
- explain various methods for assembly line balancing in the mass production. **[L2]**
- examine existing software methods for solving assembly line problems. **[L4]**
- solve a practical line balancing problems through research papers. **[L3]**

Course Outcomes:

At the end of the course the student will be able

- effectively design and analyze facility layouts. **[L4]**

- apply and evaluate appropriate facility location models. **[L3]**
- design, measure, and analyze material flow systems. **[L6]**
- apply algorithms for layout Preparation. **[L3]**
- apply algorithms for line balancing**[L3]**

Text Book(s)

1. R.L Francis and J.A White, Facilities layout and location-An analytical approach, Prentice Hall, 1992.
2. R. Panneerselvam, Production and operations management,3rd Edition, Prentice Hall Inc, 2012.

Reference:

1. J.M. Apple, Plant Layout and Material Handling, McGraw Hill, 1972.
2. P. Rama Murthy, Production and operations management, 2nd Edition, New Age International, 2006.

19 EME380 ALTERNATIVE FUELS AND ENVIRONMENTAL POLLUTION CONTROL

L	T	P	C
3	0	0	3

The course exposes the students to understand the concepts of different types of fuels and their properties. It mainly focuses on the mechanics of pollution formation which is very much essential for the students who work for the Automobile sector in the future and familiarizes the pollution control techniques.

Course Objectives:

The course provides detailed understanding of

- Different fuels and their properties
- Different Testing methods of fuels
- Factors responsible for the emissions and the methods to measure and control.

UNIT-I

Solid Fuels: classification of fuels – Conventional and Unconventional Solid, Liquid, gaseous fuels, and nuclear fuels. Coal – Carburisation, Gasification and liquification – properties of coal, efficient use of solid fuels, solid fuel handling and storage.

Liquid Fuels : Alcohols as fuels, Bio-diesel production from Vegetable oils and waste cooking oil, Blends, Fuel modifications to suit SI and CI engines, Ignition accelerators and other additives-Storage and Safety

Learning Outcomes:

After completing this unit, the student will be able to

- Understand different types of solid and liquid fuels.
- familiarize various production process.
- Acquire knowledge of different fuel additves

UNIT-II

Gaseous Fuels

Natural Gas, LPG, Hydrogen, CNG and Biogas: Availability, properties, modification required to use in engines, admission of gaseous fuels like Hydrogen, CNG, LPG, Natural Gas, Producer gas and Bio gas in engines– Safety Precautions, storage and handling, performance and emissions.

Learning Outcomes:

After completing this unit, the student will be able to

- Acquire knowledge of different gaseous fuels.

- Understand admission of gaseous fuel in engine.
- familiarize various safety and handling techniques.

UNIT-III

Properties and testing of fuels: Required properties of fuels-biofuels and their importance in the context of IC Engines. Testing of fuels for their properties -Acid number- base number, Sulphur content, Flash point -fire point, cloud -pour point, corrosion resistance, Oxidation stability- viscosity -viscosity index, carbon residue – cetane number-cetane index

Learning Outcomes:

After completing this unit, the student will be able to

- adapt the knowledge of properties of fuels.
- learn the concept of testing different fuels.

UNIT-IV

Emission formation

Pollution formation in SI and CI engines - Factors affecting emissions -Formation of NO and NO2 in Engines, Formation of CO, Flame quenching in SI engines. Unburned HC formation in SI engines, crevice HC, oil film HC and other sources, soot formation, Instrumentation to measure pollutants, Trends in vehicle emission standards, emission limits,

Learning Outcomes:

After completing this unit, the student will be able to

- familiarize themselves with factors effecting formation of emissions.
- identify causes of emissions
- learn the concept of measuring pollutants

UNIT-V

Environmental Pollution:

control of emissions inside the engine: EGR, crankcase evaporative emission control.

control of emissions outside the engine- Exhaust gas after treatment, Thermal and catalytic reactors, Elements of catalytic reactors, catalysts, and substrates. Oxidation, reduction and 3-waycatalytic reactors, catalyst deactivation mechanism, cold start HC control, Lean de-NOx catalysts, NOx traps and SCR.

Learning Outcomes:

After completing this unit, the student will be able to

Understand the method to control emissions inside the engine.

Acquire knowledge of controlling emissions outside the engines.

Course Outcomes:

The students completing the course will be able to

- understand the various kinds of fuels, their characteristics.
- Acquire knowledge about testing of fuels.
- student will be enriched with enough knowledge to understand the formation of pollution.
- learn the concept to control pollution

TEXT BOOKS:

1. B. P. Pundir, Engine Emissions: Pollutant Formation and Advances in Control Technology, Narosa Publishing House, New Delhi, 2007.

2.Alternate Fuels – Dr. S. S. Thipse – Jaico Publications

3.Osamu Hi rao and Richard K.Pefley, Present and Future Automotive Fuels, John Wiley and Sons, 1988.

4. Keith Owen and Trevor Eoley, Automotive Fuels Handbook, SAE Publications, 1990. Handbook of Air Pollution from Internal Combustion Engines: Pollutant Formation and Control, Ed. Eran Sher, Academic Press, 1998.

REFERENCE BOOKS:

1. Richard L.Bechtold, Automotive Fuels Guide Book, SAE Publications, 1997.

OPEN ELECTIVES-II
19EOE302: GERMAN FOR BEGINNERS

L	T	P	C
3	0	0	3

UNIT I **9 L**

Introduction to the German language, grammar and pronunciation. Lan-guage: Greetings; Introducing oneself, asking the way, giving directions. Grammar: The nouns, gender distinctions, cases, definite and indefinite articles. Pronunciation: Vowels.

UNIT II **8 L**

Language: Asking for and giving information; Discussing home and the household. Grammar: Conjugation of verbs, verbs with separable and inseparable prefixes, modal verbs. Pronunciation: Vowels.

UNIT III **8 L**

Language: Describing people and their qualities, describing shape, size and colour of objects. Grammar: Personal pronouns, possessive pronouns, reflexive pronouns. Pronunciation: Consonants.

UNIT IV **8 L**

Language: The Working World: Returning faulty goods to a shop, asking someone to repeat something; Refusing or declining politely. Grammar: Cases: nominative, accusative, dative. Pronunciation: Diphthongs.

UNIT V **9 L**

Language: Making Comments and Suggestions: Asking for and giving opinions. Grammar: Structure of sentence and categories of sentences; subordinate clause - causative and conditional sentences. Pronunciation: Umlaut.

References:

1. Deutsch als Fremdsprache IA Grundkurs
2. Ultimate German Beginner - Intermediate (Coursebook), Living Language, 2004.

19EOE304: CHINESE FOR BEGINNERS

L	T	P	C
3	0	0	3

UNIT I **9 L**

Introduction to the Chinese language and pronunciation system; Tones; Chinese numbers; Language: Saying hello, greetings. Pronunciation: Initials: b p m n l h; Finals: a o e I u ü / ao en ie in ing uo; First tone.

UNIT II **8 L**

Language: Asking what someone wants; Identifying people; Asking someone's name and nationality Grammar: Word order in Chinese sen-tence. Pronunciation: Initials: d t g k f; Finals: ei ou an ang eng iao iou(iu); Second tone.

UNIT III **8 L**

Language: Introducing oneself; Asking for permission. Grammar: Sentence with an adjectival predicate; "Yes-no" question. Pronunciation: Initials: zh ch sh r; Finals : -I / ai uai ong; Third tone.

UNIT IV **8 L**

Language: Introducing oneself; Asking for permission. Grammar: Ques-tions with an interrogative pronoun. Pronunciation: Initials: j q x; Finals: ia ian iang / uei(-ui) uen(-un) üe üan; Fourth tone.

UNIT V **9 L**

Language: Making comments and suggestions; Asking someone to repeat something; Refusing or declining politely. Grammar: Sentences with a verbal predicate. Pronunciation: Initials: z c s; Finals:-i er iong ua uan uang ün; Neutral tone; Retroflex ending.
*The course will focus on the pronunciation system, the introduction of common Chinese expressions and every-day phrases in the context of communicative activities.

References:

1. Liu, Yuehua, Integrated Chinese: Simplified Characters Textbook, Level 1, Part 1. Cheng and Tsui Company, Inc. Boston, 2008.

19EOE306: ANALYTICAL ESSAY WRITING

L	T	P	C
3	0	0	3

UNIT I **9 L**

Mechanics of Essay Writing: Framework of an essay, introduction, hypothesis/statement of claim, body-claims and counter claims, refuting or disproving the opposing position with reasons and examples, providing evidence and examples that prove or support one's claim, conclusion-restatement of the claim and summary of the main ideas, paragraphing, discourse markers.

UNIT II **9 L**

Analyzing an Argument: Terms and definitions, statement, argument, claim, truth value, premise, identifying premises and claims/conclusions, strengths and weaknesses of an argument, discussion on the validity of a claim, scope for counter-argument if any, critiquing an argument.

UNIT III **8 L**

Analyzing an Issue: An issue statement or statements followed by specifictask instructions, discussing the extent to which one agrees or disagrees with the statement, rationale for the position one takes, developing and supporting one's position, discussion on the validity of the given statement/ claim, addressing the different views that are presented, remaining unbi-ased in assessing a claim, taking a stand and justifying it, writing a re-sponse.

UNIT IV **9 L**

Writing an Argumentative Essay on a Topic of Contemporary Inter-est: Planning, writing and revising, clear, concise and defined thesis state-ment that occurs in the introduction, clear and logical transitions. BodyParagraphs that include Evidential Support (factual, logical, statisticalor anecdotal), conclusion that does not simply restate the thesis, but re-addresses it in light of the evidence provided.

UNIT V **7 L**

Peer Review: Preparing a template for peer review that is derived fromthe response rubric given to the student and assessment rubric used for evaluation, formulating and communicating constructive feedback on a peer's work, responding to feedback on one's work, checklist for peer review-lead strategy use in the introduction, thesis statement, supporting details given in the body, the writer's acknowledgement of a counterargument and his/her response to it, closing strategy used in the conclusion.

References:

1. Bailey S., Academic Writing: A Handbook for International Students, Routledge, London and NewYork, 2001.
2. Jordan R.R., Academic Writing Course, Nelson/Longman, London, 1999.
3. Hamp-Lyons L., Heasley B., Study Writing, Cambridge University Press, 2006.

19EOE308: INDIAN ECONOMY

L	T	P	C
3	**0**	**0**	**3**

UNIT I **9 L**

Structure of Indian Economy: Meaning of economic growth and development, features of Indian economy, changing structure of Indian economy, trends in national income, sources of growth, agriculture, industry and service sectors.

UNIT II **8 L**

Demography, Poverty and Unemployment in India: Demography: Population size and growth rates, age and gender distribution, trends of urban-ization, occupational distribution of labour force. Poverty: Nature of poverty causes for poverty, measures to eradicate poverty. Unemployment: Nature and types of unemployment, causes for unemployment, remedial measures of unemployment.

UNIT III **8 L**

Public Finance: Sources of government revenue, Indian tax structure, directand indirect taxes, composition of the government expenditure, role of monetary and fiscal policies, federal finance in India, 14th finance com-mission.

UNIT IV **8 L**

Foreign Trade: Importance, composition and direction of foreign trade,foreign direct investment, BoPs equilibrium, Foreign Exchange Manage-ment Act (FEMA).

UNIT V **8 L**

Economic Reforms in India: Industrial policy 1991, economic reforms, liberalization, privatization, and globalization.

Text Book(s)

1. V. K. Puri, S.K. Misra, Indian Economy, 31/e, Himalaya Publishing House, 2014.

References

1. R.C. Dutt, K.P.M. Sundaram, Indian Economy, S. Chand and Company, 2010.
2. A. N. Agarwal, Indian Economy, New Age International Limited, 2012.
3. I.C Dhingra, Indian Economy, Sultan Chand and Company, 2007.

19EOE310: PUBLIC ADMINISTRATION

L	T	P	C
3	0	0	3

UNIT I **10 L**

Introduction: Meaning, scope and significance of public administration, evolution of the discipline and its present status, challenges of liberalisation, privatization and globalization, good governance, electronic governance-concepts and applications, New Public Management (NPM).

UNIT II **8 L**

Administrative Thought: Scientific management theory, classical theory, bureaucratic theory, human relations theory, system theory.

UNIT III **8 L**

Accountability and Control: Legislative, executive and judicial controlover administration, role of media, interest groups, NGOs, civil society, Right to Information Act (RTI), social audit, citizen chapters.

UNIT IV **8 L**

Union and State Governments Administration: President, prime min-ister, council of ministers, cabinet, central and state secretariats, boards and commissions, governor, chief minister and council of ministers, cen-tral- state relations, finance commission, Neeti ayog.

UNIT V **8 L**

Civil Services: Recruitment, training and other condition of services, districtadministration, role of collector, local self governing institutes-73rd and 74th constitutional amendments act.

Text Book(s):

1. Avasti, Maheswari, Public Administration, 31/e, Lakshmi Narain Agarwal Book(s), India, 2014.
2. B. L. Fadia, Kuldeep Fadia, Indian Administration, 8/e, Sahitya Bhawan, India, 2014.

References:

1. Nicholas Henry, Public Administration and Public Affairs, 21/e, Prentice Hall of India, 2012.
2. D. Ravindra Prasad, V. Sivalinga Prasad, P. Satyanarayana, Administrative Thinkers, 2/e, Sterling Publishers, 1991.
3. D. D. Basu, Introduction to the Indian Constitution, 21/e, Lexis Nexis Butterworths, Wadhwa Nagpur, 2013.
4. Ramesh K. Arora, Rajni Goyal, Indian Public Administration, 3/e, New Age International Publishers, India, 1995.

19EOE 312: ENVIRONMENTAL MANAGEMENT

L	T	P	C
3	0	0	3

UNIT I

Green Building Technology

Introduction to Green Technology-Use of technology towards sustainability. IGBC rating systems, Understanding of green building measures in the areas of Site Preservation, Energy Efficiency, Materials, Water Conservation, Solar Energy- Wind energy- Basic Concepts-Sources and uses .

UNIT II

Biomedical Waste Management

Definition-Sources-Classification of biomedical waste – Objectives of Biomedical waste management-segregation-containers for biomedical waste-Labeling Collection-Transport-Disposal methods.

UNIT III

Environmental Impact Assessment (EIA)

Introduction-Definition-Scope-Objectives of EIA-Basic EIA Principles, Classification of EIA-Life Cycle Assessment-Environmental Policy of India. BASELINE DATA ACQUISITION: Environmental Inventory- Rapid EIA.

UNIT IV

E-Waste management

E-waste : Sources- Types- components; Collection process- Segregation-Disposal methods; Effect on air, water and soil; Health hazards; Role of individual for E-waste management. Current E-waste Management Rules.

UNIT V

Environmental Audit

Introduction- Environmental audit Significance for Industry-Elements of Environmental audit. Process of environmental audit-Pre audit- Activity -Activities at site- Post audit.

Text Book:

1. Juuti, P., Tapio S. K., and Vuorinen H., Environmental History of Water: Global Views on CommUNITy Water Supply and Sanitation, IWA Publishing (Intl Water Assoc), 2007.

2. Rittmann, B.E., and McCarty, P.L., Environmental Biotechnology : Principles and Applications, McGraw Hill, 2001.

References:

1. Reddy, L.N. and Inyang. H. I., Geoenvironmental Engineering –Principles and Applications, Marcel Dekker, Inc., New York., 2000
2. Industrial Wastewater Management, Treatment and Disposal, WEF Manual of practice No. FD-3, 3rd Ed., WEF Press and McGrawHill, 2008

19EOE315: TELECOMMUNICATIONS FOR SOCIETY

L	T	P	C
3	0	0	3

UNIT I **10 L**

Telecommunication Systems: Telephones, Telephone System, Facsimile, Internet Telephony.

UNIT II **10 L**

Cell Phone Technologies: Cellular Telephone Systems, A Cellular Industry Overview, 2G and 3G Digital CellPhone Systems, Long Term Evolutionand 4G Cellular Systems, Base Stations and Small Cells.

UNIT III **10 L**

Wireless Technologies: Wireless LAN, PANs and Bluetooth, ZigBee and Mesh Wireless Networks, WiMAX and Wireless Metropolitan-Area Networks, Infrared Wireless, Radio-Frequency Identification and Near-Field Communications, Ultrawideband Wireless, Additional Wireless Applications.

UNIT IV **10 L**

Optical Communication: Optical Principles, Optical Communication Systems, Fiber-Optic Cables, Optical Transmitters and Receivers, Wavelength-Division Multiplexing, Passive Optical Networks, 40/100-Gbps Networks and Beyond.

UNIT V **10 L**

Satellite Communication: Satellite Orbits, Satellite Communication Systems, Satellite Subsystems, Ground Stations, Satellite Applications, Global Navigation Satellite Systems

Text Book(s):

1. Louis E. Frenzel Jr., Principles of Electronic Communication Systems, 4/e, Mc Graw Hill Publications, McGraw-Hill Education, 2016.

References:

1. Wayne Tomasi, Electronic Communication Systems, 5/e, Pearson Education, 2009.
2. Wayne Tomasi, Advanced Electronic Communication Systems, 4/e, Pearson Education, 2013.
3. Dennis Roddy, Electronic Communications, 4/e, Pearson Education, 2003.

19EOE314: NATIONAL SERVICE SCHEME (NSS)

L	T	P	C
3	0	0	3

UNIT I **8 L**

Introduction and Basic concepts of NSS: History, Philosophy, aims and Objectives of NSS, Emblem, Flag, Motto, Song, Badge etc.; Organizational structure, role and responsibilities of various NSS Functionaries.

UNIT II **8 L**

Regular activities: College campus activities, N.S.S. activities in Urban and Rural areas, NSS Annual Activities Calendar, Suggestive List of Activities, Role of Non-Government Organisation (NGO) in social Reforms i) Red Cross ii) Rotary

UNIT III **8 L**

Special Camp activities: Nature and its objectives : Selection of camp site -Identification of commUNITy problems- physical arrangement- Organization of N.S.S. camp through various committees and discipline in the camp- adaption of village-planning for pre -camp during and post campaigning.
Activities- Activities to be undertaken during the N.S.S. camp- Use of the mass media in the N.S.S. activities

UNIT IV **8 L**

Health, Hygiene and Sanitation: Definition, needs and scope of health education, food and Nutrition, Safe drinking water, Sanitation, Swachh Bharat Abhiyan.
Disaster Management: Introduction to Disaster Management, Classification of Disasters, Role of Youth in Diasters Management, Home nursing , First Aid.
Civil/Self Defense: Civil Defense services, aims and objectives of civil defense, Need for self defence training.

UNIT V **8 L**

Social Project: Problems – Identification - Data Collection- Preparation of a Questionnaire – Schedule – Interview – Observation – Qualitative Research – Quantities Research - Major Findings – Suggestions – Conclusion – Report Writing.

Text Book(s):

1) National Service Scheme Manual (Revised) 2006, Government of India, Ministry of Youth Affairs and Sports, New Delhi.
2) NSS Diaries
3) Sanjay Bhattachaya, Social Work Interventions and Management – Deep and Deep Publications, New Delhi.

19EOE327: PROFESSIONAL COMMUNICATION

L	T	P	C
3	0	0	3

UNIT I **8 L**

Internal Communication: Memo-structure, layout and style, e-mail-structure, style, content and etiquette, notice-structure, content and layout, conducting a meeting, purpose and preparation, drafting agenda and minutes, conducting effective meetings, meeting etiquette.

UNIT II **9 L**

Making a Business Presentation: Planning-define the purpose, analyze audience and occasion, preparation-developing central idea, main ideas, gathering supporting materials, audio-visual aids, organization-introduction, body and conclusion, delivery-addressing the audience, body language, eye contact, use of appropriate language, style and tone.

UNIT III **8 L**

Business Letters: Form and structure, style and tone, letters of enquiry, letters placing orders/ giving instructions/urging action, letters of complaint and adjustment.

UNIT IV **9 L**

Proposals and Reports: Proposals, types, structure, prefatory parts, body of the proposal, supplementary parts, reports, types, informative, analytical, formal/informal, oral/written, individual/group, format and structure.

UNIT V **8 L**

Resume, Cover Letter, Interview and Telephone Etiquette: Resume, design and structure, cover letter, cover letters, accompanying resumes, opening, body, closing; Interview, planning, purpose, pre-interview preparation, conversation, two-way interaction, projecting a positive image, telephone etiquette-guidelines for telephone conversations in a professional context.

References:

1. Seely, John, Oxford Guide to Effective Writing and Speaking, Oxford University Press, India, 2013.
2. Olsen Leslie, Huckin Thomas, Technical Writing and Professional Communication for Non-Native Speakers, McGraw Hill, 1991.
3. Rizvi, M. Ashraf, Effective Technical Communication, Tata McGraw Hill, 2005. 193

19EOE317: ELECTRICAL SAFETY

L	T	P	C
3	0	0	3

UNIT I **8 L**

Basic Concepts

Charge, current, Voltage and Power; Types of supply and applications; various circuit elements, Personal Protective Equipment (PPE), Material Safety Data Sheet (MSDS), HAZOP, VFD

UNIT II **8 L**

Electrical Hazards, Safety Measures and Symbols

Primary and secondary hazards-shocks, burns, scalds, falls-human safety in the use of electricity- first aid-cardio pulmonary resuscitation (CPR).- Safety Measures for operating personal - Safety symbols used in Power control centers and motor control centers

UNIT III **8 L**

Earthing, Electrical Equipment and Cables

Introduction, need for earthing, Static electricity, effects, types of earthing, specifications, earth resistance, earth pit maintenance, Motors-Transformers-Cables: types, color coding, applications.

UNIT IV **8 L**

Hazardous Zones

Classification of hazardous zones-intrinsically safe and explosion proof electrical apparatus-safe equipment-their selection for different zones-temperature classification.

UNIT V **10 L**

Substation, Switch Gear, Supply Changeover, UPS

Voltage levels for distribution and utilization-switchgear and symbols- need for supply changeover-types of changeover-procedure; basics of UPS, MCC (motor control centre), PCC (power control centre), CT, PT, basics of breaker.

Text Book(s):

1. W. Fordham Cooper, "Electrical Safety Engineering", second edition, Butterworth & Co., 1986.
2. Rao S, Electrical Safety, Fire Safety Engineering, Khanna Publications

References:

1. Massimo A.G. Mitolo, “Electrical Safety of Low-Voltage Systems”, Mc Graw Hill, 2009.
2. D.C. Winburn, "Practical Electrical Safety", Marcel Dekker Inc., 1988.
3. Handbook of International Electrical Safety Practices, Princeton energy Resources

19MOE301: BASICS OF FINANCE

UNIT I

Financial Management: An Introduction - Meaning and Definition of financial Management, objectives of Financial Management, Finance Functions, Organization of finance function, functions of finance Manager - Interface between Finance and other business functions.

UNIT II

Sources of finance – classification of sources- security financing – kinds of ownership securities- debentures-bonds- types of bonds -internal financing– loan financing – innovative source of finance- venture capital-seed capital –private equity.

UNIT III

Time value of money – introduction – concept – techniques of time value of money – compounding technique- doubling period-compound value of annuity-discounting or present value of technique – present value of annuity.

UNIT IV

Financing Decisions: Cost of Capital - Cost of Debt, Cost of Preference Shares, Cost of Equity Shares, Cost of Retained Earnings, Weighted Average Cost of Capital.

UNIT V

Working capital management- meaning – concept – components of working capital -factors determining working capital management – operating cycle- determinants of working capital - estimation of working capital management.

Textbook(s):

1. Shashi K. Gupta & R.K. Sharma, "Financial Management –theory and practices" 8th revised edition, 2014, Kalyani Publishers.

REFERENCES (All Latest Editions)

2. Pandey, I. M., "Financial Management", Vikas Publications Print, New Delh, 2012
3. Khan, M. Y., & Jain, P. K., "Financial Management", Tata McGraw Hill, New Delhi, 2012
4. Maheswari, S. N., "Financial Management", Sultan Publications, New Delhi, 2013

JOURNALS

1. Chartered Financial Analyst - ICFAI - Hyderabad
2. Journal of Accounting and Finance - Research Development Association, Jaipur
3. GITAM Journal of Management, GITAM Institute of Management, GITAM University, Visakhapatnam

19LOE301: FUNDAMENTALS OF CYBER LAW

L	T	P	C
3	0	0	3

UNIT-I

Conceptual and theoretical perspectives of Cyber Law - Computer and Web Technology – Evolution of Cyber Law – National &International Perspectivesof Cyber Law - Legal Issues &Challenges in India, USA and EU - Data Protection - Cyber Security, etc.

UNIT-II

International Perspectives - Budapest Convention on Cybercrimes - ICANN’s core principles and the domain names disputes - Net neutrality - EU electronic communications regulatory framework - Web Content Accessibility Guidelines (WCAG).

UNIT-III

Information Technology Act, 2008 as amended - Overview of the Act - Jurisdiction -Electronic Governance - Electronic Evidence (Relevant portions of Indian Evidence Act) - Digital Signature Certificates (DSCs) - Duties of Subscribers of DSCs - Role of DSC Certifying Authorities - The Cyber Regulations Appellate Tribunal - Internet Service Providers and their Liability – Powers of Police - Impact of the Act on other Laws - Social Networking Sites vis-à-vis Human Rights.

UNIT-IV

Cyber Laws vis-à-vis IPRs - Copyright in Information Technology - Software - Copyrights Vs Patents debate - Authorship and Assignment Issues - Copyright in Internet - Multimedia and Copyright issues - Software Piracy - Patents - European Position on Computer related Patents - Legal position of U.S and India on Computer related Patents - Trademarks in Internet - Domain name registration - Domain Name Disputes & World Intellectual Property Organization (WIPO) - Databases in Information Technology - Protection of database in USA, EU &India.

UNIT-V

Mobile Technology- SIM (Subscriber Identity UNIT) cloning–Mobile frauds - Usage of mobile software - Special reference to the relevant provisions of IT ACT 2008, India Penal Code and Evidence Act.

Textbook(s):

1. Yatindra Singh : Cyber Laws
2. Vakul Sharma, Handbook of Cyber Laws

References:

1. Linda Brennan and Victoria Johnson: Social, ethical and policy implication of Information Technology.
2. Kamath Nandan : Law relating to Computer, Internet and E-Commerce.
3. Mike Godwin: Cyber Rights Defencing free speech in the Digital Age.

19EOE313: PERSONALITY DEVELOPMENT

L	T	P	C
3	0	0	3

UNIT I **8 L**

Self Awareness: Know yourself, have a snapshot of yourself, assess your personal traits, discover natural potential. Activities and Tasks: Class discussion, questionnaires, Johari Window, SWOC analysis (strengths, weaknesses, opportUNITies and challenges).

UNIT II **8 L**

Self Discipline: Importance of self discipline, characteristics of a self disciplined achiever, self discipline in personal life and career. Activities and Tasks: Viewing short videos followed by discussion and analysis, brainstorming in small groups, creating an action plan to realize academic and career goals.

UNIT III **8 L**

Motivating Oneself: Self motivation, confidence building, goal setting, decision making. Activities and Tasks: Discussion and analysis of case studies, completing self-assessment questionnaires.

UNIT IV **9 L**

Managing Oneself: Handling emotions, time management, stress management, change management. Activities and Tasks: Discussion and analysis of case studies, completing self-assessment questionnaires.

UNIT V **9 L**

Interpersonal Behaviour: Attitude towards persons and situations, team work, leadership skills, problem solving skills, interpersonal adaptability, cultural adaptability. Activities and Tasks: Team-building games and activities.

References

1. Hurlock Elizabeth B., Personality Development, McGraw Hill Education, India, 1979.
2. Covey, Stephen R., The 7 Habits of Highly Effective People: Powerful Lessons in Personal Change, Free Press, 2004.
3. Carnegie, Dale, Levine, Stuart. R., The Leader In You: How to Win Friends, Influence People and Succeed in a Changing World, Pocket Book(s), 1995.
4. Swami Vivekananda, Personality Development, Advaita Ashrama, 1993.

*This will be supplemented by materials and activities from internet-related sources.

19MOE305: BASICS OF MARKETING

L	T	P	C
3	0	0	3

UNIT I:

Introduction to Marketing – Nature, Scope and Importance of Marketing – Concepts and Approaches to Marketing – Product Vs. Service Marketing, Role of Marketing in the Economic Development – Latest Trends in Marketing.

UNIT II:

Analyzing Consumer Markets and Buyer Behaviour – Factors Influencing the Buyer Behaviour; Market Segmentation and Targeting.

UNIT III:

Marketing Mix Strategies & Extended Marketing Mix : Product, Service Product, Classification of Products – Product Life Cycle Stages, New Product Development

UNIT IV:

Pricing & Channels of Distribution: Pricing Objectives – Factors Influencing the Pricing Policy – Pricing Methods, Channels of Distribution – Channel Design Decisions – Channel Management.

UNIT V:

Promotion Mix – Importance of Promotion – Managing Advertising – Sales Promotion –, Personal Selling and Direct Marketing– Publicity and Public Relations.
Case study (Not exceeding 250 words).

Text Book:

Philip Kotler (2014), *A Framework for Marketing Management*, New Delhi: Pearson Education.

Reference Book(s):

1. W.J. Stanton (2011), *Fundamentals of Marketing* , New Delhi: McGraw Hill Publishing Co. Ltd.,
2. Gravens Hills & Wood Ruff (2012), *Marketing Management*, New Delhi: Cravens Hills, AITBS.
3. Rajan Saxena (2010), *Marketing Management*, New Delhi: Tata Mc-Graw Hill.
4. Sontakki C.N. (2012), *Marketing Management*, New Delhi: Kalyani Publications.

Journals

1. GITAM Journal of Management, Visakhapatnam.
2. Journal of Marketing, New Delhi.
3. Advertising & Marketing, New Delhi.
4. Indian Management, New Delhi.
5. Indian Journal of Commerce, New Delhi.

19EHS302: ENGINEERING ECONOMICS AND MANAGEMENT

L	T	P	C
3	**0**	**0**	**3**

This course aims at introducing the student with basic concepts of engineering economic analysis, principles of management and its role in engineering decision making. The students are introduced to the basic tools needed for presentation of the effect of the time value of money in engineering problem solving. The tools introduced include topics such as demand and supply analysis, depreciation, costing analysis and break even analysis. It also helps the students to analyze financial statements.

Course objectives

- To define the basic terms of economics and analyze law of demand and elasticity of demand.
- To analyze the cost concepts and interpret financial statements.
- To apply break even analysis concept in business organization.
- To discuss the advantages of different forms of organization.
- To elaborate the principles of Management.

UNIT I **8 L**

Economics: Utility, value, wealth, consumption, wants necessaries, comforts and luxuries.
Demand: Law of demand, elasticity of demand, price elasticity of demand, factors affecting elasticity of demand, problems.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- define utility and time value of economic goods. [**L1**]
- distinguish between necessities, comforts and luxuries . [**L2**]
- classify demand for different types of goods. [**L2**]
- analyze the elasticity of demand for various economic goods. [**L4**]

UNIT II **8 L**

Costing: Cost concepts, elements of cost, marginal cost, marginal revenue, sunk cost, opportUNITy costs, methods of distribution of overhead costs, UNIT costing, job costing and process costing; Simple problems.
Accounts: Preparation of profit and loss account and balance sheet (outlines only).

Learning Outcomes:

At the end of this UNIT, the student will be able to

- list elements and types of costs. **[L1]**
- apply cost analysis to determine profit. **[L3]**
- classify accounts.**[L2]**
- compose & interpret balance sheet for a given enterprise. [**L3**]

UNIT III **6 L**

Break-Even Analysis: Assumptions, break-even charts, simple problems.
Depreciation: Depreciation methods - Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation-Simple problems.

Learning Outcomes:
At the end of this UNIT, the student will be able to

- apply break even analysis in business organization. **[L3]**
- examine the impact of fixed and variable costs on profits. **[L2]**
- list depreciation methods. **[L1]**
- compute the depreciation of assets. **[L3]**

UNIT IV **10 L**

Forms of Business Organization: Single trader, partnership and public limited company.
Principles of Organization: Types of organization; Span of management; Authority, delegation and decentralization, source of formal authority, difference between authority and power, line and staff authority, simple case studies.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- comprehend the pros and cons of different forms of business organization. **[L1]**
- illustrate advantages and disadvantages of each form of organization. **[L2]**
- evaluate the effect of span of management on decision making. **[L2]**
- differentiate between authority and power.**[L2]**

UNIT V **10 L**

Principles of Management: Importance of management, definition of management, management process, roles of a manager; Management, a science or art - Management, a profession; Functions of management.
Leadership: Difference between a leader and a manager, characteristics of leadership, functions of a leader, simple case studies.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- summarize the function of management. **[L1]**
- recall the roles of manager. **[L1]**
- compare and contrast between Leader and Manager. **[L2]**
- list the characteristics of Leader. **[L1]**

Course outcomes

- obtain the basic terminology, laws of demand and supply.**[L1]**
- evaluate the economic theories and cost concepts.**[L2]**
- analyze various accounting concepts and financial management techniques for preparing effective profit and loss statements.**[L3]**
- examine and analyze break even evaluation concepts for identification of minimum production volume for survival and to gain profits.**[L3]**
- adapt and build good manager skills by employing the concepts of various skills like good leadership qualities, utilizing motivation capabilities and incorporating communications skills.**[L2]**

Text Book(s):

1. Tara Chand, Engineering Economics, Vol - 1, 13/e, Nem Chand & Bros, 2012
2. O.P Khanna, Industrial Engineering and Management, 14/e, Dhanpat Rai Publications, 2011.

References:

1. Maheswari, Engineering and Managerial Economics, 19/e, Sultan Chand & Co, 2009
2. Shukla, Grewal, Cost Accounting, 12/e, S.Chand & Company, 2007
3. L.M.Prasad, Principles and Practice of Management, 8/e, Sultan Chand & Sons, 2012

19EMC382: ENGINEERING ETHICS

L T P C
3 0 0 3

UNIT I **8 L**

Basic Concepts: Terminology, morals, ethics, values, integrity and spiri-tuality, edicts-religious, social and constitutional edicts, the question of universality, personal and professional ethics, emotional intelligence, dimensions of ethics.

UNIT II **8 L**

Rights and Responsibilities: As citizens, as professionals, concepts of justice and fairness, preservation, production, exchange for mutual fulfilment vs. storage for future use, social responsibility and individual rights.

UNIT III **9 L**

Global Issues in Ethics: Technology and globalization, business ethics, corporate social responsibility, environmental ethics, media ethics, protecting the common good while respecting the values and beliefs of nations/ ethnic groups, issues of compliance and governance, equal opportunities.

UNIT IV **8 L**

Ethical Integrity and Attitudes: Integrity as wholeness and consistency of character, beliefs, actions, methods and principles, core group of values, accountability, prioritization, subjectivity and objectivity, attitude, com-ponents (cognitive, behavioral and affective), attitude formation and at-titude change.

UNIT V **9 L**

Ethical Living: Needs of life, materialistic and non-materialistic, qualitative and quantitative, harmony in living, self (physical and mental well being), family, building trust, sharing of responsibilities, cultivating sense of security, society, peace, non-violence, diversity, multiculturalism and oneness, nature, environmental sustainability, reorganizing living conditions, reappraising economic sectors and work practices, developing green technologies, ethical consumerism.

References:

1. G. Subba Rao, Roy Chowdhury, P.N. Ethics, Integrity and Aptitude: For Civil Services Main Examination Paper V, Access Publishing, 2013.
2. Singer, Peter. Practical Ethics, Cambridge University Press, 1999.
3. Swami Tathagatananda, Healthy Values of Living, Advaita Ashrama, Kolkata, 2010.

4. M. Frost (Ed), Values and Ethics in the 21st Century, BBVA, Available at https://www.bbvaopenmind.com/wp-content/uploads/2013/10/Val-ues-and-Ethics-for-the-21st-Century_BBVA.pdf

19EME322: DESIGN ANALYSIS AND SIMULATION LAB

L	T	P	C
0	**0**	**3**	**1.5**

Course Objectives

- To introduce the fundamental concepts of mathematical modelling.
- To expose the student to a variety of simulation problems.
- To create a basic understanding of the simulation process.
- To familiarize the student with the application of simulation in design analysis.
- To enable students to setup simple numerical simulations.

List of experiments to be performed on the model selected by the student:

1. Geometry Preparation (ANSYS/Design Modeler (or) PTC/Creo):
   a. Practice the concepts of part modeling and assembly.
   b. Implement the geometry cleanup procedures on .stp and .stl files
   c. Prepare the geometry for CFD simulation.
2. Preprocessing (ANSYS/Mechanical and/or ANSYS/CFX)
   a. Generate mesh using automatic or block methods.
   b. Apply initial and boundary conditions
   c. Apply loads and define contact
3. Choose the solver and provide right settings and complete the simulation (ANSYS/Mechanical or ANSYS/CFX).
4. Postprocessing (ANSYS/Mechanical or ANSYS/CFDPost)
   a. Understand the results and rerun the simulation with modified design
   b. Understand the results and rerun with modified Mesh/boundary conditions/loads etc.
   c. Understand the results and rerun the simulation with modified solver settings

Text Book:

1. Prof. Sham Tickoo, PTC/Creo Parametric for Engineers and Designers, Dreamtech press, 2019.
2. Pramote Dechaumphai, S. Sucharitpwatskul, Finite Element Analysis with ANSYS Workbench, Alpha Science, 2018

Reference Book(s):

1. Erdogan Madenci, Ibrahim Guven, The Finite Element Method and Applications in Engineering Using ANSYS, Springer US, 2015.
2. Zied Driss,Brahim Necib,Hao-Chun Zhang, CFD Techniques and Energy Applications, Springer International Publishing, 2018.

Course Outcomes:

After the completion of this course work the student will be able to

- Understand various stages of mathematical modeling. L1
- Understand the results provided by the solver. L2
- Determine the numerical method needed for solving a design problem. L3
- Analyze the results and suggest the next steps. L4
- Propose design changes to part/assembly based on the results. L5

19EHS304 UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY

L	T	P	C
2	**1**	**0**	**3**

Pre-requisites: None. Universal Human Values 1 (Desirable)

Course code: HSMC (H-102) :Universal Human Values 2: Understanding Harmony
Semester: 6th or 7th semester
Course Title:
Human Values Courses: During the Induction Program, students would get an initial exposure to human values through Universal Human Values – I. This exposure is to be augmented by this compulsory full semester foundation course.

OBJECTIVE: The objective of the course is fourfold:
1. Development of a holistic perspective based on self- exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

COURSE TOPICS: The course has 28 lectures and 14 practice sessions in 5 modules:

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education
1. Purpose and motivation for the course, recapitulation from Universal Human Values-I.
2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration.
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority.
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

Module 2: Understanding Harmony in the Human Being - Harmony in Myself!

1. Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’.
2. Understanding the needs of Self (‘I’) and ‘Body’ - happiness and physical facility.
3. Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer).
4. Understanding the characteristics and activities of ‘I’ and harmony in ‘I’.
5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.
6. Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available tome. Identifying from one’s own life.

Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

Module 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

1. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
2. Understanding the meaning of Trust; Difference between intention and competence
3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
4. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
5. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students’ lives.

Module 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

1. Understanding the harmony in the Nature
2. Interconnectedness and mutual fulfilment among the four orders of nature-recyclability and self-regulation in nature.
3. Understanding Existence as Co-existence of mutually interacting units in

all-pervasive space.
4. Holistic perception of harmony at all levels of existence.
5. Include practice sessions to discuss human being as cause of imbalance in nature (film “Home” can be used), pollution, depletion of resources and role of technology etc.

Module 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics

1. Natural acceptance of human values
2. Definitiveness of Ethical Human Conduct
3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
4. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
5. Case studies of typical holistic technologies, management models and production systems
6. Strategy for transition from the present state to Universal Human Order:
   a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers
   b. At the level of society: as mutually enriching institutions and organizations
7. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions e.g. To discuss the conduct as an engineer or scientist etc.

READINGS: Text Book

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

Reference Books

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

MODE OF CONDUCT (L-T-P-C 2-1-0-3 or 2L:1T:0P 3 credits): Lectures hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them.

Tutorial hours are to be used for practice sessions.

While analysing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.

In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self- observation, self-reflection and self-exploration.

Scenarios may be used to initiate discussion. The student is encouraged to take up "ordinary" situations rather than" extra-ordinary" situations.

Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions (tutorials)would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.

It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses.

This course is to be taught by faculty from every teaching department, including HSS faculty.

Teacher preparation with a minimum exposure to at least one 8- day FDP on Universal Human Values is deemed essential.

ASSESSMENT:
This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self-assessment, peer assessment etc. will be used in evaluation.

Example:
Assessment by faculty mentor: 10 marks
Self-assessment: 10 marks
Assessment by peers: 10 marks
Socially relevant project/Group Activities/Assignments: 20 marks Semester End Examination: 50 marks
The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.
OUTCOME OF THE COURSE: By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with

sustainable solutions, while keeping human relationships and human nature in mind.

They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to- day settings in real life, at least a beginning would be made in this direction.

This is only an introductory foundational input. It would be desirable to follow it up by

a) faculty-student or mentor-mentee programs throughout their time with the institution
b) Higher level courses on human values in every aspect of living. E.g. as a professional

Semester -V (3-1)

Stream	Course Code	Course Title	Category	L	T	P	C	Marks
Comprehensive Skill Development	Department specific	Soft Skills and Quantitative Aptitude	PW	1	2		1	50
		Coding				3		50
Total number of hrs per week						6		100

Coding Syllabus:-

Permutations and Combination, Probability, Hash Tables, Heap, Greedy Method, Backtracking

Recommendations For Comprehensive Skill Development course For Mechanical , Aerospace, Civil Engineering, CSE, ECE &EEE and BIO-Tech in 6th and 7th Sem for 2020-21.

Semester –VI & VII (3-2 & 4-1)

Stream	Course Code	Course Title	Category	L	T	P	C	Marks
Comprehensive Skill Development	Department specific	Soft Skills and Quantitative Aptitude	PW	1	2		1	50
		Coding				3		50
Total number of hrs per week						6*		100

*If number of hrs is reduced to 4 then 2 hrs will be allocated to domain skills i.e. 50% for soft skills and 50% for Domain skills.

Note:-Faculty of the respective departments has to handle the CSD Domain Skills in 6th and 7th sem. Respective BOS can define guidelines based on the below recommendations.

The Department BOS can ask the student to attend one or more of the below mentioned in order to award credits in 3-2 and 4-1.

1. Revision of Important concepts in their respective branches (Orientation towards Gate or Placement)

2. Certificate Course offered by Coursera, CEMS Vizag, Courses offered by various Academies and any industry related courses (Partial list of Courses are given for example).

3. However Board of Studies of the departments can Identify and offer their own courses and can define their own internal evaluation pattern for 6th Semester (3-2) and 7th Semester (4-1)

4. The Recommended Courses by CGC Directors or given below in Appendix- 1.

5. Scheme of evaluation will be decided by concerned Departments for 3-2 and 4-1 Semesters.

APPENDIX-1

S.No	Specialization	Name of the Course	No of Hours
1	All Branches	Introduction to Digital technologies	20
2	ECE	IoT and Micro controllers	20
3	ECE	Embedded programming	20
4	CSE	AI/ML	20
5	CSE	Data Science	20
6	MECH	Simulation technologies and python programming	30
7	MECH	AI in mechanical Engineering	30
8	MECH	Robotics and Automation	30
9	MECH	Electrical Vehicle Design/ Batteries Technology.	30
10	MECH	3-D Printing in Mechanical Engineering	30
11	MECH	Industry 4.0	20
12	MECH	MATLAB Python and CFD using Solid works for Mechanical Engineering Application	60
13	MECH	Introduction to Automotive Cyber security and Vehicle Networks	60
14	MECH	Introduction to Structural Analysis using ANSYS Workbench	60
15	MECH	Certification in Hybrid Vehicle Design & Analysis	60
16	Mech	Design tools - Autodesk / hyper mesh etc	
17	Mech	Augmented Reality - Human & Automation	
18	ECE	computer vision and AR	

These are the some of the Additional courses departments can consider by MECH and CIVIL

1. Introduction to Automation using ANSYS Workbench and Python
2. Advanced CFD Meshing using ANSA
3. Automation Using TCL/TK for Hyper Mesh
4. Certification courses in Autonomous Vehicles.
5. Certification in Robotics.
6. SIEMENS SITRAIN Course Certificate
7. Design Loads considered on Bridges using STAAD.Pro
    a. Certificate Program In High Raise Building Design (Structural design and analysis – input from L & T Technology and Eversendai)
8. Program In Bridge Design and Analysis.
9. Program In Smart Cities and Green Cities
    a. Renewable energy and sustainable environment – input from centre for green energy, Pondicherry University, Schneider Electric
    b. Recycle and reuse – input from Tata & Sons, UN
    c. Fly ash constructions – Input from Eversendai
    d. Precast concrete – Input from Eversendai
10. Industrial IoT – input from Robert Bosch, Hirotech India
11. Project Management and workstation planning – Input from Renault Nissan
12. BIM – based on input from L & T

SEMESTER VII

19EME431: MEASUREMENTS AND METROLOGY

L	T	P	C
3	0	2	4

Course Description

The objective is to make the students to have knowledge on the various measuring and inspection devices and to provide tolerances during design. This is useful for every engineer who is working in any industry as every industry producing any good should be inspected and then only will be sent out for the release in the market for customers. Course intends to introduce the technological and engineering concepts and study the applications of measuring quantities like force, torque and temperature.

Pre-requisites: None

Co-requisties: None

Specific Instructional Objectives: None

Course Objectives:

- To introduce the basic concepts of metrology and measurement methods.

- To demonstrate the importance of metrology in manufacturing.
- To explain the concepts of transducers and its practical applications.
- To expose with various measuring instruments
- To familiarize calibration methods of various measuring instruments.

UNIT I **8 hrs**

Concept of Measurement: General concept-generalized measurement system, units and standards, measuring instruments, sensitivity, readability, range of accuracy, precision, static and dynamic response, repeatability, systematic and random errors, correction, calibration, terminology and limits fits and tolerances, hole basis and shaft basis system, interchangeability.

Learning Outcomes:
At the end of this unit the student will be able to
- Identify important parameters in metrology. (L3).
- Differentiate interchangeability and selective assembly. (L4).
- Select limits and tolerances for different assemblies. (L1)

UNIT II **8 hrs**

Linear measuring instruments: Vernier instruments, micrometers, slip gauges, tool makers microscope. Comparators: Mechanical-Johansson mikrokator, sigma and reed type, pneumatic-solex and differential type and electrical- visual gauging and multi gauging.
Angular measurements: Sine bar, bevel protractor and angle dekkor.

Learning Outcomes:
At the end of this unit the student will be able to
- Explain the principles of measurement of various comparators. (L2).
- Discuss about the principles of slip gauges, micrometers and vernier height gauges. (L2)

UNIT III **8 hrs**

Screw thread measurements: Elements of threads, errors in screw threads, various methods of measuring external and internal screw threads, screw thread gauges and errors in screw threads.
Gear Measurement: Gear tooth terminology, measurement of gear elements-runout, lead, pitch backlash, profile and tooth thickness by chordal thickness method, constant chord and base tangent method.

Learning Outcomes:
At the end of this unit, the student will be able to
- Identify the errors in screw threads. (L3)
- Explain the principles of gear measuring instruments. (L2)
- Select the tools and methods for measuring screw thread, gear profiles. (L1)

UNIT IV **8 hrs**

Surface Roughness: Terminology, differences between surface roughness and surface waviness- Numerical assessment of surface finish - CLA, RMS and ten point height average

Value. Methods of measurement of surface finish-Profilometer, Tomlinson surface meter, Taylor Hobson talysurf.
Inspections systems: Classification of automatic inspections systems, co-ordinate- measuring machines, non-contact inspection techniques-machine vision, laser scanning systems.

Learning Outcomes:
At the end of this unit, the student will be able to

- Recall the terms used in surface roughness measurement. (L1)
- Explain the factors affecting the surface finish in machining. (L2)
- Demonstrate the application of different surface measuring instruments. (L2)

UNIT V **8 hrs**

Measurement of Force: Direct method - analytical balance, platform balance; elastic members – load cells, cantilever beams and proving rings.
Measurement of Torque: Torsion bar dynomometer, servo controlled dynamometer and absorption dynamometer.
Measurement of Temperature: Pressure thermometers and bimetallic strip thermometers.

Learning Outcomes:
At the end of this unit, the student will be able to

- Identify various types of transducers used for the measurement of force, torque, and temperature. (L3)
- Explain methods of measurement of force, torque and temperature. (L2)
- Develop the techniques for calibration of force, torque and temperature measuring devices. (L3)

Course Outcomes:

1. Have knowledge on basic concepts and apply the concepts of limits, fits, tolerances to engineering drawing & design (L4)
2. Demonstrate the concepts of linear and angular measurements to practical applications (L3)
3. Examine geometry of screw threads and gear profiles. (L4)
4. Evaluate surface finish and also to inspect various components using non-contact and contact techniques. (L5)
5. Select suitable techniques to measure and evaluate force torque and temperature. (L5)

Textbooks:

1. Beckwith, Marangoni, Linehard, Mechanical Measurements, 6/e, PHI, 2013.
2. R.K. Jain, Engineering Metrology, 20/e, Khanna Publishers, 2013.

Reference Books:

1. Mahajan, Engineering Metrology, 2/e, DhanpatRai, 2013.
2. S.Bhaskar, Basic Principles - Measurments and Control Systems, Anuradha Publications, 2014.
3. Anand K Bewoor&Vinay A Kulkarni, Metrology & Measurement, 15/e, McGrawHill, 2015

Practical Experiment

1) Calibration of micrometer and dial gauge by using slip gauges.
2) a. Measurement of V-groove angle using 2 roller method.

   b. Measurement of angles using angle gauges
3) To determine the gear tooth thickness and height of a given spur gear
4) Measurement of screw thread parameters using tool makers microscope
5) Measurement of roundness and concentricity of a given spigot
6) Measurement of angles using vernier bevel protractor and sine bar
7) Measurement of central distance between two holes by using vernier height gauge
8) a. Measurement of straightness using Autocollimator

   b. Measurement of flatness using monochromatic checklite
9) To measure surface roughness parameters of a given specimen

19EHS405: OPERATIONS RESEARCH

L	T	P	C
3	**0**	**0**	**3**

This course is to aid decision making and improving efficiency of the system by applying advanced analytical methods. This course addresses a few quantitative tools and techniques and provides students with knowledge and skills needed to apply these tools and techniques for decision making in organizations.

Course Objectives:

- To Introduce the basics of Operations research, formulation and solution of Linear Programming Problems using different methods
- To Learn Formulation and solve problems of optimization problems in transportation and assignment of jobs.
- To explore different queuing models and sequencing techniques for optimal schedule of jobs on machines
- To impart knowledge on replacement policies for estimation of economic life of equipment and the concept of game theory to arrive at the optimal business strategy for a given situation.
- To introduce basic inventory models to optimize inventory costs and Project scheduling techniques – CPM & PERT for optimum time and costs

UNIT- I **10 Hrs**

Basics of Operations Research: History, definition, operations research models, phases of implementing operations research in practice.
Linear Programming: Introduction, formulation, graphical method, simplex method, Big M and Two-Phase methods, concept of duality.

Learning Outcome:
After completion of Module-I, the students will be able to:
- **recognize** the significance of Operations Research and mathematical modelling while analysing the practical problems in industry [**L1]**
- **formulate** the various linear Programming Models [**L6]**
- **evaluate** the optimal solution to simple linear programming problems [**L4]**

UNIT- II **8Hrs**

Transportation Model: Formulation, methods for initial feasible solution, optimal solution – MODI method, unbalanced transportation problems, degeneracy in transportation problems.
Assignment Model: Formulation, optimal solution, Hungarian method, travelling salesman problem.
Learning Outcome:
After completion of Module-II, the students will be able to:
- **formulate** the linear programming problem as a Transportation model [**L6**]
- **formulate** the linear programming problem as an Assignment model [**L6]**
- **evaluate** the optimal solution to Transportation Problems [**L4]**
- **evaluate** the optimal solution to Assignment Problems [**L4]**

UNIT- III **8Hrs**

Queuing Models: Introduction, Kendall's notation, Empirical Queueing Models – (M/M/1):(GD/∞/ ∞), (M/M/C) :(GD/∞/ ∞), (M/M/1) :(GD/N/ ∞).
Sequencing Models: Introduction, assumptions, processing n-jobs through two machines, n-jobs through three machines, n-jobs through m-machines, graphic solution for processing 2 jobs through n machines with different order of sequence.
Learning Outcome:
After completion of Module-III, the students will be able to:
- **define** the various queuing models(**L1**)
- **calculate** Queue length & waiting time of a given queue system(**L3**)
- **evaluate** the optimal sequence of the jobs on machines for minimum cycle time(**L4**)

UNIT- IV **8Hrs**

Replacement Models: Introduction, replacement of items that deteriorate with time - value of money unchanging and changing, simple probabilistic model for replacement of items that fail completely.
Game Theory: Introduction, game with pure strategies, game with mixed strategies, dominance property, graphical method for 2xn and mx2 games.
Learning Outcome:
After completion of Module-IV, the students will be able to:
- **analyze** the replacement and maintenance costs of items under various replacement policies [**L4]**
- **evaluate** the optimal replacement policy of items [**L4]**
- **analyze** the players' strategies and thereby **Evaluate** optimal business strategies for the players [**L4**]

UNIT- V **8Hrs**

Inventory Models: Introduction, inventory costs, purchase and manufacturing models, inventory models with quantity discounts.
Project Management: Introduction, phases of project management, network construction, numbering the events-Fulkerson's rule, Critical Path Method (CPM), Programme Evaluation and Review Technique (PERT)

Learning Outcome:
After completion of Module-V, the students will be able to:
- **recognize** the significance of Inventory models & Project Management in real world industrial scenarios [**L1]**
- **differentiate** between the critical and non-critical activities of a given project [**L4]**
- **propose** the optimal schedule of the activities involved in a project [**L6]**
- **evaluate** the optimal order/batch quantity for minimum inventory cost [**L4]**

Course Outcomes:
After successful completion of this course, the students will be able to
- **develop** the mathematical models and **propose** the optimal resource allocation [**L3&L6]**
- **formulate** and **solve** transportation & assignment models for optimum resources [**L6&L3]**
- **analyze** the queue system and to **propose** the optimal sequence of jobs on machines [**L4 & L6]**
- **evaluate** the optimal replacement policy of the equipment and to **analyze** the strategic interaction between rational decision-makers [**L6&L4]**
- **design** the inventory systems and to **plan** the project activities [**L6]**

Textbook(s)
1. Paneerselvam R., Operations Research, 2/e, Prentice Hall of India, 2010.
2. Gupta P K. & Hira D.S., Operation Research, 6/e, S Chand Publishers, 2006.

References
1. Harvey M. Wagner, Principles of Operations Research: With Applications to Managerial Decisions, 2/e, Prentice Hall of India, 1975.
2. Kanti Swarup., Man Mohan., and Gupta, P.K., Introduction to Operations Research, 7/e, Sultan Chand &Sons, 2005.
3. Hillier, F.S., and Lieberman G.J., Introduction to Operations Research, 7/e, Tata McGraw Hill, 2009.

19EME495: COMPREHENSIVE SKILL DEVELOPMENT VI

Stream	Course Code	Course Title	Category	L	T	P	C	Marks
Comprehensive Skill Development	Department specific	Soft Skills and Quantitative Aptitude	PW	1	2		1	50
		Domain skills				3		50
Total number of hrs per week						*6		100

Soft skill

Unit	Module/ Topics	Hrs
1.	GRE-Oriented Tests and Discussions	4
2.	CAT-Oriented Tests and Discussions	4
3.	TCS, Infosys-Oriented Tests and Discussions	4
4.	Other Company-Specific Tests & Discussions	3
	Total	15

Verbal skills

Unit	Module/ Topics	Hrs
1.	Resume Writing & Acing Job Interviews	**4**
2.	Corporate Readiness 1	**3**
3.	Mock Tests with Solutions 1	**5**
4.	Company-Specific Tests with Solutions 1	**3**
	Total	**15**

Domain skills

60 hours of training in any of the following courses

S.No	Specialization	Name of the Course	No of Hours
1	All Branches	Introduction to Digital technologies	20
2	MECH	Simulation technologies and python programming	30
3	MECH	AI in mechanical Engineering	30
4	MECH	Robotics and Automation	30
5	MECH	Electrical Vehicle Design/ Batteries Technology.	30
6	MECH	3-D Printing in Mechanical Engineering	30
7	MECH	Industry 4.0	20
8	MECH	MATLAB Python and CFD using Solid works for Mechanical Engineering Application	60
9	MECH	Introduction to Automotive Cyber security and Vehicle Networks	60
10	MECH	Introduction to Structural Analysis using ANSYS Workbench	60
11	MECH	Certification in Hybrid Vehicle Design & Analysis	60
12	ECE, Mech	Industrial IoT	60
13	Mech	Design tools - Autodesk / hyper mesh etc	60
14	All Branches	Project Management Skills	60
15	Mech	Augmented Reality - Human & Automation	60

PROGRAM ELECTIVE IV

19EME441: COMPUTATIONAL FLUID DYNAMICS

L	T	P	C
3	0	0	3

COURSE DESCRIPTION

This course helps to understanding the importance of governing equations while solving fluid flow problems. It explains the importance of Navier-Stokes equation, boundary conditions and various types of boundary conditions. Also, it explains essence of boundary conditions while solving the realistic physics involved in the engineering problems. The course helps to acquire the knowledge on formulation of mathematical model and its solution using finite difference and finite volume method. In addition to, various errors come across during simulation and importance of convergence, consistency of the solution. Moreover, it provides various grid generation and FVM methods to solve fluid flow problems. It explains the introduction to turbulence modelling and various models used in fluid flow.

Pre-requisites: Fluid Mechanics

Course Objectives

- To provide the students with essential background to understand the mathematical representation of the governing equations for fluid flow problems.
- To equip the students to formulate fluid flow problems by approximating the governing differential equations with boundary conditions through Finite difference and finite volume discretization methods.
- To acquire the knowledge of various grid generation methods and approximation of errors while solving problems subsequently suitability for different engineering applications.
- To introduce various turbulence for solving engineering problems.

Module I **8 Hrs**

CFD overview, importance of CFD in modelling the engineering problems, application of CFD in various engineering field. Conservative and Non-conservative form, Governing equations- Mass, Momentum and Energy.

Learning Outcomes

Upon completion of Unit 1, the student will be able to

• Understand the importance of CFD in various engineering applications	L2
• Derive governing equations and deduce them according to physics involved in the problem	L1
• Comprehend the difference between conservative and non-conservative forms	L1

Module II **6 Hrs**

Numerical solution of PDE: Classification of PDEs- elliptic, parabolic and hyperbolic
Boundary conditions: Classification of boundary conditions, explain with suitable example, definition of BVP and IVP

Finite difference method (FDM): Basic aspects of Discretization- Comparison of finite difference, finite volume, and finite element techniques

Learning Outcomes
Upon completion of Unit 2, the student will be able to

- Classify PDEs and identify them through examples L1
- Acquire the knowledge of boundary conditions used in CFD and implementation in governing equations L2
- Understand the discretization aspects of computational domain L2

Module III **8 Hrs**

Finite difference method (FDM): Forward, Backward and Central difference schemes, Transient 1D and 2D conduction - Explicit, implicit. Stability analysis and error estimation

Learning Outcomes
Upon completion of Unit 3, the student will be able to

- Understand various FDM schemes L2
- Apply FDM schemes to both 1D and 2D problems L3
- Acquire the knowledge of stability analysis and estimation of error L3

Module IV **8 Hrs**

Finite volume method (FVM): Concept of discretization, methods of deriving discretization equations, finite volume method for one dimensional steady state diffusion, conservativeness, boundedness, transportiveness, four basic rules for FV discretization, assessment of central and upwind differencing schemes.

Learning Outcomes
Upon completion of Unit 4, the student will be able to

- Understand the basic rules of finite volume method and FVM discretization methods L2
- Analyze 1D steady state diffusive problems using FVM method L4
- Understand and learn various FVM schemes to discretize the pressure velocity coupling terms L2

Module V **6 Hrs**

Incompressible Fluid Flow: Discretization of the momentum equation. Primitive variable approach, staggered grid and collocated grid, SIMPLE algorithm, SIMPLER algorithm. Introduction to turbulence models.

Learning Outcomes
Upon completion of Unit 5, the student will be able to

- Understand the SIMPLE and SIMPLER algorithms L2
- Apply and analyze both SIMPLE and SIMPLER algorithms to 1D steady diffusive problems. L4

- Learn elementary treatment of turbulence models L1

Textbook(s)	**Topics**
1. J.D.Anderson Jr., Computational Fluid Dynamics, 2/e, McGraw Hill, 2012.	Module 1, 2, 3
2. H.K.Versteeg and W. Malalasekera, An Introduction to Computational Fluid Dynamics: The Finite Volume Method, Pearson, 2007 2.	Module 4,5

References

1. Gautam Biswas, Somenath Mukherjee, Computational Fluid Dynamics, Narosa, 2013.
2. T.J.Chung, Introduction to Computational Fluid Dynamics, Cambridge University Press, 2010.
3. J.H.Ferziger, M.Peric, Computational Methods for Fluid Dynamics, Springer, 2002.

CO-PO MAPPING

	POs												**PSOs**		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	0	0	2	0	0	0	0	0	0	0	0	3	0	0
2	0	3	0	0	0	0	0	0	0	0	0	0	2	0	0
3	0	0	0	2	0	0	0	1	0	0	0	0	2	0	0
4	0	0	0	0	0	2	0	0	0	0	0	0	2	0	0
5	0	3	0	0	0	0	0	0	0	0	0	0	3	0	0

1-Low, 2- Medium and 3- High Correlation

Course Outcomes (COs)

After completion of this course, the student will be able to

1. Apply mathematics and engineering fundamentals to formulate mathematical problem by imposing appropriate boundary conditions and governing equations.
2. Solve 1D and 2D governing equations using FDM schemes.
3. Adopt appropriate grid generation methods for solving engineering problems accurately.
4. Solve fluid flow and heat transfer problems using commercial CFD tools.
5. Comprehend the application of turbulence models used in incompressible fluid flow analysis.

19EME443: WIND ENERGY

L	T	P	C
3	0	0	3

Pre-requisite: None

This course introduces the fundamental concepts, principles, analysis, and design of wind turbine in different regions. This course is an intended for learning the Fundamentals of aerodynamics for wind turbines. This course is gives the brief ideas of power in wind -Design of rotor – Wind Energy Conversion Systems techniques-monitoring techniques-testing methods with safety aspects.

Course Objective:

- To Understand the basic knowledge of how wind is generated
- To Improve skills to visualize energy extraction from the sources with help of aerodynamics
- Learn how to design and estimate the potential of resource area
- Learn basic principles of modern wind electric turbines
- A brief idea about principal operation of wind farms and monitoring techniques

Course Outcomes:

After completion of the course, the student will be able to

- Identify global and Indian wind energy scenario in terms of applications
- Apply the fundamentals of aerodynamics designs to wind turbine rotor
- Analyse the operation of a wind turbine principle in different applications
- Identify different components involved in Electrical aspects of wind turbine
- Analyse techniques related safety and monitoring of wind turbines

Module I **8 hrs**

Introduction: Historical Perspectives on Wind Turbines, Indian Energy Scenario, Global Energy Scenario, Introduction to Indian Wind Industry, Wind Energy potential of India and Global Wind Installations

Power in the wind, Wind Characteristics, Measurement of wind using anemometers (cup anemometer, propeller anemometer, pressure plate anemometer, pressure tube anemometer, sonic anemometer and other remote wind speed sensing techniques), Turbulence, Wind Power Density. Average wind speed calculation, Statistical models for wind data analysis (Weibull and Rayleigh distribution), Energy estimation of wind regimes, Wind Rose, Wind Monitoring Station Siting and Instrumentation.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- acquaint basic knowledge of Indian energy scenario. [L1]
- understand different wind measurement methods. [L2]
- acquire fundamental concepts of wind calculations. [L2]

Module II: **8 Hrs**

Aerodynamics: Introduction to Aerofoil design, NACA profiles, Lift and drag principle, Lift and drag co-efficient, Axial Momentum theory, Momentum theory for rotating Wake, Blade element theory, Strip theory, Tip losses.

Learning Outcomes:

At the end of this UNIT, the student will be able to

- acquaint with aerofoil design. [L1]
- understand the effect of wing speed on power generation. [L2]
- study the blade element theory. [L2]
- design the structure of NACA profiles. [L4]

Module III: **8 Hrs**

Rotor Design and Performance: Design of rotor, Wind Machine parameters (swept area, power co-efficient, torque co-efficient, thrust, solidity, tip-speed ratio, angle of attack etc.), Power Curve, Energy Estimation, Capacity Factor

Learning Outcomes:

At the end of this UNIT, the student will be able to

● study the principle of rotor design. [L2]

● acquaint with power co-efficient, torque co-efficient. [L2]

● summarize different Energy Estimation. [L2]

Module IV: 8 Hrs

Wind Energy Conversion Systems: Types, Components of Modern Wind Turbine (HAWT and VAWT), Fixed and Variable Speed operations, Power Control (Passive stall, Active pitch, Passive pitch and Active stall), Electrical aspects of wind turbine, Safety of wind turbines

Learning Outcomes:

At the end of this UNIT, the student will be able to

● understand the Components of Modern Wind Turbine. [L1]

● acquaint with the principles and power control. [L2]

● study about Electrical aspects of wind turbine. [L2]

Module V: 8 Hrs

Wind Farm Design and Health (Condition) Monitoring: Planning of wind farm, Site selection, Micrositing, Grid Integration, Power evacuation, Wind Farm Feasibility Studies, Preparation of DPR, Environmental Benefits and Impacts.

Small Wind Turbines: Water pumping windmills, offshore wind energy, Wind turbine testing, future developments.

Learning Outcomes:

At the end of this UNIT, the student will be able to

● understand and acquire the need for monitoring .[L1]

● acquaint basic knowledge of Environmental Benefits and Impacts. [L1]

● understand the performance of Wind turbine testing. [L2]

Textbook(s):

1. Wind Energy Fundamentals, Resource Analysis and Economics, Sathyajith Mathew, Springer Publications, ISBN 978-3-540-30906-2, 2006 edition

References:

1. A Guide to Small Wind Energy Conversion Systems, John Twidell, CAMBRIDGE UNIVERSITY PRESS, 2011, ISBN 10: 0521281628
2. Offshore Wind Power, Edited by John Twidell and Gaetano Gaudiosi, 2009 Edition, ISBN 978-0906522-639
3. Robert Gasch and Jochen Twele, Wind Power Plants. Fundamentals, Design, Construction and Operation. 2012

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	3	1	3	0	2	0	0	1	1	2	1	0
CO2	2	3	2	3	1	3	0	2	0	0	1	1	2	1	0

CO3	2	3	2	3	1	3	0	2	0	0	1	1	2	1	0
CO4	2	3	2	3	1	3	0	2	0	0	1	1	2	1	0
CO5	**2**	3	2	3	1	**3**	0	2	0	0	**1**	1	2	1	0

19EME447: COMPUTER INTEGRATED MANUFACTURING

L	T	P	C
3	**0**	**0**	**3**

This course provides basic knowledge about computer integrated manufacturing, and it deals with grouping technology which is one of the most important technology followed in leading industries.
It provides the basic knowledge of Computer aided process planning, Artificial Intelligence, Integrative Manufacturing Planning and Control. CIM combines various technologies like computer-aided design (CAD) and computer-aided manufacturing (CAM) to provide an error-free manufacturing process that reduces manual labour and automates repetitive tasks.

Pre-requisites:
Introduction to CAD,CAM and Automation knowledge.

Course Objectives
- To introduce the concepts of automation, group technology integrated to Computer aided design and manufacturing.
- To obtain an overview on computer aided process planning
- To impart the knowledge of forecasting, scheduling capacity planning, shop-floor control in manufacturing systems and the concept of JIT manufacturing.
- To impart the basic knowledge of quality control, inspection methods and computer-aided testing.
- To classify and summarise the manufacturing systems, and integration of CAQC with CAD/CAM.
-

Unit-I **10 Hrs**

Introduction: Scope of computer integrated manufacturing, product life cycle, production automation. Group technology: Role of group technology in CAD/CAM integration, methods for developing part families, classification and coding, examples of coding systems, facility design using group technology, economics of group technology.

Learning outcomes:
At the end of this unit, the student will be able to know the

- understand importance and scope of CIM in fabrication/ manufacturing industry. [L1]
- demonstrate automated production and assembly lines. [L2]
- identify the stages of the product life cycle and related challenges. [L2]
- learn the importance of group technology. [L1]
- applying the types of coding system to different part designs. [L3]

Pedagogy tools:
Lecture, PPTs, Few Videos

Unit-II **10 Hrs**

Computer Aided Process Planning: Role of Process Planning, Approaches to process planning- manual, variant, generative approach, Implementation techniques, process planning systems – CAM-I’S CAPP system, MI Plan system, criteria for selecting a CAPP system, benefits and advantages of CAPP.

Learning outcomes:
At the end of this unit, the student will be able to know the

- demonstrate automated storage/retrieval system. [L1]
- understand the computer aided process planning. [L1]
- acquiring the knowledge of different forms of learning. [L3]

Pedagogy tools:
Lecture, PPTs

Unit-III **9 Hrs**

Integrative Manufacturing Planning and Control: Role of integrative manufacturing in CAD /CAM integration, over view of production control, forecasting, master production schedule, capacity planning, MRP, order release, shop-floor control, quality assurance, planning and control systems, cellular manufacturing, JIT manufacturing philosophy.

Learning outcomes:
At the end of this unit, the student will be able to know the

- application of industrial engineering theory and practice to the area of operations management and production planning/control. [L3]
- analysis and understanding of forecasting, aggregate planning, capacity planning, materials requirement planning, inventory management, short-term scheduling and sequencing. [L2]
- ability to use and compare various statistical forecasting models [L2]
- knowledge of lean manufacturing, tools, techniques and implementation outcomes. [L1]
- understanding of just-in-time systems. [L1]

Pedagogy tools:
Lecture, PPTs, Few Videos

Unit-IV **8 Hrs**

Computer Aided Quality Control: Terminology in quality control, Automated inspection principles and methods, computer aided inspection, computer aided testing, contact inspection methods, noncontact inspection methods, integration of CAQC with CAD/CAM.

Learning outcomes:

At the end of this unit, the student will be able to
- demonstrate automated inspection system. [L2]
- apply the knowledge of inspection techniques. [L3]
- understand the concept of integration of CAQC with CAD/CAM. [L2]
- apply knowledge about computer aided quality control and process planning. [L3]

Pedagogy tools:
Lecture, PPTs, Few Videos

Unit-V **8 Hrs**

Computer Integrated Manufacturing Systems: Types of manufacturing systems, machine tools and related equipment, material handling systems, computer control systems, FMS.

Learning outcomes:
At the end of this unit, the student will be able to
- demonstrate flexible manufacturing system. [L2]
- demonstrate automated material handling system. [L2]
- understand processing stations and material handling systems used in FMS environments. [L1]
- implement FMS concept in a manufacturing environment [L3]
- identify the various elements and their activities in the Computer Integrated Manufacturing Systems. [L1]

Pedagogy tools:
Lecture, PPTs and Few Videos

Texbook(s)	**Topics**
. Mikell P. Groover, Automation, Production Systems, and Computer Aided Manufacturing, 2/e., Prentice Hall, 2001	1,2,3,4,5
Mikell P. Groover, and Zimmers, CAD/CAM: Principles and Applications, 3/e, Tata-McGraw hill, 2010.	1,2,3,4,5
Dr.Sadhu Singh, Computer Aided Design and Manufacturing, Khanna Publishers	2

References
1 M.M.M. Sarcar, K. Mallikarjuna Rao, K. Lalit Narayan, Computer Aided Design and Manufacturing, 2/e, Prentice Hall of India, 2008.

CO-PO Mapping

Subject code	PROGRAMME OUTCOMES												PSO 1	PSO 2	PSO 3
EME446 : COMPUTER INTEGRATED MANUFACTURING	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12		2	
CO1						2									
CO2		2				1							2		
CO3		3											1		
CO4			2										1		
CO5		2											1		

Course Outcomes:

After the successful completion of this course, the student will be able to

- To understand the concepts of Production Automation, Process Planning & Quality control in Computer Integrated Manufacturing Systems.
- To acquire the knowledge on quality control; computer aided testing and inspection methods.
- To analyse the Computer Aided Process Planning &Control, Material handling, and Artificial intelligence in FMS.
- To design and solve the problems of Forecasting, Scheduling, and capacity planning in manufacturing and assembling.
- To integrate computer aided design and computer aided manufacturing protocols to manufacture products.

19EME451: MECHANICS OF COMPOSITE MATERIALS

L	T	P	C
3	0	0	3

This course primarily focusses on the design, processing, and behavior of composite materials. Concepts such as linear elastic analysis, anisotropic material behavior, damage criteria are also discussed in this course.

Prerequisite:
Mechanics, Strength of Materials

Course Objectives:

- To introduce the concept of composite materials with more emphasis on fiber-reinforced composite materials.
- To explain the response of a unidirectional lamina under applied stresses.
- To conduct stress analyses using laminated plate theories and appropriate strength criteria
- To Familiarize with the basic expressions and methods used in the mechanics of composite structures
- To explain different failure theories

Unit I

Introduction: Composite materials, classification and characteristics of composite materials- fibrous composite materials, laminated composite materials, particulate composite materials, mechanical behavior of composite materials, basic terminology of laminated fiber-reinforced composite materials, manufacturing of laminated fiber-reinforced composite materials -Layup, curing, advantages of laminated fiber-reinforced composite materials, applications of composite materials

Learning outcomes

After completion of this unit, students will be able to

- differentiate composite and alloy [L2]
- understand basic terminology of laminated fiber-reinforced composite materials [L2]
- fabricate composite materials [L4]

Unit II

Macromechanical behavior of a lamina: Introduction, Stress strain relations for anisotropic materials, stiffness, compliance matrix and engineering constants for orthotropic materials, relations, Stress strain relations for plane stress in a unidirectional orthotropic material and arbitrary oriented orthotropic material.

Learning outcomes

After completion of this unit, students will be able to

- understand stress strain relations for anisotropic materials [L2]
- understand stress strain relations for orthotropic materials [L2]

Unit III

Micromechanical behavior of a lamina: Introduction, mechanics of materials approach to stiffness, mechanics of materials approach to strength, comparison of approaches to strength.

Learning outcomes

After completion of this unit, students will be able to

- explain mechanics of materials approach to stiffness [L3]
- explain mechanics of materials approach to strength [L3]

Unit IV

Macromechanical behavior of a laminate: Classical Lamination Theory: Lamina stress-strain behavior, stress and strain variation in a laminate, resultant laminate forces and moments. Special Cases of Laminate Stiffness: Single-layered, symmetrical laminates, anti-symmetrical laminates, unsymmetrical laminates.

Learning outcomes

After completion of this unit, students will be able to

- evaluate stresses and strains in a laminate [L4]
- explain classical lamination theory [L3]

Unit V

Performance of composite materials: Strength Criteria of Orthotropic Lamina: Maximum stress failure, criterion, maximum strain failure criterion, Tsai-Hill failure criterion, Hoffman failure criterion and Tsai-Wu failure criterion.

Learning outcomes

After completion of this unit, students will be able to

- explain different failure creteria [L3]

Text Book(s)

R M Jones, Mechanics of Composite Materials, 2/e, Taylor and Francis, 1999.

References

Nicholas J. Pagano, Reddy J.N, Mechanics of Composite Materials, Kluwer Academic Publishers, 1994.

Agarwal. B. D, Broutman. L. J, Chandrasekhara K, Analysis and Performance of Fiber Composites, 3/e, John Wiley and Sons, 2006.

Mallick P.K, Fiber Reinforced Composites, 3/e, CRC Press, 2013.

Autar K Kaw, Mechanics of Composite Materials, 2/e, Taylor and Francis, 2013.

Course Outcomes:

- Understand the basics of composite materials, classification, and the fabrication techniques.
- Apply constitutive equations of composite materials and understand mechanical behavior at micro and macro levels.
- Perform stress and strain analysis in anisotropic and orthotropic materials having continuous fiber reinforcement
- Use classical lamination theory to predict strains, displacements bending and twisting deformation of laminates.
- Predict the failure in laminates using failure theories.

19EME455: ADVANCED MECHANICS OF SOLIDS

L	T	P	C
3	0	0	3

This course aims at finding deflections, stresses for various beams at different loading conditions. The pre-requisite for this course is basics of strength of materials. The knowledge gained from this course also helps in designing pressure vessels.

Course Objectives:

- To introduce the concept of columns and struts
- To demonstrate the calculation of bending moments and deflections of fixed and continuous beams.
- To explain the concept of shear center and unsymmetrical bending
- To analyze open and close coiled and laminate springs.

Unit I

Columns and Struts: Euler's theory, equivalent length, limitations of Euler's theory, Rankine formula, strut with eccentric loading, strut with initial curvature- Simple problems.

Learning Outcomes:

After completing this unit, the student will be able to

- contrast between a column and strut [l2]
- analyze columns at different loading conditions [L4]

Unit II

Fixed and continuous beams: Moment-area method, Macaulay's method, Clapeyron's three-moment equation, moment distribution method.

Learning Outcomes:
After completing this unit, the student will be able to

- explain different types of beams [L3]
- analyze fixed and continuous beams [L4]

Unit III

Springs: Close coiled helical springs, springs in series and parallel, concentric springs, open-coiled helical springs, laminated springs- Simple problems.

Learning Outcomes:
After completing this unit, the student will be able to

- differentiate closed and open coiled springs [L2]
- analyze closed and open coiled springs [L4]

Unit IV

Shear centre: Bending axis and shear center-shear center for axi-symmetric and unsymmetrical sections.
Unsymmetrical bending: Bending stresses in beams subjected to Nonsymmetrical bending; Deflection of straight beams due to nonsymmetrical bending.

Learning Outcomes:
After completing this unit, the student will be able to

- find the shear center [L4]
- determine the stresses in beams due to nonsymmetrical bending [L4]

Unit-V

Cylinders and Spheres: Thin cylinder, thin spherical shell, thin cylinder with spherical ends, volumetric strain, thick cylinders- lame's theory, compound tubes.
Learning Outcomes:
After completing this unit, the student will be able to

- differentiate thin and thick cylinder [L2]
- evaluate stresses in cylinders [L4]

Text books:

1. S S rattan, Strength of Materials, 2nd Edition, McGraw Hill, 2013.

References:

1. M. H. Sadd, Elasticity: theory, applications, and numeric, 3rd edition, Academic Press, 2014.
2. L. S. Srinath, Advanced mechanics of solids, 3rd Edition, McGraw-Hill, 2009.
3. R. G. Budynas, Advanced Strength and Applied Stress Analysis, 2nd Edition, McGraw Hill, 1999.
4. P. Boresi, R. J. Schmidt, Advanced Mechanics of Materials, 6th Edition, John Willey and Sons, 2009.

Course Outcomes:

After successful completion of this course student will be able to

- Design and analyze a column/strut for different loading conditions [L4].
- Evaluate the moments, deflections in fixed and continuous beams [L4].
- Evaluate the stresses, deflections and strain energy in springs [L4].
- Locate shear center and evaluate the stresses for different cross-sections subjected to unsymmetrical bending [L4].
- Analyze cylinders and spheres and design steam boilers, reservoirs, pressure vessels [L5].

19EME457: PRODUCTION PLANNING AND CONTROL

Production Planning and Control helps manufacturers in allocating resources such as people, materials, machines, and money for their efficient and optimum utilization to meet the product demand from customers

L	T	P	C
3	0	0	3

Pre-requisites: No pre-requisites are required

Course Objectives

- Know the importance of Production Planning and Control, Forecasting and Master Production Schedule.
- Acquaint with deterministic inventory models.
- Evaluate costs of production and inventory.
- Familiarize with planning procedure, seasonal and non-seasonal demand, make or buy decisions.
- Understand types of production control, applications of computers in production planning and control

Course Outcomes

After successful completion of this curse the student will be able to:

- acquaint with basic concepts of production planning and control and apply appropriate forecasting models to predict the demand.
- solve problems pertaining to inventory by choosing the right models.
- acquire fundamentals of cost accounting and evaluate the inventory models to reduce inventories costs.
- apply planning strategies and scheduling, loading, and other functions for smooth running of the organization.
- Apply controlling functions to manage manufacturing processes effectively.

Module I **10 Hrs**

Introduction: Objectives of production planning and control, definition,functions of production planning and control, organization of production planning and control department, the internal organization of the department.
Forecasting: Forecasting models, aggregate production planning, master production scheduling, materials requirements planning.

Learning outcomes:
At the end of this module, the student will be able to
- recognize the importance of Production Planning and Control [L2]
- understand the various planning methods and forecasting[L2]

Pedagogy tools:
Lecture, PPTs

Module II **10 Hrs**

Inventory Control: Objectives, economic and social complications of inventory management, limitations of inventory control. Functions of inventory, demand, and production characteristics. Measures of inventory performance.
Systematic Control of Inventory: Fixed order quantity systems, fixed interval systems, (s, S) systems, classification of items in inventory. Computer-based inventory control systems.

Learning outcomes:
At the end of this module, the student will be able to
- recognize the significance of Inventory Control[L2]
- understand Inventory systems[L2]

Pedagogy tools:
Lecture, PPTs

Module III **9 Hrs**

Cost Factor: The importance of costs, elements of costs, principles of cost determination and accounting systems, production and inventory cost factors, other costs to the firm.
Economic Quantities of Manufacture or Purchase: Lot size problems, finite production rates in manufacturing, quantity discounts.
Uncertainty: Effects of uncertainty, demand, and supply, safety stock, role of forecasting in production and inventory control. Uncertainty in production cycling.

Learning outcomes:
At the end of this unit, the student will be able to
- understand the significance of various costs associated with production and inventory[L2]
- solve lot size and discount quantity problems[L3]

Pedagogy tools:

Lecture, PPTs

Module IV **8 Hrs**

Production Planning: Scope of planning, types of production planning, demand analysis, seasonal and non-seasonal demand. Planning procedures, short term, and long term planning - make and buy decisions, product design and process selection, Scheduling, Loading

Learning outcomes:
At the end of this unit, the student will be able to
- understand planning procedure, seasonal and non-seasonal demand[L2]
- recognize the importance of make or buy decisions[L2]

Pedagogy tools:
Lecture, PPTs

Module V **8 Hrs.**

Production Control: Control objectives, problems in production control, types of production and production control systems, controlling production, Dispatching, Controlling. The layout of the physical system, design of production planning, and control systems. Application of computers in production planning and control.

Learning outcomes:
At the end of this unit, the student will be able to
- understand Production control and associated problems[L2]
- recognize the role of computers in Production Planning and Control[L2]

Pedagogy tools:
Lecture, PPTs

Text Book(s)
1.O. P Khanna, Industrial Engineering and Management, 4/e, Dhanpat Rai Publications, 2011.
2. Samuel Eilon,Elements of Production Planning and Control, Universal Publishing Corporation, 1999.

References
1.Magee and Boodman, Production Planning and Inventory Control, 2/e, McGraw Hill, 1967.
2.John E Biegal, Production Control: A Quantatative Approach, 2/e, Prentice Hall, 1971.
3. EH Mac Niece, Production Forecasting, Planning and Control, 3/e, John Wiley and Sons, 1961.
4. Seetharama L Narasimhan, Dennis W, McLeavey, Peter J Billington, Production Planning and Inventory Control, 2/e, PHI, 2004.

19EME459: LOGISTICS AND SUPPLY CHAIN MANAGEMENT

L	T	P	C
3	0	0	3

This course emphasizes on the existing logistical and supply-chain practices within the private and public sector industries. Students will be able to plan and coordinate the forward and backward flow of services and goods from one place to another in industry. ideas related to business strategy, project management, risk management, trade-off analysis and economics, as well as tools from probability/statistics, and optimization. Students will gain knowledge on applying logistics and supply-chain principles to achieve competitive advantage

Course Objectives:
- Introduce the major building blocks, functions, business processes, performance metrics and decisions (Strategic, tactical and operational) in the Supply chain.
- Analyze the inventory management methodologies to improve the performance of the supply chain.
- Explore three fundamental design concepts: component commonality, modularity vs. integral design, and universality, and a cost/benefit framework.
- Compare various procurement strategies and the Impact of technology on supply chain optimization in procurement strategy.
- Acquire knowledge on Risks and issues in Local and Global supply chains.

UNIT I ` **8 Hrs**

Introduction to Supply Chain Management (SCM):
Concept of supply management and SCM, the importance of supply chain flows, core competency, value chain, elements of supply chain efficiency, key issues in SCM, decision phases, supply chain integration, process view of a supply chain, competitive strategy and supply chain strategies, uncertainties in the supply chain, supply chain drivers.

Learning Outcomes:
After completing this unit, the student will be able to
- Explain operations and supply chain management issues in a firm. **[L-2]**
- Predict the importance of critical thinking skills in business situations**. [L-2]**
- analyze the manufacturing operations of a firm**[L-4]**
- apply logistics and purchasing concepts to improve supply chain operations**[L-3]**
- analyze the global business environment. **[L-4]**

UNIT II **8 Hrs**

Inventory Management: Introduction, selective control techniques, cost involved in the inventory system, single-stage inventory control, economic lot size models, application to economic production quantity, the effect of demand uncertainty, single-period models, initial inventory, multiple order opportunities, deterministic models, quantity discounts. periodic and quantity review policies, mathematical modelling under known stockout costs and service levels, joint replenishment for multiple items, inventory system constraints, working capital restrictions, and storage space restrictions.

Learning Outcomes:

After completing this unit, the student will be able to
- interpret inventory tracking system **[L-2]**
- classify Effective Inventory Management systems **[L-4]**
- analyze the satisfactory levels of customer service while keeping inventory costs within reasonable bounds. **[L-4]**

UNIT III **8 Hrs**

Designing Supply Chain Network: Introduction, network design, factors influencing network design, data collection, data aggregation, transportation rates, warehouse costs, capacities and locations, models and data validation, key features of a network configuration, impact of uncertainty on network design, network design in an uncertain environment, the value of information: Bullwhip effect, information sharing, information and supply chain trade-offs, distribution strategies, direct shipment distribution strategies, transhipment and selecting appropriate strategies.

Learning Outcomes:
After completing this unit, the student will be able to
- Recognize supply chain management in all its diverse aspects and applicability **[L-1]**
- Infer comprehensive strategic and tactical plans for an organization **[L-2]**
- associate supply chain design facilitates network integration**[L-2]**
- apply the main network design and implementation steps with case studies. **[L-3]**
- identify the factors that are to be taken into account during network design and in locating facilities**. [L-2]**

UNIT IV **8 Hrs**

Supply Chain Integration: Introduction, push, pull and push-pull supply chains, identifying appropriate supply chain strategy, sourcing and procurement, outsourcing benefits, the importance of suppliers, evaluating a potential supplier, supply contracts, competitive bidding and negotiation. Purchasing, objectives of purchasing, relations with other departments, centralized and decentralized purchasing, purchasing procedure, types of orders, e-procurement, tender buying, the role of business in supply chains.

Learning Outcomes:
After completing this unit, the student will be able to
- identify the components of an integrated logistics management system. **[L-2]**
- discuss the decisions involved in transportation management. **[L-2]**
- analyze suitable methodologies to design a solution for an LSM problem. **[L-4]**

UNIT V **10 Hrs**

Issues in Supply Chain Management: Introduction, risk management, managing global risk, issues in the international supply chain, regional differences in logistics. Local issues in the supply chain, issues in a natural disaster and other calamities, issues for SMEs, organized retail in India, reverse logistics.

Learning Outcomes:
After completing this unit, the student will be able to
- describe fundamental issues in supply chain management. **[L-1]**

● apply knowledge to evaluate and manage an effective supply chain by minimizing the risk factors. **[L-3]**
● associate supply chain management goals with corporate goals and strategies. **[L-2]**
● analyze the issues and search for methodologies to improve supply chain processes. **[L-4]**

Course Outcomes:
After successful completion of this course, the students will be able to
● explain strategic and operational frameworks to analyze supply chains. **[L-2]**
● interpret the concepts of inventory management in improving the performance of the supply chain. **[L-3]**
● categorize inventory control models and develop inventory control systems under deterministic and constrained scenarios **[L-4]**
● simulate the design of a supply chain network. **[L-3]**
● analyze the role of collaborative planning method in supply chain performance enhancement**[L-4]**

Text Books
1. Simchi-Levi, D. Kaminsky, P.Simchi-Levi, E. and Ravi Shankar, Designing and Managing the Supply Chain: Concepts, Strategies and Case Studies, 3/e, Tata McGraw-Hill, 2008.
2. Chopra, S. and Meindl, Supply Chain Management: Strategy, Planning and Operations, 2/e, Pearson Education, 2004

References
1. Doebler, D.W. and Burt, D.N, Purchasing and Supply Management-Text and Cases, 6/e, McGraw-Hill, 1996.
2. Tersine, R.J, Principles of Inventory and Materials Management, 4/e, Prentice Hall, 1994.

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	3	0	1	0	0	0	0	0	1	0	2		2	0	1
2	2	0	3	0	0	0	0	0	1	0	2		2	0	1
3	2	0	3	0	0	0	0	0	1	0	2		2	1	1
4	2	0	2	0	0	0	0	0	1	0	2		2	1	1
5	2	0	2	0	0	0	0	0	1	0	2		2	0	1

PROGRAM ELECTIVE V

19EME461: ENERGY CONSERVATION AND MANAGEMENT

L	T	P	C
3	0	0	3

Course Objectives

1. To impart the knowledge of energy resources, scenario and the importance of energy conservation techniques.
2. To identify various components and processes where possibility of energy recovery is possible like power plants.
3. To know the energy efficient methods in power production sector and to know the means of reducing loses in transmissions.
4. To impart the need of energy auditing in various industries even in domestic appliances. Also to identify energy efficient methods to reduce (optimize) energy input.

Course Outcomes

After successful completion of this course, the students will be able to

1. understand the need of energy conservation in the present scenario in the households and industries and need to perform energy audit and to perform above all the need of managing skills.
2. apply energy conservation tools and auditing techniques to bring efficient mechanism.
3. analyse the possible areas of energy conservation in the industries and process.
4. test the performance of the industrial components and processes using various methods available.
5. suggest methods to save valuable currency and foreign exchange by proper management of energy systems

UNIT I **7 Hrs**

Introduction

Introduction: Energy kinds: Indian energy scenario. Energy needs, energy security, energy conservation importance, energy conservation potential, industries and commercial establishments, energy conservation Act.

Learning Outcomes:

At the end of this **UNIT** , the student will be able to

- Understand the significance of energy conservation and energy conservation Act. [L1]
- Understand the energy consumption scenario in India [L1]

UNIT II **8 Hrs**

Energy Efficiency in Thermal Systems

Energy Efficiency in Thermal Systems: Boilers: Performances evaluation, analysis of losses, feed water treatment; blow down, energy conservation opportunities. FBC boilers- mechanism and advantages. Steam System: Assessment of steam distribution losses, steam leakages, steam trapping, condensate and flash steam recovery system, energy savings.; Furnaces: Classification, general fuel economy measures in furnaces, excess air, heat distribution, temperature control, draft control, waste heat recovery.

Learning Outcomes:

At the end of this **UNIT** , the student will be able to

- Understand the analysis of various losses in thermal systems [L1]
- Acquire the mechanism and advantages of FBC boilers [L2]
- Estimate the various losses in steam supply systems [L2]

UNIT III **8 Hrs**

Energy Efficiency in Electrical Utilities Energy Efficiency in Electrical Utilities: Electrical load management and maximum demand control, power factor improvement and its benefit, transformers, distribution and transformer losses, analysis of electrical power systems; Lighting System: Light source, choice of lighting, luminance requirements, and energy conservation

Learning Outcomes:
At the end of this **UNIT** , the student will be able to

- Understand the energy efficient mechanisms in electrical and lighting systems [L1]
- Acquire the knowledge to chose energy efficient lighting system [L1]
- Comprehend the lighting system luminance requirements for energy conservation. [L2]

UNIT IV **8 Hrs**

Energy Conservation in Utilities: Energy Conservation in Utilities: Fans, blowers, pumps, compressed air systems, refrigeration and air conditioning systems and cooling towers: Performance evaluation, efficient system operation and energy conservation

Learning Outcomes:

At the end of this **UNIT,** the student will be able to

- understand energy star rating for various rotodynamic appliances [L1]
- acquaint with the principles and design of efficient performance system [L2]
- Acquire the knowledge of performance evaluation [L3]

UNIT V **9 Hrs**

Biogas
Energy Conservation and Auditing: Definition, need, and types of energy audit, energy management (audit) approach, understanding energy costs, bench marking, energy performance, optimizing the input energy requirements, energy audit instruments; Preliminary and detailed energy audit, energy conservation act, Duties and responsibilities of energy managers and auditors.

Learning Outcomes:
At the end of this **UNIT,** the student will be able to

- Understand various types of energy audits.[L1]
- Comprehend the energy audit instruments and detailed analysis [L1]
- Apply energy audit procedure and propose strategies to conserve energy. [L2]

Text Books

1 Energy Manager Training Manual (4 Volumes) Bureau of Energy Efficiency: http://www.beeindia.in/energy_managers_auditors/ema.php?id=4
2 Y.P. Abbi, Shashank Jain, Handbook on Energy Audit and Environment Management, The Energy and Resources Institute, TERI, 2009

Reference Books

1 Steve Doty, Wayne C. Turner Energy Management Handbook, 7/e, the Fairmont Press, Inc., 2009
2 F Kreith, D. Y Goswami, Energy Management and Conservation handbook, CRC Press, 2008

3 YP Abbi and Shashank Jain. Handbook on Energy Audit and Environment Management, TERI Publications, 2006

19EME463: BIOENERGY

L	T	P	C
3	0	0	3

This course introduces the basic principles and different technologies of converting bioenergy. Student will be able to appropriately identify the methods and build biomass gasification systems of different capacities depending on application requirements, and Life cycle analysis.

Course Objectives

- Identify potential biomass feedstocks including energy crops;
- Have an understanding of the existing and emerging biomass to energy technologies;
- Have an understanding of LCA and applications;
- Develop a critical thinking about sustainability & resilience; and
- Determine potential solutions for energy needs and problems by incorporating the bioenergy technologies being explored.

Module 1

Bioenergy Concepts- Introduction: Biomass, Bio-Energy and Bio-Refinery, Basic concepts of circular economy based on organics. Biomass: Properties and types, Systems thinking, Biopower, bioheat, Biofuels, advanced liquid fuels, drop-in fuels, Biobased products.
Biofuels: liquid (biodiesel, bioethanol), gaseous (syngas, biogas), solid (charcoal and biochar).

Learning Outcomes:
After the completion of this unit, the student will be able to
- distinguish different types bio energy sources (L1)
- classify different methods of fuel production (L3)
- identify different bio mass properties (L4)

Module 2

Bioenergy conversion: Physical conversion: Dewatering, drying, size reduction, steam explosion, densification, pelleting, chipping, oil extraction.
Chemical conversion: Oil trans-esterification (biodiesel production), Hydrolysis, Pyrolysis - Other thermochemical conversion technologies.
Biochemical conversion: Anaerobic digestion (biogas production from organic waste and wastewater) and Fermentation (bioethanol production).

Learning Outcomes:
After the completion of this unit, the student will be able to
- distinguish different types conversion techniques (L1)
- classify different methods for biodiesel production (L3)
- identify different biochemical conversion techniques (L4)

Module 3

Biomass storage and feeding systems: Combustion plants for heat generation: wood and pellet burning stoves; wood, pellet and wood chips boilers; plant schemes for heat generation; control, protection and safety systems. Gasification plants, Pyrolysis plants. Innovative bioenergy plants: biomass to synthetic natural gas; biomass to liquid biofuels through Fisher Tropsch; absorption enhanced reforming. Hydrothermal processes: carbonization, liquefaction, gasification.

Learning Outcomes:
After the completion of this unit, the student will be able to
- classify the different types of biomass storage methods (L1)
- describe the different methods of hydrothermal processes (L2)
- explain the process of gasification plants (L2)

Module 4

Bioenergy & Environment: Criteria Pollutants, Carbon Footprint-Emissions of biomass to power generation applications -Emissions from biofuels, Emission control strategies.
Algal biofuels: Growth/harvest rates, transesterification

Learning Outcomes:
After the completion of this unit, the student will be able to
- explain different power generation techniques from biomass (L2)
- classify different emission control techniques (L3)
- describe the pollution criteria from biomass (L2)

Module 5

Life Cycle Analysis: General understanding of LCA - Cradle-to-grave, field to wheels concepts -Goal and scope determination, defining LCA boundaries, Life Cycle Inventory - Life Cycle Assessment.

Learning Outcomes:
After the completion of this unit, the student will be able to
- explain the understanding of LCA (L2)
- classify different LCA Inventory techniques (L3)
- describe the LCA assessment (L2)

Text Books
1. Biomass for renewable energy, fuels, and chemicals. D.L.Klass, Academic Press,
2. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
3. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
4. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
5. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

References

1. Advanced Biofuels and Bioproducts, J. W. Lee,
2. Algae for Biofuels and Energy, M.A. Borowitzka, N.R. Moheimani,
3. Biomass Conversion, C. Baskar, S. Baskar, R.S. Dhillon, https://link.springer.com/book/10.1007%2F978-3-642- 28418-2
4. Recycling of Solid Waste for Biofuels and Bio-chemicals, O.P. Karthikeyan, K. Heimann, S.S. Muthu, http://www.springer.com/cn/book/978981100148

Course Outcomes:
After the successful completion of the course, the student will be able to
- classify different types bioenergy production methods(L3)
- describe the biomass pyrolysis and transesterification process (L2)
- outline the different biomass gasification processes and their construction arrangements(L3)
- explain the types storage methods and emission control strategies (L2)
- analyze the Life cycle analysis (L5)

19EME467: AUTOMATION IN MANUFACTURING

L	T	P	C
3	0	0	3

Automated manufacturing systems operate in the factory on the physical product. They perform operations such as processing, assembly, inspection and material handling. Manufacturing automation is the use of control systems, such as computers and information technologies for handling different processes and machines in an industry to replace a human being. Students will get exposure to automated manufacturing systems and their importance in the modern automated factory.

Pre-requisites:
Manufacturing Processes, Introduction to CAD, CAM and Practical CNC Machining, Measurements and Metrology
Course Objectives
- To learn various concepts of automation and work part transport mechanisms.
- To study the assembly systems and their applications.
- To understand the importance of handling systems and identification systems.
- To apply the concepts of part families and machine cells into various production systems
- To recognize the importance of automated inspection and to distinguish the various control systems

Course Outcomes:
After the successful completion of this course, the student will be able to
- understand various concepts of automation and work part transport mechanisms.
- select and identify suitable transfer mechanisms and assembly systems for the given application.
- recognize the importance of handling systems and identification systems.
- understand various production systems and transfer lines and their applications
- differentiate various quality control aspects and automatic inspection techniques in automation

Unit-I **10 hours**

Manufacturing and Automation-Over View: Production systems, Automation in production systems, Automation principles and strategies, Reasons for Automation, Manufacturing operations, Functions in Manufacturing, production facilities. Basic elements of an automated system, levels of automation; Hardware components for automation and process control, programmable logic controllers, and personal computers. Automation for machining operations.

Learning outcomes:
At the end of this unit, the student will be able to

- recognize the significance of automation in production[L2]
- examine the various configurations of transfer lines, features and how they work[L2]

Pedagogy tools:
Lecture, PPTs, Few Videos

Unit-II **10 hours**

Assembly Systems and Line Balancing- Assembly Process-Assembly lines-manual single stations assembly, Manual assembly line, automated assembly system-Line balancing. **Automated Assembly Systems** – Design for automated assembly-Types of automated assembly systems-Parts feeding devices.

Learning outcomes:
At the end of this unit, the student will be able to

- explain the basic concepts of the assembly process and the systems[L2]
- solve the line balancing problems[L3]

Pedagogy tools:
Lecture, PPTs

Unit-III **9 hours**

Automated Material Handling and storage system: Material Handling and Identification Technologies: Material handling, equipment, Storage systems, performance and location strategies, Automated storage systems, AS/RS, types. Functions, material handling equipment-Conveyors, AGVS, Industrial Robots-Anatomy, Robot configurations, work volume-AS/RS. Automatic identification methods, Barcode technology, RFID.

Learning outcomes:
At the end of this unit, the student will be able to

- recognize the importance of various automated material storage and handling systems(AS/RS)[L2]
- understand the role of identification systems in AS/RS[L2]

Pedagogy tools:
Lecture, PPTs, Few Videos

Unit-IV **8 hours**

Manufacturing Systems and Automated Production Lines: Manufacturing systems: components of a manufacturing system, Single station manufacturing cells, Automated production lines, Applications.

Learning outcomes:
At the end of this unit, the student will be able to
- understand the fundamentals of automated production lines[L2]
- recognize the applications of transfer lines[L2]

Pedagogy tools:
Lecture, PPTs, Few Videos

Unit-V **8hours**

Control Systems-Process Industries Versus Discrete Manufacturing Industries, Continuous Versus Discrete Control: Continuous Control Systems, Discrete Control Systems, Computer Process Control: Control Requirements, Capabilities of Computer Control, Forms of Computer Process Control
Quality Control and Support Systems- Inspection principles and strategies, Automated inspection, contact and non-contact, CMM and machine vision techniques.

Learning outcomes:
At the end of this unit, the student will be able to
- examine the principles of automated inspection and sensor technologies[L2]
- recognize various control systems used in automation[L2]

Pedagogy tools:
Lecture, PPTs
Texbook(s)

1. Milkell P. Groover, Automation, Production Systems and Computer-Integrated Manufacturing, Kindle Edition, Prentice Hall of India, 2016.

References

1. C. Roy, “Robots and Manufacturing Automation”, Asfahl John Wiley & Sons.
2. Krishna Kant, “Computer Based Industrial Control”, EEE-PHI, 2nd edition, 2010.

19EME469: MOBILE ROBOTICS

L	T	P	C
3	0	0	3

Course description
This course is designed with fundamentals of mobile robots and study of algorithms for mobile robots. This course provides a general understanding of mobile robotics and related concepts such as kinematics and dynamics of mobile robots, sensing perception, localization, motion control, and planning. The unifying themes of this course are how mobile robots can navigate in known and unknown worlds and how to structure software to control a mobile robot.

Pre-requisites: Kinematics, and dynamics of Machinery, linear algebra, calculus, and differential equations

Co-requisites: Robotics and its Automation

Course Objectives
- To understand the basic concepts of robot locomotion and control systems of mobile robots.
- To impart and analyse the computational skills of robot kinematics and drive systems in mobile robots.
- To develop the ability to solve the problems and approaches of dynamic models in mobile robotics.
- To acquire the knowledge on vision-based sensors and localization systems and apply the concepts in robotic operation/environment.
- To offer knowledge on path planning algorithms to develop a robot for a given real-life application.

Unit 1 **8 Hrs**

Robot Locomotion: Types of locomotion wheeled and legged mobile robots, stability of mobile robots (non-holonomic, omnidirectional) - controllability and manoeuvrability.

Learning Outcomes
After completion of this unit, the student will be able to

Identify different types of robot locomotion and gain knowledge on mobile robots.	L2
Apply the concepts of stability control on real time mobile robots.	L4
Design the robot wheels and the mobile platform that can be controlled by the system.	L5

Pedagogy tools:
Video, Lecture, Practical

Unit 2 **10 Hrs**

Mobile Robot Kinematics: Forward and inverse kinematics, holonomic and nonholonomic constraints (unicycle, differential drive, tricycle, and car-like wheeled mobile robots (WMRs)) - kinematic models of 3-wheel, 4-wheel, and multi-wheel omni-directional WMRs.

Learning Outcomes

After completion of this unit, the student will be able to

Practice and solve the problems on Forward kinematic and inverse kinematics	L3
Gain the knowledge on differential drive wheeled robots	L1
Develop the kinematic models and analyse the computational skills to solve the problems	L4

Pedagogy tools: Video, Lecture, Practical

Unit 3 **8 Hrs**

Mobile Robot Dynamics: Dynamic modelling concepts and techniques of robots, dynamic models of simple car and legged robots, dynamic model of mecanum wheels and omni-directional robots, and dynamics simulation of mobile robots.

Learning Outcomes

After completion of this unit, the student will be able to

Gain the knowledge on Dynamic modelling concepts of mobile robots	L1
Analyse the dynamics models of mobile robots for various drive systems	L4
Compare and interpret the simulation models and applying the concepts on robotic systems.	L2

Pedagogy tools:

Video, Lecture, Practical

Unit 4 **8 Hrs**

Perception and Localization: Passive and active sensors, sensors for mobile robots like global positioning system (GPS), Doppler effect-based sensors, vision-based sensors. Odometric position estimation, probabilistic mapping, Markov localization, Bayesian localization, and positioning beacon systems

Learning Outcomes

After completion of this unit, the student will be able to

Demonstrate the types of sensors and their working principles based on applications.	L2
Identify the position and orientation of the robots with the help of Odometric application.	L3
Apply the concepts of localization and positioning systems in robotic environment.	L4

Pedagogy tools:

Video, Lecture, Practical

Unit 5 **10 Hrs**

Introduction to planning and navigation: Path planning algorithms based on A-star, Voronoi diagrams, probabilistic roadmaps (PRM), rapidly exploring random trees (RRT), Markov Decision Processes (MDP), stochastic dynamic programming (SDP)

Learning Outcomes

After completion of this unit, the student will be able to

Develop path planning algorithms for mobile robots to move in the robotic environment.	L3
Identify best suitable path planning algorithms for given mobile robots	L2
Apply the concepts of dynamic programming on real time robots with better navigation	L4

Pedagogy tools:

Video, Lecture , Practical

Texbook(s)	**Topics**
3. R. Siegwart, I. R. Nourbakhsh, “Introduction to Autonomous Mobile Robots”, The MIT Press, 2011	All
4. H. Choset, K. M. Lynch, S. Hutchinson, G. Kantor, W. Burgard, L. E. Kavraki, and S. Thrun, Principles of Robot Motion: Theory, Algorithms and Implementations, PHI Ltd., 2005	4,5
5. Peter Corke , Robotics, Vision and Control: Fundamental Algorithms in MATLAB, Springer Tracts in Advanced Robotics, 2011	3,4,5

Additional Reading(s)	**Topics**
1. Mikell P. Groover, Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey, Industrial Robotics, Technology programming and Applications, McGraw Hill International Edition, 2014	1,2,3
2. K.S. Fu, R.C. Gonzalez, C.S.G. Lee, Robotics Control, Sensing Vision and Intelligence, McGraw Hill Book Company, 2008	1,2,3

Journal(s)	**Topics**
1. S. Thrun, D. Hahnel, D. Ferguson, M. Montemerlo, R. Triebel, W. Burgard, C. Baker, Z. Omohundro, S. Thayer, W. Whittaker, A system for volumetric robotic mapping of abandoned mines, in: Proceedings of the IEEE International Conference on Robotics and Automation, 2003 2. W. Burgard, D. Fox, D. Henning, Fast grid-based position Tracking for mobile robots, in: KI—Kunstliche Intelligenz, 1997, pp. 289–300	All

Website(s)	**Topics**
1. S. M. LaValle, “Planning Algorithms”, Cambridge University Press, 2006. (Available online http://planning.cs.uiuc.edu/)	All

CO-PO MAPPING

	POs												**PSOs**		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	2	1	3	0	0	1	1	2	1			2
2	3	3	3	2	1	2	0	0	1	1	2	1		3	
3	3	2	3	2	1	3	0	0	1	1	2	1	3		

POs													PSOs		
4	3	3	3	2	1	1	0	0	1	1	2	1			2
5	3	3	3	2	1	2	0	0	1	1	2	1	2		

1-Low, 2- Medium and 3- High Correlation

Course Outcomes (COs)

After completion of this course, the student will be able to

1. Illustrate different types of robot locomotion and gain knowledge on mobile robots **[L2].**
2. Predict and solve the problems on Forward kinematic and inverse kinematics of mobile manipulators **[L3].**
3. Compute and analyse the equations of dynamics models of mobile robots for various drive systems **[L4].**
4. Apply the concepts of localization and positioning systems in robotic environment **[L5].**
5. Develop path planning algorithms for mobile robots to move in the robotic environment **[L2].**

19EME473: MECHANICAL VIBRATIONS

L T P C
3 0 0 3

The primary objective of this course is to enable to build and solve mathematical models of vibrating systems. The response of single and two degree of freedom systems and continuous system under free and forced vibrations will also be covered. Also discusses the various aspects of vibration control, including the problems of elimination, isolation, and absorption.

Course objectives

- ➢ To understand the basics of Vibration theory and types of vibration.
- ➢ Able to mathematically model real-world mechanical vibration problems.
- ➢ Able to write the differential equation of motion of vibratory systems.
- ➢ To make free and forced (harmonic, periodic, non-periodic) vibration analysis of single and two-degree of freedom linear systems.
- ➢ To derive the equation of motion of a continuous system from the using Newton s second law.
- ➢ To find the natural frequencies and mode shapes of the system using harmonic solution.

Unit I **10L**

Fundamentals of Vibration: Brief history of vibration, Importance of the study of vibration, basic concepts of vibration, classification of vibrations

Free Vibration of Single Degree of Freedom Systems: Introduction, Free vibration of an undamped translational system, free vibration of an undamped torsional system, stability conditions, Raleigh’s energy method, free vibration with viscous damping

Learning outcomes:

After completion of this unit, students will be able to

- ● describe briefly the history of vibration and indicate the importance of study of

vibration**[L3]**
● compute the values of spring constants, masses, and damping constants**[L3]**
● compute the natural frequency, damped frequency, logarithmic decrement, time constant. **[L3]**

Unit II **9L**

Harmonically Excited Vibrations: Introduction, Equation of motion, response of an undamped system under harmonic force, Response of a damped system under harmonic force, Response of a damped system under harmonic motion of the base.

Learning outcomes:
After completion of this unit, students will be able to
● find the responses of undamped and viscously damped single-degree-of-freedom systems subjected to different types of harmonic force **[L3]**
● distinguish between transient, steady-state, and total solutions. **[L2]**
● understand the variations of magnification factor and phase angles with the frequency of excitation and the phenomena of resonance and beats. **[L1]**

Unit III **10L**

Vibration Under General Forcing Conditions: Introduction, Response under a general periodic force, Response under a periodic force of irregular form
Two Degree of Freedom Systems: Introduction, Equation of motion for forced vibration, free vibration analysis of an undamped system, Torsional system

Learning outcomes:
After completion of this unit, students will be able to
find the responses of single-degree-of-freedom systems subjected to general periodic forces using Fourier series. **[L3]**
formulate the equations of motion of two-degree-of-freedom systems. **[L2]**
compute the eigenvalues or natural frequencies of vibration and the modal vectors. **[L3]**
determine the forced-vibration solutions under harmonic forces. **[L3]**

Unit IV **10L**

Determination of Natural Frequencies and Mode Shapes: Introduction, Dunkerley's formula, Rayleigh's method, Holzers' method, Matrix iteration method, Jacobi's method.

Learning outcomes:
After completion of this unit, students will be able to
- determine the free- and forced-vibration response of undamped systems using modal analysis.**[L3]**
- understand Rayleigh s principle, and the properties of Rayleigh s quotient, and compute the fundamental natural frequency of a system using Rayleigh s method.**[L1]**
- find the approximate natural frequencies of vibration and the modal vectors by using Holzer s method, Matrix iteration method, Jacobi's method.**[L3]**

Unit V **9L**

Continuous Systems: Transverse vibration of a spring or a cable, longitudinal vibration of bar or rod, Torsional vibration of a bar or rod, Lateral vibration of beams, Critical speeds of rotors.

Learning outcomes:
After completion of this unit, students will be able to

- find the natural frequencies and mode shapes of the system using harmonic solution.**[L3]**
- apply one- and two-plane balancing techniques for eliminating vibration (unbalance).**[L3]**
- design vibration and shock isolations for systems with fixed base as well as vibrating base.**[L5]**

Text Book(s):

1. S.S.Rao, Mechanical Vibrations, 5/e, Pearson publications.

References:

1. G.K. Grover, Mechanical Vibrations, 8/e, S. Chand & Co.
2. W.T. Thomson, Mechanical Vibrations, 2/e, Prentice Hill India.
3. S. Graham Kelly, Fundamentals of mechanical vibrations, 2/e McGraw-Hill.

Course Outcomes
After successful completion of the course, the student will be able to

- analyze free vibrations of single degree of freedom systems.
- Analyze harmonically excited vibratory systems
- Evaluate forced vibratory systems
- Determine natural frequencies and mode shapes of single and two degree of freedom systems
- Analyze continuous systems and critical rotors

CO-PO Mapping

Subject code	PROGRAMME OUTCOMES													
MECHANICAL VIBRATIONS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1						2							1		
CO2		2				2							1		
CO3		3											1		
CO4			2										1		
CO5		3											1		

19EME475: PRODUCT LIFE CYCLE MANAGEMENT

L T P C
3 0 0 3

Leading manufacturing firms aim to base their product realisation processes on the use of digital models of the product and the IT-systems that support the product throughout its lifecycle. Information Technology (IT) supports a wide range of tasks throughout a product's lifecycle including managing requirements, generating concepts, defining geometry, simulating function and properties, planning production, managing spare parts, maintaining, recycling and, retirement of the product. Industry has a strong need for engineers who are competent in using and adapting modern IT tools for product development and manufacturing. This requires knowledge and skills ranging from understanding the overall business down to the adaptation of IT tools. The course Product Lifecycle Management (PLM) aims to develop these skills.

Pre-requisites:
Before taking up this course, the student is expected to have the knowledge of :

- Product design
- Management concepts

Co-requisites:
Course Objectives:

- Familiarize with various strategies of PLM
- Understand the concept of product mapping and simulation.
- Develop New product development, product structure and supporting systems
- Interpret the technology forecasting and product innovation and development in business processes.
- Understand product building and Product Configuration.

UNIT I
INTRODUCTION TO PRODUCT LIFE CYCLE MANAGEMENT
Product life cycle – Introduction, growth, maturity & decline, Product Lifecycle Management-Definition & Overview, Background for PLM-corporate challenges, Need of PLM, Components/Elements of PLM, Emergence of PLM, Significance of PLM - life cycle problems to be resolved, product development problems to be resolved.

Learning Outcomes:
At the end of this unit the student will be able to

- Understand meaning of product life cycle management.(L1)
- Learn about CAD and EDM . (L4)
- Learn the PLM characteristics.(L3)

Pedagogy tools:
While teaching this module, the teacher may use power presentation of pictures and play Videos and can use black board for lectures.

UNIT II
DIGITAL LIFE CYCLE
Collaborative Product Development, Mapping Requirements to specifications. Part Numbering, Engineering Vaulting, Product reuse, Engineering Change Management, Bill of

Material and Process Consistency. Digital Mock up and Prototype development. Virtual testing and collateral. Introduction to Digital Manufacturing.

Learning Outcomes:
At the end of this unit the student will be able to

- Understand meaning of product development.(L1)
- Learn about requirements of mapping . (L4)
- Learn the digital manufacturing.(L3)

Pedagogy tools:
While teaching this module, the teacher may use power presentation of pictures and play Videos and can use black board for lectures.

UNIT III
PRODUCT LIFE CYCLE MANAGEMENT SYSTEM
Product life cycle management system- system architecture, Information models and product structure, Information model, the product information data model, the product model, functioning of the system. Reasons for the deployment of PLM systems.

Learning Outcomes:
At the end of this unit the student will be able to

- Understand meaning of PLM system.(L1)
- Learn about system architecture . (L4)
- Learn the information model.(L3)

Pedagogy tools:
While teaching this module, the teacher may use power presentation of pictures and play Videos and can use black board for lectures.

UNIT IV

P**RODUCT LIFE CYCLE ENVIRONMENT**
Product Data issues – Access, applications, Archiving, Availability, Change, Confidentiality. Product Workflow, The Link between Product Data and Product Workflow, Key Management Issues around Product Data and Product Workflow, Company's PLM vision, The PLM Strategy, Principles for PLM strategy, Preparing for the PLM strategy, Developing a PLM strategy, Strategy identification and selection.

Learning Outcomes:
At the end of this unit the student will be able to

- Understand the product data issues.(L1)
- Learn about PLM strategy . (L4)
- Learn how to prepare PLM strategy.(L3)

Pedagogy tools:
While teaching this module, the teacher may use power presentation of pictures and play Videos and can use black board for lectures.

UNIT V

COMPONENTS OF PRODUCT LIFE CYCLE MANAGEMENT

Different phases of product lifecycle and corresponding technologies, Foundation technologies and standards e.g. visualization, collaboration and enterprise application integration, Core functions e.g., data vaults, document and content management, workflow and program management, Functional applications e.g., configuration management. Human resources in product lifecycle. PLM Case Study.

Learning Outcomes:

At the end of this unit the student will be able to

- Understand different phases of product life cycle.(L1)
- Learn about core functions of PLM . (L4)
- Learn the functional applications of PLM.(L3)

Pedagogy tools:

While teaching this module, the teacher may use power presentation of pictures and play Videos and can use black board for lectures.

Course Outcomes:

CO1: Explain the various strategies of PLM and Product Data Management
CO2: Describe decomposition of product design and model simulation
CO3: Apply the concept of New Product Development and its structuring.
CO4: Analyze the technological forecasting and the tools in the innovation.
CO5: Apply the virtual product development and model analysis

Text Books:

1. Stark, John. Product Lifecycle Management: Paradigm for 21st Century ProductRealisation, Springer-Verlag, 2004. ISBN 1852338105
2. Fabio Giudice, Guido La Rosa, Product Design for the environment-A life cycle approach, Taylor & Francis 2006

Reference Books:

1. Product Lifecycle Management, Michael Grieves, Tata McGraw Hill, 2006.
2. Antti Saaksvuori, Anselmi Immonen, Product Life Cycle Management - Springer, 1st Edition (Nov.5, 2003).

CO-PO MAPPING

	POs												**PSOs**		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	1	1	0	0	2	2	2	1	0	1	1	1	0	0	1
2	1	1	0	0	2	2	2	1	0	1	1	1	0	0	1
3	1	1	0	0	2	2	2	1	0	1	1	1	0	0	1
4	1	1	0	0	2	2	2	1	0	1	1	1	0	0	1
5	1	1	0	0	2	2	2	1	0	1	1	1	0	0	1

19EME479 : MANAGEMENT INFORMATION SYSTEMS (Elective)

L	T	P	C
3	0	0	3

The course is a unified approach on computer-based information systems in business firms and government agencies. MIS combines the work of computer science, management science, and operations research with a practical orientation toward developing system solutions to real-world problems and managing information technology resources. It is also concerned with behavioral issues surrounding the development, use, and impact of information systems, which are typically discussed in the fields of sociology, economics, and psychology.

Course Objectives:

- To Provide overall understanding of the fundamental concepts of information systems, and to highlight the importance of information systems in modern organizations and societies.
- Understand the information processing pertaining to achieving goals, objectives and targets of business organization.
- To understand how Decision Support Systems (DSS) use models to process data and information.
- To impart knowledge on basic components of information technology infrastructure.
- To Gain insight of concepts of Business process reengineering (BPR) and process improvement, business value of systems.

Module I **10 Hrs**

Organizations, Management and the Networked Enterprise: Managing digital firm; Necessity of information systems (IS); New Role of IS in organizations; New opportunities with technology for IS. IS in the Enterprise: Major types, functional perspective and enterprise applications. IS, organizations, management and strategy.

Learning Outcomes:

After completion of this unit, the learners will be able to

- Understand Necessity of information systems (IS) in business environment.
- Assess the impact of the Internet and Internet technology on business and government.
- Integrate the organization business relationships with customers, suppliers, and employees in digital form.
- Explain how enterprise applications promote business process integration and improve organizational performance.
- Identify and describe important features of organizations that managers need to know about in order to build and use information systems successfully.
- Analyze how information systems support various business strategies for competitive advantage.

Module II **8 Hrs**

Information Technology Infrastructure: Categories of computer systems, types of software, managing hardware and software assets. Managing data resources; Telecommunications and networks.

Learning Outcomes:

After completion of this unit, the learners will be able to

- Define IT infrastructure and describe the components and levels of IT infrastructure.
- Assess contemporary computer hardware platform trends.
- Describe how a database management system organizes information and compare the principal database models.
- Describe the features of a contemporary corporate network infrastructure and key networking technologies.
- Evaluate alternative transmission media, types of networks, and network services.

Module III **8 Hrs**

Management and Organizational Support Systems for Digital Firm: Managing knowledge for the digital firm; Information and knowledge work systems, artificial intelligence, other intelligence techniques. MIS and decision support system (DSS).

Learning Outcomes:
After completion of this unit, the learners will be able to

- Assess the role of knowledge management and knowledge management programs in business.
- Evaluate the business benefits of using intelligent techniques for knowledge management.
- Describe different types of decisions and the decision-making process.
- Evaluate the role of information systems in helping people working individually and in a group make decisions more efficiently.

Module IV **8 Hrs**

Building Information Systems in the Digital Firm: Redesigning the organization with IS; Systems as planned organizational change; Business process reengineering (BPR) and process improvement. Understanding the business value of systems.

Learning Outcomes:
After completion of this unit, the learners will be able to

- Demonstrate how building new systems produces organizational change.
- Explain how a company can develop information systems that fit its business plan.
- Identify and describe the core activities in the systems development process.
- Evaluate alternative methods for building information systems and alternative methodologies for modeling systems.

Module V **8 Hrs**

Managing Change: Importance of change management in IS success and failure; Managing implementation.

Learning Outcomes:
After completion of this unit, the learners will be able to

- Evaluate models for understanding the business value of information systems.
- Analyze the principal causes of information system failure.
- Assess the change management requirements for building successful systems.

- Select appropriate strategies to manage the system implementation process.

Course Outcomes:
After successful completion of this course student will be able to
Assess role of MIS in ever evolving complex business scenario.

- Assimilate knowledge obtained in core concepts like Decision support systems and AI.
- Appreciate the role of MIS in organizations related to service and manufacturing sectors.
- Analyze real cases study by studying BPR (business process reengineering) to manage resources effectively and incorporating latest-cutting edge technology.
- Develop IT skills to become a successful IT and Business managers.

EME 452	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1					2			2		1	1				
CO2		3		3		3		1			1				
CO3				3				3	3						
CO4				3	3	3			3						
CO5				3				3	3						

Text Book(s):
K.C.Laudon and J.P.Laudon, Management Information Systems - Managing the Digital Firm, 8/e, PHI, 2004.

References:
1. Data C.J, An introduction to Data Base Management System, Narosa Publication House,, 1985.
2. Murdic, Ross and Clagget, Information Systems for Modern Management, PHI, 1985.
3. Davis Gordon, Management Information Systems – Conceptual Foundations, McGraw Hill, 1993.

PROGRAM ELECTIVE – VI

19EME440: ENERGY STORAGE AND CONVERSION SYSTEMS

L	T	P	C
3	0	0	3

The conversion of today's energy supply systems that still are based to a large extent on fossil and nuclear resources into energy supply systems that completely rely on renewable sources is the goal for the next decades. Most renewable sources are of intermittent nature – as it is with the topic of the master course on wind energy – and this will lead to completely new overall system design requirements to maintain reliable energy systems. Reliability of those converted energy systems will rely on mainly three pillars: energy storage, renewable overproduction, and their interconnection by smart grid technologies. This course is about energy storage.

Course Objectives: This course enables the students to:

- To learn about current and upcoming energy storage systems
- Critically examine the technology of energy systems that will be acceptable in a world faced with global warming, local pollution, and declining supplies of oil.
- Focus on renewable energy sources and other non-carbon/reduced-carbon emitting sources.
- Discuss the scientific principles underpinning the operation of energy storage systems.
- Work with a team to apply energy storage knowledge to develop and conduct a project.

Module – 1

Introduction to energy storage for power systems: Role of energy storage systems, applications.
Overview of energy storage technologies: Thermal, Mechanical, Chemical, Electrochemical, Electrical. Efficiency of energy storage systems.

Learning Outcomes:

- Understand need of energy storage systems (L1)
- Demonstrate the basic concepts energy storage systems (L3)
- Understand the necessity and usage of different energy storage schemes for different purposes (L5)

Module - 2
Electrical energy storage: Batteries, Super capacitors, Superconducting Magnetic Energy Storage (SMES), charging methodologies, SoC, SoH estimation techniques. Hydrogen production and storage, fuel cells.

Learning Outcomes:

- Demonstrate the basic concepts of **Electrical energy storage (L2)**
- Understand the concepts of Hydrogen production and storage (L4)
- Explain the physics of the environmental issues, including the greenhouse effect and global climate change (L3)

Module - 3

Storage for renewable energy systems: Solar energy, Wind energy, Pumped hydro energy. Energy storage in Micro-grid and Smart grid. Energy Management with storage systems, Battery SCADA, Increase of energy conversion efficiencies by introducing energy storage.
Learning Outcomes:

- Acquire knowledge pertaining to various ways to store energy, its analysis and use. (L2)
- Demonstrate knowledge of the different energy conversion systems and their typical applications (L2)

Module - 4

Thermal energy conversion: Thermo-electric generator, Concepts and design considerations of MHD generators, Cycle analysis of MHD systems, Thermionic power conversion and plasma diodes, Thermo chemical Conversion.

Learning Outcomes:
- Understand basic concepts of Energy conversion. (L2)
- Apply engineering design and analysis techniques to emerging energy conversion technologies

Module - 5

Bio-energy conversion systems: Bio-energy conversion, bio methanation technology, Thermo chemical conversions.

Learning Outcomes:
- Explain the concepts of Bio-energy conversion system. (L3)
- Analyze, perform and conduct preliminary design of various energy conversion systems.(L5)

Course Outcomes: Upon Successful Completion of this course, Students will be able to
- ➢ Understand the operational mechanisms of each energy storage system
- ➢ Analyze the thermal conversion system
- ➢ Evaluate the thermal conversion systems for high temperature applications
- ➢ The student will be able to cope up with upcoming technologies in the energy storage systems.
- ➢ Apply engineering design and analysis techniques to emerging energy conversion technologies

Textbook/s

1. Energy Storage - Technologies and Applications by Ahmed Faheem Zobaa, InTech
2. Energy Storage: Fundmentals, Materials and Applications, by Huggins R. A., Springer
3. Francisco Díaz-González, Andreas Sumper, Oriol Gomis-Bellmunt," Energy Storage in Power Systems" Wiley Publication, ISBN: 978-1-118-97130-7, Mar 2016.
4. S. S. L. Chang, Energy Conversion, Prentice Hall, 1963. 2. S. W. Angrist, Direct Energy Conversion, Pearson, 1982.

Reference Books

1. ***'Energy Storage Technology'*** is a course offered in the M. Tech. in Power & Energy Engineering program at School of Engineering, Amrita Vishwa Vidyapeetham, Amritapuri campus.
2. Kettani, M.A., Direct energy conversion, Addison-Wesley, Reading, Mass, 1970

19EME446: MODERN MANUFACTURING METHODS (Elective)

L	T	P	C
3	**0**	**0**	**3**

Modern manufacturing is at the heart of industrial production, from raw materials to semi-finished products and finished goods. Over the last decade, a number of innovative approaches have been developed that enable for more adaptable, energy-efficient, and environmentally friendly production processes. The students will learn about modern manufacturing procedures that are used in today's industry. Modern manufacturing methods concentrate on crucial factors of manufacturing, such as waste reduction, manpower, materials, capacity, and so on.

Course Objectives:
This subject provides students with

- An understanding of adaptive control to overcome the adverse effect of rapid changes in the system behavior.
- The Knowledge on manufacturing philosophies to achieve a competitive advantage through cost reduction and efficient service of customer demands.
- An understanding of form, fit and function of a part before expensive tooling is purchased.
- Comprehensive knowledge on material handling system to reduce unit cost of the part, reduced manufacturing cycle, reduced delays and damage.
- Analyze the existing production systems for the purpose of optimization, design verification of new systems, bottlenecks of the project, risks etc.

Course Outcomes:
Upon completion of the course the students will be able to

- Demonstrate a basic understanding of adaptive control machining; understand the various manufacturing philosophies, and role and material handling in manufacturing.

- Analyze the importance of Lean and Agile manufacturing strategies over mass production and can demonstrate the improvement in productivity and quality of the components.

- Improves the soft skills during development of customized software for manufacturing system simulation.

- It gives a clear insight in the area of prototype development and use of advanced materials for the product development.

Module I **8 hours**

Adaptive Control (AC): Definition of adaptive control, Importance of adaptive control system, comparison of conventional, CNC and AC systems; classification of adaptive control, adaptive control constraint, adaptive optimization, adaptive controlled optimization for machining process.

Module II **9 hours**

Lean, Agile and JIT Manufacturing: Introduction to Lean manufacturing, types of wastes in lean manufacturing, comparison lean and agile manufacturing, comparison of lean and agile. JIT Approach: Introduction, definition, elements of JIT, how JIT works, effects of JIT production, plant layout for JIT, product design for JIT, steps in implementation of JIT, benefits of JIT.

Module III **9 hours**

Rapid Prototyping: Definition, basic steps in rapid prototyping, various techniques in rapid prototyping - Stereolithography, Laminated Object Manufacturing, Selective Laser Sintering, Fused Deposition Modeling, Solid Ground Curing, 3D Printing; applications of rapid prototyping.

Module IV **8 hours**

Nano Manufacturing: Introduction, definition, Importance of nanomaterials, Classification of preparation methods, Nanomaterial - synthesis and processing - Mechanical grinding, wet chemical synthesis - Sol-gel process, Gas phase synthesis – Chemical vapour deposition (CVD), characteristics of Nano particles, applications of nanomaterials.

Module V **8 hours**

Micromachining processes: Definition, Need and applications of micromachining in engineering industries. Principle of mechanical, thermoelectric, electrochemical, and chemical micromachining processes - Size comparisons in micro manufacturing and micro products. Problems in micro machining.

Text Book(s)

1. Serope Kalpakjian, Steven Schmid, Manufacturing Engineering and Technology, 7/e, Pearson Education Publications, 2013.
2. David D Bedworth, M R Henderson, Philip M Wolfe, Computer Integrated Design and Manufacturing, McGraw Hill College, 1991.

References

1. Dr. Sadhu Singh, Computer Aided Design and Manufacturing, 5/e, Khanna Publishers, 2014.
2. P.N. Rao, CAD/CAM Principles and Applications, 6/e, Tata Mc Graw Hill, 2006.
3. Jain V. K., Introduction to Micromachining, 2nd edition, Narosa Publishers, New Delhi 2014.

19EME448: INTELLIGENT MANUFACTURING SYSTEMS

L	T	P	C
3	0	0	3

Course description:

This course is designed with fundamentals of automation and knowledge based intelligent manufacturing systems, study of machine learning concepts and apply to manufacturing domain. This course provides a general understanding of Group technology, automated process planning, Knowledge Based System for Equipment Selection (KBSES), Knowledge Based Group Technology. The unifying themes of this course are how manufacturing systems work and its uses in intelligent environments.

Pre-requisites: Manufacturing Processes, Group Technology, CIM, Manufacturing systems.

Course Objectives

- To learn various concepts of CIM systems, Manufacturing system design
- To study the process plans, inference engines and their applications.
- To understand the importance of clustering algorithm and expert systems for process planning

- To apply the concepts of Group technology models and algorithms into various production systems.
- To recognize the importance of artificial intelligence and Machine learning and apply to various manufacturing systems.

Unit 1 **8 Hrs**

Computer Integrated Manufacturing Systems: Structure and functional areas of CIM system- CAD, CAPP, CAM, CAQC, ASRS. Advantages of CIM. Manufacturing Communication Systems – MAP/TOP, OSI Model, Data Redundancy, Top down and Bottom-up Approach, Volume of Information. Intelligent Manufacturing – System Components, System Architecture and Data Flow, System Operation.

Learning Outcomes

After completion of this unit, the student will be able to

Identify different types of and gain knowledge on CIM systems	L2
Apply the concepts of on real time Intelligent Manufacturing	L4
Design the Intelligent Manufacturing System that can be controlled by the CIM systems.	L5

Pedagogy tools:

Video, Lecture, Practical

Unit 2 **10 Hrs**

Components of Knowledge Based Systems: Basic Components of Knowledge Based Systems, Knowledge Representation, Interference Engine, Knowledge Acquisition. Machine Learning – Concept of Artificial Intelligence, Conceptual Learning, Artificial Neural Networks, Applications in Manufacturing.

Learning Outcomes

After completion of this unit, the student will be able to

Understand the concepts of on basic components of Knowledge Based Systems	L3
Gain the knowledge on Artificial Neural Networks and Machine Learning	L1
Apply the concepts on real life manufacturing systems	L4

Pedagogy tools: Video, Lecture, Practical

Unit 3 **8 Hrs**

Automated Process Planning: Variant Approach, Generative Approach, Expert Systems for Process Planning, Feature Recognition, Phases of Process planning.

Learning Outcomes

After completion of this unit, the student will be able to

Gain the knowledge on generative approach concepts of automated process planning	L1
Develop the expert systems for automated process planning	L4
Identify the concepts of feature recognition on automated phases of process planning	L2

Pedagogy tools:
Video, Lecture, Practical

Unit 4 **8 Hrs**

Knowledge Based System for Equipment Selection (KBSES): Manufacturing system design, Equipment Selection Problem, Modeling the Manufacturing Equipment Selection Problem, Problem Solving approach in KBSES, Structure of the KBSES.

Learning Outcomes
After completion of this unit, the student will be able to

Demonstrate the types of Manufacturing system design and related equipment	L2
Gain the knowledge on Problem Solving approach in KBSES	L3
Apply the concepts of Modeling the manufacturing equipment on structure of the KBSES	L4

Pedagogy tools:
Video, Lecture, Practical

Unit 5 **10 Hrs**

Group Technology: Models and Algorithms – Visual Method, Coding Method, Cluster Analysis Method, Matrix Formation – Similarity Coefficient Method, Sorting-based Algorithms, Bond Energy Algorithm, Knowledge Based Group Technology - Group Technology in Automated Manufacturing System.

Learning Outcomes
After completion of this unit, the student will be able to

Develop models and algorithms for Intelligent manufacturing systems environment.	L3
Gain the knowledge on Knowledge Based Group Technology	L2
Apply the concepts of Group Technology in Automated Manufacturing System	L4

Pedagogy tools:
Video, Lecture , Practical

Texbook(s)	**Topics**
1. Intelligent Manufacturing Systems by Andre Kusaic.	All

Additional Reading(s)	**Topics**
1.Neural Networks by Wasserman.	3
2.Artificial Neural Networks by Yagna Narayana	3
3.Automation, Production Systems and CIM by Groover M.P.	1,2

CO-PO MAPPING

POs													**PSOs**		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**

1	3	3	3	2	1	3	0	0	0	1	2	1			2
2	3	3	2	2	1	2	0	0	0	1	2	1		3	
3	2	2	2	2	1	3	0	0	0	1	2	1	3		
4	2	3	3	2	1	1	0	0	0	1	2	1			3
5	3	3	3	2	1	2	0	0	0	1	2	1	2		

1-Low, 2- Medium and 3- High Correlation

Course Outcomes (COs)

After the successful completion of this course, the student will be able to

- defining the structure and functions of knowledge-based systems.
- understand various concepts of intelligent manufacturing and and its components.
- select and identify suitable algorithm for Group technology and assembly systems for the given application.
- recognize the importance of Manufacturing Communication Systems, Expert systems
- understand ANN, conceptual learning, ML and their applications in manufacturing industries.
- differentiate various structures in KBSGT and KBSES

19EME456: OPTIMIZATION TECHNIQUES

L	T	P	C
3	**0**	**0**	**3**

This course exposes the evaluation of the best possible solution for various engineering planning and design problems. The aim of the course is to train the students to develop a mathematical model and to solve the model by applying an appropriate mathematical programming technique. This course also covers advanced optimization techniques to solve dynamic and integer programming problems.

Course Objectives:

- To illustrate the importance of optimization techniques in theory and practice.
- To formulate and solve engineering design problems in the industry for optimal results
- To test the analytical skills in solving real engineering problems by applying appropriate optimization technique.
- To demonstrate various advanced optimization techniques being developed in recent times.
- To develop and promote research interest in problems of Engineering and Technology

UNIT I **8 Hrs**

Introduction to optimization: Introduction, engineering applications of optimization, statement of an optimization problem-design vector, design constraints, constraint surface, objective function, classification of optimization problems.

Classical Optimization techniques: Introduction, single variable optimization, multi variable optimization with no constraints, multi variable optimization with equality and inequality constraints.

Learning outcomes:

After completing this unit, the student will be able to

- **describe** the need and origin of the optimization methods [**L1]**
- **classify** design points, constraints, and optimization problems **[L2]**
- **choose** the method needed to solve the optimization problem [**L3]**

UNIT II **10 Hrs**

One Dimensional Minimization Methods: Introduction, unimodal function, elimination methods-exhaustive search, interval halving method, Fibonacci method, golden section method, interpolation methods-quadratic & cubic interpolation methods, direct root methods-Newton method, secant method.

Learning outcomes:
After completing this unit, the student will be able to

- **apply** elimination methods to find the narrowest region in which optimum point lies **[L3]**
- **solve** one dimensional minimization problems using interpolation and direct root methods **[L3]**

UNIT III **8 Hrs**

Unconstrained Minimization Methods: Introduction, Direct Methods- random search methods, univariate method, Powell's method. Descent method - steepest descent method (Cauchy's method)

Learning outcomes:
After completing this unit, the student will be able to

- **apply** random search methods to solve unconstrained multi-variable optimization problems [**L3]**
- **employ** pattern directions to find the optimal solution [**L3]**

UNIT IV **8 Hrs**

Dynamic Programming: Introduction, Bellman's optimality principle, application of Dynamic Programming - Shortest Path Problem, cargo-loading problem, optimal subdividing problem, Linear programming problem.

Learning outcomes:
After completing this unit, the student will be able to

- **formulate** the given linear/non-linear programming problem as a dynamic programming problem[**L6**]
- **evaluate** the optimal solution to dynamic programming problems using multi-stage decision process [**L4]**

UNIT V **8 Hrs**

Integer Programming: Introduction, All Integer and Mixed Integer Programming problems-Gomory's cutting plane method & Branch-and-bound method. Balas algorithm for zero-one programming.

Learning outcomes:
After completing this unit, the student will be able to

- **formulate** the integer and/or binary programming problem [**L3**]
- evaluate the optimal solution to integer and/or binary programming problem [**L4**]

Course outcomes:

- **classify** optimization problems and **apply** classical optimization techniques to solve NLPPs having differentiable functions [**L2&L3]**
- **apply** the concept of uni-modal function to **solve** one dimensional minimization problems **[L3]**
- **solve** any multi variable optimization problems
- **solve** any complex optimization problem as a dynamic programming problem and **analyze** its solution [**L3&L4]**
- recognize the significance of integer and/or binary solutions and apply a suitable algorithm for better decision making [**L1&L3]**

Textbooks:

1. S.S.Rao, Engineering optimization theory and practice,3rd Edition, New age international,2007.

Reference

1. H.A.Taha, Operations Research, 9th Edition, Prentice Hall of India, 2010.
2. F.S.Hillier, and G.J.Lieberman, Introduction to Operations Research, 7th Edition, TMH, 2009.

19EME458: PROJECT PLANNING AND MANAGEMENT

L	T	P	C
3	**0**	**0**	**3**

Course Objectives:

- This course is an introduction to the basic processes of project management for instructional design projects.
- Students will be introduced to organizational issues, methods of planning, and techniques for managing the business and creative processes that determine the success of a project.
- Students will learn to use project management software for organizing scheduling and monitoring project progress.

Unit I **8 Hrs.**

Project Planning: Analysis and Appraisal Generation of project ideas, Scouting for project ideas, Preliminary screening, Project rating index, Cost of project.
Investment Appraisal: Social cost benefit analysis, UNIDO approach, Net benefit in terms of economic prices, Measurement of impact on distribution, Savings impact and its value, Income distribution impact, Adjustment for merit and demerit, Goods Little Mirrless approach, Shadow prices.

Learning outcomes:

After completing this unit, the student will be able to

- Understand the role of Project Management in instructional technology and project development (L2)
- Apply theoretical aspects and approaches to managing technology-based projects (L2)
- Comprehend the importance of social cost benefit analysis(L2)
- Interpret the usage of social cost benefit analysis, UNIDO approach(L2)

Unit II **10 Hrs.**

Project Implementation: Development of project network, Dummy activities, Activity on node networks, Cyclic network, Forward pass and backward pass computations, Algorithm for critical path, Total slacks, free slacks, and their interpretations.

Time-cost Trade off Procedure: Schedule related project costs, Time cost trade off, lowest cost schedule.

PERT Network: Three time estimates for activities, Estimation of mean and variance of activity times, Event oriented algorithm for critical path, Probability of meeting a schedule date.

Learning outcomes:

After completing this unit, the student will be able to

- Identify major stakeholders and organizational dynamics in a projects life cycle (L2)
- Identify potential factors that impact successful project management including scope creep, budgeting, team dynamics and working with overseas development vendors(L2)
- Apply knowledge and skills to create a formal project planning document (L2)

Unit III **8 Hrs.**

Network Analysis:

Algorithms for shortest route problems-Dijkstra's, Floyd’s, and Pollack’s, algorithms.

Algorithms for minimal spanning tree- Kruskal's algorithm and Prim's algorithm;

Algorithms for maximal flow problems-Ford and Fulkerson's algorithm.

Learning outcomes:

After completing this unit, the student will be able to

- Recognize the importance of evaluating emerging technology in technology project management(L2)
- Explores algorithms and uses them in real time environments(L2)

Unit IV **8 Hrs.**

Linear Programming Formulation of Network Problems: A flow network interpretation for determination of critical paths, Time cost trade off and maximal flow, Chance constrained linear programming for probabilistic durations of activities in PERT network.

Learning outcomes:
After completing this unit, the student will be able to

- Apply theoretical aspects and approaches to managing technology based projects in network problems(L2)
- Explores linear programming problems and uses them in real time environments(L2)

Unit V **8 Hrs**

Project Scheduling with Limited Resources: Complexity of project scheduling with limited resources, leveling the demands on key resources, a simple heuristic program for resource allocation.

Learning outcomes:
After completing this unit, the student will be able to

- Identify the technical requirements of project management using MS Project(L2)
- Create and manipulate a projects specifics using Microsoft Project (L2)
- Apply knowledge and skills to create a formal scheduling project(L2)

Text books:

1. Parameshwar P. Iyer. Engineering Project Management with Case Studies, Vikas Publishing House Pvt. Ltd. New Delhi, 2005.
2. Prasanna Chandra, Projects Planning, Implementation and Control, Tata McGraw Hill Publishing Company Limited, New Delhi, 1995.

References:

1. Project Management Institute (PMI), A Guide to the Project Management of Knowledge Newton Square, PA, 1996
2. J.R. Meredith and S.J. Mantel. Project Management: A Managerial Approach. John Wiley and Sons, New York, 1995.
3. L.S. Srinath, PERT & CPM Principles & Applications, 3rd edition, East west Press,2001.

Course Outcomes:

- Understand the role of Project Management in instructional technology and project development
- Apply theoretical aspects and approaches to managing technology-based projects
- Identify major stakeholders and organizational dynamics in a project's life cycle
- Identify potential factors that impact successful project management including scope creep, budgeting, team dynamics and working with overseas development vendors
- Recognize the importance of evaluating emerging technology in technology project management
- Recognize the importance of consulting skills in working with clients and teams to properly manage and guide technology-based projects
- Apply knowledge and skills to create a formal project planning document

INTER DISCIPLINARY ELECTIVE II

19EHS475: ENTREPRENEURSHIP DEVELOPMENT

L T P C
3 0 0 3

This course aims to provide entrepreneurial abilities because business conditions have changed significantly since the advent of new technologies and business started demanding from both CEOs and managers entrepreneurial abilities which are in line with latest and contemporary business models in the era of globalization and disruption. This course includes a description of various concepts like process of entrepreneurship, opportunity identification, business plan preparation, registration process of business enterprise, funds requirement for business and evaluation of business enterprise.

Course Objectives:

- To identify the concept and process of Entrepreneurship and its role in the society.
- To recognize opportunity identification, different business model and business plan preparation.
- To explain the entrepreneurship development programmes (EDP) and Central government policy initiatives for entrepreneurship development
- To identify registration process of business enterprise.
- To assess funds requirement and evaluation of business enterprise.

Unit I: **8L**

Introduction: Entrepreneur and Entrepreneurship; Description of an Entrepreneur; Traits of an Entrepreneur; evolution of Entrepreneurship; functions of an entrepreneur; Entrepreneurial mindset; Entrepreneurial Motivation; entrepreneurial process; entrepreneurial competencies; types of entrepreneurship; role of entrepreneurship in the economic development.

Learning Outcomes:

At the end of this unit, the student will be able to

- identify the traits and functions of entrepreneur(L2).
- recognize entrepreneurial process and entrepreneurial competencies(L3).
- demonstrate the role of entrepreneurship in the economic development(L4).

Unit II: 8L

Business Idea Generation and Business Opportunity Identification: Scanning the environment; finding the gaps for new business and new ways of business, Start-up Culture and Incubation; Boot Camps; Mentoring the ideation process, validation of different ideas, Proto type Development; Business Model Development; need and importance of Business Plan preparation- process of Business Plan.

Learning Outcomes:

At the end of this unit, the student will be able to

- list the gaps for new business and new ways of business(L1).
- identify startup culture and incubation and boot Camps(L2).
- recognize mentoring the ideation process, validation of different ideas(L2).
- apply proto type development and business model development(L3).
- demonstrate the need for and importance of business plan preparation- process of Business Plan(L3).

Unit III: 8L

Entrepreneurship Development Programmes and Government Support to Entrepreneurs: Evolution of

Entrepreneurship Development Programmes (EDP)-Phases of EDPs-Course content and curriculum of EDPs– Educational Institutions and Entrepreneurship Development Programmes; Definition of Micro, Small and Medium Enterprises (MSME), growth and development of MSME's in India; Central Government Policy initiatives; District Industrial Centres and Industrial Estates.

Learning Outcomes:

At the end of this unit, the student will be able to

- identify the phases of EDPs and curriculum of EDPs(L2).
- recognize growth and development of MSME's in India(L2).
- to explain central government policy initiatives and district industrial centres(L2).

Unit IV: 8L

Registration of Business Enterprises: Business Name registration; Trademark registration; Patent registration and legal formalities; Sole Proprietorship, Partnership, Limited Liability Partnership (LLP), Private Limited Company and Public Limited Company Registration process; benefits of registration of enterprises; process of obtaining licenses and permissions including export and import license; Income Tax and Goods and Service Tax (GST) registration process.

Learning Outcomes:

At the end of this unit, the student will be able to

• interpret registration of business enterprises (L3).

• evaluate sole Proprietorship, Partnership, Limited Liability Partnership (LLP) (L6).

• Identify process of obtaining licenses and permissions including export and import license (L2).

Unit V: 8L

Funds Requirement and Evaluation of Business Enterprise: Own Capital v/s Loan Capital (equity and debt); Cost of the project; evaluation of different sources of funds - Projected Income and Turnover statements; Seed Capital, Angel Investment and Venture Capital; Institutional Financing to Entrepreneurs; Working Capital; Short term-medium term and Long term financing to entrepreneurs by financial institutions and commercial banks.

Learning Outcomes:

At the end of this unit, the student will be able to

• interpret the cost of the project, projected income and turn over statements (L3).

• evaluate different sources of funds (L6).

• recognize institutional Financing to Entrepreneurs financial institutions and commercial banks (L2). • Identify
process of obtaining licenses and permissions including export and import license (L2).

Case Analysis (not exceeding 200 words): Any Software Company Business Plan- Any Automobile Company
Business Plan- Any Ecommerce Business plan.

Course Outcomes:

At the end of the course, the student will be able to

• interpret the concept and process of Entrepreneurship and its role in the society (L3).

• differentiate different business model and analyse business plan preparation (L4).

• appraise entrepreneurship development programmes (EDP) and Central government policy initiatives for
entrepreneurship development (L4).

• conclude registration process of business enterprise (L6).

• estimate funds requirement and interpret short term, medium term and long term financing to entrepreneurs by financial institutions and commercial banks (L6).

Teaching and learning resources

1. Donald F. Kuratko, Entrepreneurship: Theory, Process, Practice, Cengage Learning, New Delhi, Latest Edition.
2. Robert Hisrich, M.J.Manimala, M.P.Peters and D. A.Shepherd “Entrepreneurship” MC Graw Hill Education, Latest Edition.
3. Bruce R Barringer, Preparing effective Business Plan-an Entrepreneurial Approach, New Delhi: Pearson Publication, Latest Edition.
4. Jeffrey A Timmons, New Venture Creation, New Delhi: Irwin publishers, Latest Edition.
5. Dr. S. S. Khanka “Entrepreneurship Development”, S. Chand and Company Limited, New Delhi, Latest Edition.
6.PoornimaM.Charantimath,"EntrepreneurshipDevelopment-SmallBusiness Enterprises", Pearson, New Delhi, Latest Edition.
7. Arya Kumar, & quot; Entrepreneurship: Creating and Leading an Entrepreneurial Organization" Pearson, New Delhi, Latest Edition.
8. Vasant Desai, Dynamics of Entrepreneurial Development and Management New Delhi: Himalaya Publishing House, Latest Edition.

Journals

1. Harvard Business Review
2. International Journal of Entrepreneurial Behaviour And Research
3. International Journal of Small Business Management
4. International Journal of Entrepreneurship And Innovation Management

Daily English News Papers

1. The Mint
2. The Economic Times
3. Business Standard
4. Business Line

19ECS473: INTRODUCTION TO SOFTWARE ENGINEERING

L	T	P	C
2	1	0	3

This course provides the fundamentals of software engineering, including understanding system requirements, effective methods of design, coding and testing, team software development, and the application of engineering tools. By applying the above scientific knowledge, we can create practical, cost effective solutions to computing and information processing problems.

Course objectives:

- Have a good understanding of the Software Development Life Cycle [SDLC].
- Good Knowledge about how to the design based on the project requirements and planning.
- Knowing what kind of process model has to be implemented based on the Communication and Planning.
- Understanding of the Project, Quality and Risk Managements in the Project.
- All will have good expose to the S/W testing strategies, Tactics and Software Metrics.
- They will have the good understanding of the good software development practices

Module I:

Introduction: Evolution, Software Development Projects, Exploratory Style of Software Development, Emergence of Software Engineering, Notable Changes in Software Development Practices, Computer Systems Engineering

Software Life Cycle Models: A Few Basic Concepts, Waterfall Model and its Extensions, Rapid Application Development (RAD), Agile Development Models, Spiral Model, A Comparison of Different Life Cycle Models

Learning utcomes:

After completion of this unit, the student will be able to:

- illustrate the importance of software engineering (L2)
- identify the changes in software development practices (L3)
- outline different software life cycle models (L2)
- select which model fits for different types of problems (L3)

Module II:

Requirements Analysis And Specification: Requirements Gathering and Analysis,

Software Requirements Specification (SRS), Formal System Specification, Axiomatic Specification, Algebraic Specification, Executable Specification and 4GL

Software Design: Overview of the Design Process, How to Characterise a Good Software Design? Cohesion and Coupling, Layered Arrangement of Units, Approaches to Software Design.

Learning Outcomes:

After completion of this unit, the student will be able to:

- find the requirements for different types of problems (L1)
- list different specification methods for a given problem (L1)
- identify project constraints and solutions, problem decomposition, requirements elicitation (L3)
- develop a model for a given problem using different levels of design methodologies

(L3)

Module III:

Function-Oriented Software Design: Structured Analysis, Developing the DFD, Model of a System, Structured Design, Detailed Design, Design Review

Basic Object-Orientation Concepts: Unified Modelling Language (UML), UML Diagrams, Use Case Model, Class Diagrams, Interaction Diagrams, Activity Diagram, State Chart Diagram

User Interface Design: Characteristics of a Good User Interface, Basic Concepts, Types of User Interfaces, Fundamentals of Component-based GUI Development, A User Interface Design Methodology

Learning utcomes:

After completion of this unit, the student will be able to:

- develop a design for software problem using UML diagrams (L3)
- show the solution of software problem in various UML diagrams (L2)
- understand the multiple levels of detail and abstraction of a solution (L2)
- identify design patterns that best suits for a problem solution (L3)

Module IV:

Coding and Testing: Coding, Software Documentation, Testing, Unit Testing, Black-box Testing, White-Box Testing, Debugging, Program Analysis Tools, Integration Testing, Testing Object-Oriented Programs, System Testing

Software Reliability and Quality Management: Software Reliability, Statistical Testing, Software Quality, Software Quality Management

Learning utcomes:

After completion of this unit, the student will be able to:

- distinguish various types of testing methods and their importance (L4)
- Apply these methods for testing the solution of a problem (L3)
- Develops a reliable software solution for a problem (L3)
- Understand the importance of software quality (L2)

Module V:

Computer Aided Software Engineering, Case and its Scope, Case Environment, CASE Support in Software Life Cycle, Other Characteristics of Case Tools, Towards Second Generation CASE Tool, Architecture of a Case Environment.

Software Maintenance: Characteristics of Software Maintenance, Software Reverse Engineering, Software Maintenance Process Models, Estimation of Maintenance Cost.

Learning utcomes:

After completion of this unit, the student will be able to:

- explain three different perspectives for CASE tools classification (L2)
- compare and contrast the fitness of existing CASE Tools to the needs of specific software development context (L2)
- construct documentation and presentations for effective software reuse (L3)

Text Books(s)

1. Rajib Mall, Fundamentals of Software Engineering, 4/e, PHI, 2009.

Reference Book(s)

1. Roger S. Pressman, Software Engineering: A Practitioner's Approach, 7/e, McGraw Hill, International Edition, 2009
2. K.K. Agarwal &Yogesh Singh, Software Engineering, New Age International Publishers, 2007.
3. Waman S Jawadekar, Software Engineering Principles and Practice, McGraw Hill, 2004.

Course Outcomes:

- make use of different process models in the SDLC. (L3)
- construct system design by using different types of modeling i.e., object oriented, scenario based, flow oriented, class based (L3)
- understand Pattern based design, Architectural Design; Component based Design, user Interface Design (L2)
- develop different test strategies, understand different test tactics (L3)
- understand project estimation and quality, of Risk and Quality Management and apply in applications (L2)

19ECS475 Introduction to Web Technologies

L	T	P	C
2	**1**	**0**	**3**

Course objectives:

- Design static web page using Markup languages.
- Design and implement webpages using style sheets.
- Implement with java script web applications with dynamic webpages.
- Understand working of Webservers and Design Methodologies.
- Develop web applications using XML.

Module I **8 hours**

Introduction to HTML Version 5 and Cascading Style Sheets (CSS)Version 3: Basic syntax, elements, attributes and tags, paragraph, heading, forms, frames, CSS: levels of style sheets, style specification formats, selector forms, span and div tags.

Learning Outcomes:

After completion of this unit, the student will be able to:

- outline various steps to design static websites. (L2)
- demonstrate the importance of HTML tags for designing web pages. (L2)

- distinguish the design from content using various levels of Style Sheets. (L4)

Module II **8 hours**

Introduction to Java Script and Document Object Model (DOM): Variables, literals, operator and control structures, arrays, functions, the window object, the location object, the history object and event handlers: Key Press, Mouse handlers.

Learning Outcomes:

After completion of this unit, the student will be able to:

- Illustrate dynamic, interactive web pages by embedding Javascript code in HTML (L3)
- Demonstrate validations of user input and perform dynamic documents. (L2)

Module III **8 hours**

Introduction to XML: Syntax of XML, document structure, and document type definition, namespaces, XML schemas, document object model.

Learning Outcomes:

After completion of this unit, the student will be able to:

- Understand XML document structure (L1)
- Create XML documents (L3)

Module IV **9 hours**

Introduction to Servlets and Tomcat Web Server: Lifecycle of a servlet, the servlet API, the javax.servlet package, Tomcat Server and testing Tomcat, structure of web application, deploying web application.

Learning Outcomes:

After completion of this unit, the student will be able to:

- demonstrate running of application on Tomcat server instance(L2)
- Illustrate structure of web application and its deployment. (L3)

Module V **9 hours**

Introduction to JSP: JSP and servlet, the anatomy of a JSP page, JSP syntax, comments, expressions, scriptlets, scope of objects and synchronization.

Learning Outcomes:

After completion of this unit, the student will be able to:

- Understand the anatomy of JSP page. (L1)
- Illustrate application development framework using JSP objects. (L3)

Text Book(s)

1.Uttam K.Roy, Web Technologies, 2/e, Oxford Higher Education Publication,2010.

References

1.Dietel and Nieto, Internet and World Wide Web – How to Program, Pearson Education, Asia, 2009.

2.Chris Bates, Web Programming Building Internet Applications, 3/e, Wiley India,2009.

Course Outcomes:

- Demonstrate the importance of HTML & DHTML tags for designing webpages and separate design from content using Cascading Style Sheet(L2)
- Interprets the design process of interactive web pages with client and server-side scripting(L4)
- Apply validations on user input using JavaScript (L3)
- Understand XML document structure. (L2)
- Understand how to create and deploy Web Applications over webserver. (L2)

INTER DISCIPLINARY ELECTIVE II

19EEI472: Micro Electromechanical Systems

L	T	P	C
2	1	0	3

This course introduces the fundamentals and applications of MEMS. The course emphasizes the working principles, fabrication technologies and packaging methods of MEMS and Microsystems. This course also deals with operating principles of Micro characterization techniques.

Course Objectives:

- To make clear the fundamentals and applications of MEMS and micro systems.
- To explain the working principles of micro sensors and actuators.
- To impart knowledge on various micro fabrication technologies.
- To outline the fundamentals of Micro characterization methods.
- To discuss different packaging methods used in MEMS and microsystems.

UNIT I **8L**

Introduction: Need for miniaturization, Microsystems versus MEMS, micro fabrication, smart materials, structures and systems, integrated microsystems: micromechanical structures, microsensors, microactuators, applications of smart materials and microsystems. Applications of MEMS in the automotive, health care, aerospace, industrial products, consumer products and telecommunications.

Learning outcomes:

After completion of this unit, the student will be able to

- get an overview of MEMS and microsystems (L1).
- state the need for miniaturization (L1).
- describe the role of micro fabrication (L2).
- differentiate the micro sensors and actuators(L4).
- recognize the applications of MEMS in various fields(L1).

UNIT II **8L**

Microsensors and Actuators: Silicon capacitive accelerometer, piezo resistive pressure sensor, conductometric gas sensor, electrostatic comb drive, a magnetic micro relay, portable blood analyzer, piezoelectric inkjet print head, micromirror array for video projection, micro-PCR systems, smart materials and systems.

Learning outcomes:

After completion of this unit, the student will be able to

- illustrate the working principles of various MEMS sensors (L1).
- discuss about the differences between micro sensors and actuators (L2).
- explain the operation of MEMS accelerometers, pressure sensors and gas sensors (L2).
- summarize the advantages and limitations of various MEMS sensors and actuators (L2).
- list the applications of various smart materials and systems (L1).

UNIT -III **8L**

Micro Fabrication Technologies: Silicon as a material for micromachining, thin-film deposition, lithography, doping, etching, silicon micromachining: bulk and surface, specialized materials for microsystems: polymers and ceramic materials, advanced processes for micro fabrication: wafer bonding techniques, dissolved wafer processes, LIGA process, HexSil process.

Learning outcomes:

After completion of this unit, the student will able to

- identify the importance of silicon as a substrate material (L1).
- get on overview on physical and chemical techniques for thin film deposition (L1).
- distinguish dry and wet chemical etching techniques (L4).
- compare bulk and surface micromachining processes (L2).
- describe polymeric and ceramic materials and their processing (L2).

UNIT -IV **8L**

Micro Characterization Techniques: Scanning electron microscopy, X-ray diffraction, X-ray photoelectron spectroscopy, atomic force microscopy, UV-visible spectroscopy, Fourier transform infrared spectroscopy, transmission electron spectroscopy.

Learning outcomes:

After completion of this unit, the student will able to

- understand the working principles of various characterization techniques (L1).
- explain the advantages and limitations of different characterization techniques (L2).
- recognize the techniques to characterize a material (L2).
- summarize the features of various characterization techniques (L4).
- differentiate the types of spectroscopy techniques(L4).

UNIT -V **8L**

MEMs Packaging: Overview of mechanical packaging of microelectronics, micro-system packaging, interfaces in micro-system Packaging, essential packaging technologies, three-dimensional packaging, assembly of MEMS, selection of packaging materials, signal mapping and transduction, design case: pressure sensor packaging.

Learning outcomes:

After completion of this unit, the student will able to

- differentiate microelectronic packaging and microsystem packaging (L4).
- describe different interfaces in microsystem packaging (L2).
- summarize the features of three dimensional packaging (L4).
- identify materials used for microsystem packaging (L1).
- describe the major steps involved in pressure sensor packaging (L2).

Text Books:

1. G.K. Ananthasuresh, K.J. Vinoy, S. Gopalakrishnan, K.N. Bhat, V.K. Aatre, Micro and Smart Systems, Wiley India, 2010.
2. Tai-Ran Hsu, MEMS and Microsystems: Design and Manufacture, Mc Graw Hill India, 1st edition, 2004.

References:

1. Vijay K. Varadan, K. J. Vinoy, S. Gopalakrishnan, Smart Material Systems and MEMS: Design and Development Methodologies, John Wiley, 2006.
2. Mohamed GadelHak, The MEMS Handbook, 2nd Edition, CRC Press, 2005
3. M.-H. Bao, Micromechanical Transducers: Pressure sensors, accelerometers, and gyroscopes, Elsevier, New York, 2000.
4. M.J. Madou, Fundamentals of Microfabrication, 3rd Ed, CRC Press, 2011.
5. Vinod Kumar Khanna, Nano sensors: Physical, Chemical and Biological, Series in Sensors, CRC press, Taylor and Francis Group, 2012.

Course outcomes:

After completion of this course, the student will be able to

- understand the MEMS and microsystem working principles (L1).
- acquire knowledge on micro sensors and actuators (L2).
- describe various MEMS fabrication methods (L2).
- explain the working principles of various types of micro characterization methods (L2).
- understand different microsystems packaging techniques (L1).

19EEI371: Sensors and Signal Conditioning

L	T	P	C
2	**1**	**0**	**3**

Measurements pervade our life. Industry, commerce, medicine, and science rely on measurements. Sensors enable measurements because they yield electric signals with embedded information about the measurand. Electronic circuits process those signals to extract that information. Hence, sensors are the basis of measurement systems. The emphasis of this course is on the design of a sensor and its signal conditioning circuits

Course Objective:

1. To understand the basic fundamentals of sensors and their characteristics.
2. To implement the principles of Resistive sensors and its signal conditioning circuit
3. To apply the concepts of Reactance variation and Electromagnetic sensors
4. To realize the Self-Generating sensors and its signal conditioning circuits
5. To interpret the concepts of Intelligent Sensors & other sensing methods

UNIT I **8L**

Introduction to sensor-based measurement systems: General concepts and terminology, sensor classification, static characteristics & dynamic characteristics of measurement systems **Primary Sensors:** Temperature, pressure, flow velocity and flow-rate, level, force and torque, acceleration and inclination, velocity sensors, microsensor technology.

Learning Outcomes: The students will be able to

- Understand the basic sensor classification (L1)
- Analyze the Sensor Performance Characteristics(L4)
- Limitations of sensor. (L3)
- Understand about the Different primary sensors. (L1)
- Analyze Purpose of microsensor technology(L4)

UNIT II **8L**

Resistive Sensors: Potentiometers, strain gauges, resistive temperature detectors (rtds), thermistors, magnetoresistors, light-dependent resistors (LDRs), resistive hygrometers, resistive gas sensors, liquid conductivity sensors, **Signal conditioning for resistive sensors:** Measurement of resistance, voltage dividers, Wheatstone bridge: balance measurements, Wheatstone bridge: deflection measurements, differential and instrumentation amplifiers, interference.

Learning Outcomes: The students will be able to

- Understand the basics resistive sensors
- Describe the signal conditioning for the measurement of resistance
- Explain the basic circuits for Wheatstone Bridge.
- Analyze the Amplifiers circuits.
- Outline the concepts of interference circuits.

UNIT III **8L**

Reactance variation and electromagnetic sensors: capacitive sensors, inductive sensors, electromagnetic sensors, **Signal conditioning for reactance variation sensors:** problems and alternatives, ac bridges, carrier amplifiers and coherent detection, specific signal conditioners for capacitive sensors, resolver-to-digital and digital-to-resolver converters.

Learning Outcomes: The students will be able to

- describe the working principle of electromagnetic, capacitive, inductive sensors
- Analyze the problems related to AC Bridges.
- Understand the signal conditioning circuits reactance variation sensors
- Illustrate converters of sensors
- Amplify and detect signal conditioning

UNIT IV **8L**

Self-generating sensors: thermoelectric sensors: thermocouples, piezoelectric sensors, pyroelectric sensors, photovoltaic sensors, electrochemical sensors, **Signal conditioning for self-generating sensors:** chopper and low-drift amplifiers, electrometer and transimpedance amplifiers, charge amplifiers, noise in amplifiers, noise and drift in resistors

Learning Outcomes: The students will be able to

- elaborate the basic principles related to temperature sensors.
- Describe the Working principle of photodiodes and its types.
- Illustrate the self generating sensors
- Amplify the signal conditioning circuits
- Detect noise and drift in amplifiers & Resistors

UNIT V **8L**

Digital and intelligent sensors: position encoders, resonant sensors, variable oscillators, conversion to frequency, period, or time duration, direct sensor-microcontroller interfacing, communication systems for sensors, intelligent sensors, **Other sensing methods:** Sensors based on semiconductor junctions, sensors based on MOSFET transistors, charge-coupled and CMOS image sensors, fiber-optic sensors, ultrasonic-based sensors, biosensors

Learning Outcomes: The students will be able to

- Describe the construction and operation of Interfacing circuits
- Enumerate the working principle related to intelligent sensors
- Outline the concepts of sensors based on semiconductors
- Apply the principle related o Fiber optic sensors
- Illustrate the various Biosensors

TEXTBOOK:

1. Sensors and Signal Conditioning, 2nd Edition,Ramon Pallas-Areny, John G. Webster,John Wiley & Sons, 2000.

REFERENCES:

1. A. K. Sawhney, PuneetSawhney, A Course in Mechanical Measurements and Instrumentation, 1/e, Dhanpat Rai and Company, 2001.
2. D. V. S. Murthy, Transducers and Instrumentation, 1/e, Prentice Hall of India, 1995.
3. D. Patranabis, Sensors and Transducers, 1/e, Prentice Hall of India, 2004.
4. D. Patranabis, Principles of Industrial Instrumentation, 1/e, Tata McGraw Hill Education, 2010.

Course Outcomes:

After the completion of the course the student will be able to

1. Classify different types of sensors and their characteristics (L2)
2. Build the signal conditioning circuits for different resistive sensors (L3)
3. Develop the signal conditioning for reactance variation and electromagnetic sensors (L4)
4. Implement the signal conditioning for self-generating sensors (L2)
5. Identify the differences between conventional sensors and Intelligent sensors (L1)

INTERDISCIPLINARY ELECTIVES III

19ECS344: Introduction To Machine Learning

L	T	P	C
2	1	0	3

Machine Learning is a flourishing subject in Computer Science which devises models that can automatically learn from data and detect patterns from data. The applications of machine learning are diverse ranging from self-driven cars to disaster management systems. With easy availability of data from different devices and measurements, machine learning techniques become imperative in analysing trends hidden in the data. This course focuses on the major tasks of machine learning viz., supervised and unsupervised learning approaches that can robustly address data that is non-linear, noisy as well as high-dimensional in nature.

Course objectives

1. Introduce the concepts of machine learning and the complete process model for working with real data
2. Impart the various approaches to supervised learning.
3. Demonstrate unsupervised learning approaches.
4. Illustrate the performance of ensemble models and familiarize with dimensionality reduction techniques
5. Differentiate between shallow and deep neural networks.

Module I: Machine Learning Fundamentals Number of hours 8

Machine Learning Fundamentals: Use of Machine Learning, Types of machine learning systems, machine learning challenges, testing and validating, working with real data, obtaining the data, visualizing the data, data preparation.

Learning Outcomes:
After completion of this unit, the student will be able to:
1. Identify different machine learning approaches and applications (L1)
2. Demonstrate basic machine learning approach using real world data (L2)
3. Use machine learning approach to train and fine tune a learner (L3)

Module II: Supervised Learning Number of hours 9

Supervised Learning: Classification, training a binary classifier, performance measures, multiclass classification, error analysis, multi label classification, multi output classification.
Linear Regression, Polynomial Regression, Logistic Regression.

Learning Outcomes:
After completion of this unit, the student will be able to:
1. Demonstrate various supervised learning approaches (L2)
2. Describe classification techniques for real-time data. (L2)
3. Apply regression to make good predictions (L3)

Module III: Unsupervised Learning Number of hours 8

Unsupervised Learning: Clustering, K-Means, Using clustering for image segmentation, Semi-supervised learning, DBSCAN, other clustering algorithms.
Gaussian Mixtures, anomaly detection, selecting number of clusters.
Learning Outcomes:
After completion of this unit, the student will be able to:
1. Illustrate various clustering techniques (L2)
2. Construct Gaussian Mixture Models to implement anomaly detection (L3)
3. Analyze suitability of different clustering techniques for real-time data (L4)

Module IV: Dimensionality Reduction & Ensemble Learning Number of hours 9

Dimensionality Reduction: The curse of dimensionality, main approaches for dimensionality reduction, PCA, Kernel PCA, LLE.
Learning Outcomes:
After completion of this unit, the student will be able to:
1. Choose best features defining a dataset through dimensionality reduction (L3)
2. Apply PCA and its variants to find the significant feature subset (L3)
3. Compare the performance of ensemble learners to weak learners (L4)

Module V: Neural Networks & Deep Neural Networks Number of hours 8
Neural Networks: From biological to artificial neurons, implementing MLPs with Keras, fine tuning neural network hyperparameters.
Learning Outcomes:
After completion of this unit, the student will be able to:
1. Show the working of neural networks (L3)
2. Differentiate between shallow and deep neural networks (L4)
3. Evaluate the performance of deep neural networks on real time data (L5)

Text Books(s)
1. AurelionGeron, Hands-on Machine Learning with Scikit-Learn, Keras, and Tensor Flow: Concepts, Tools and Techniques to build Intelligent Systems, 2/e, O'Reilly Media, 2019.

Reference Book(s)
1. Tom M. Mitchell, Machine Learning, McGraw Hill, 2017.
2. EthemAlpaydin, Introduction to Machine Learning, 3/e, PHI, 2015.

Course Outcomes:
1. Describe different machine learning categories (L2)
2. Apply supervised learning approaches on real-time problems (L3)
3. Utilize unsupervised learning approaches for applications such as anomaly detection (L3)
4. Analyze ensemble models for performance improvement (L4)
5. Estimate significant feature subset to handle high dimensionality issue (L5)
6. Construct deep neural networks for computer vision applications (L6)

19ECS472: Introduction Augmented Reality and Virtual Reality

L	T	P	C
2	1	0	3

The objective of this course is to mainly establish and cultivate a broad and comprehensive understanding of this rapidly evolving and commercially viable growing field of Computer Science. Augmented Reality and Virtual Reality technologies are really hitting the ground right now and are the buzz words among the technical communities. With these methods, the businesses are trying to get their brands to a whole new level of success and popularity. Integrating AR/VR in Education can increase the experience of learning, in medicine, increases of experience of understanding, in engineering, increases the experience of visualization, in business, increases the In-User Engagement, Boost In Brand Loyalty, Mobility, Better Advertising of products and many more.

Course objectives
1. To provide an understanding of Mixed reality and the cause for its origins
2. To give a practical understanding of Virtual Reality with an immersive Experience
3. To provide a practical understanding of Augmented Reality with the available devices
4. To make aware of necessary hardware and software to develop AR/VR applications and to enable in attaining skills for using hardware and software.
5. To pave a way to analyse the existing AR/VR applications as case studies and create some new applications.

Module I: Introduction to Mixed Reality (MR) Number of hours 8

Introduction, A history of Mixed Reality Technologies, The Origin of MR Concept
Learning outcomes:
After completion of this unit, the student will be able to:
- describe the origins of MR concept – L1
- understand the concept of Mixed Reality – L2
- describe real time applications of MR technologies – L1
- analyse the usage of MR Technologies in various fields – L4

Module II: Introduction to Virtual Reality (VR) Number of hours 8
Fundamental of VR, Types of VR, Current VR Technologies, Benefits, Disadvantages, Case study which cover the applications in various fields, like in Education, Military, Engineering, Architecture, Medical etc.,
Learning Outcomes:
After completion of this unit, the student will be able to:
- describe the types of VR with a practical understanding – L1
- understand the concept of Virtual Reality – L2
- analyse the current VR Technologies – L3
- understand the benefits and disadvantages of VR Technologies – L2
- analyse the VR Applications in various fields for creating new applications – L3

Module III: Introduction to Augmented Reality Number of hours 8
Definitions and Terminology, Types of AR- Marker and Marker-less based AR tracking, Current AR Technologies like Hardware, Tracking devices and Headmounted displays along with softwares, Benefits of AR, Disadvantages and Case study AR Applications in Education, Medicine, Military etc.,
Learning Outcomes:
After completion of this unit, the student will be able to:
1. understand the concept of Augmented Reality – L2
2. describe the types of AR with a practical understanding – L1
3. analyse the current AR Technologies and Tracking Techniques – L3
4. understand the benefits and disadvantages of AR Technologies – L2
5. analyse the AR Applications in various fields for creating new applications – L3

Module IV: Development Tools and Frame Works Number of hours 8
Human factors: Introduction, the eye, the ear, the somatic senses. Hardware: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems. Software: Introduction, Modelling virtual world, Physical simulation, VR toolkits, Introduction to Blender, Meshroom and UNITY
Learning Outcomes:
After completion of this unit, the student will be able to:
- understand the different sensors available for AR/VR – L2
- describe the existing Hardware like head mounted displays and haptics – L1
- hands-on experience with available software – L3
- analyse and Convert a 2D image to 3D using Meshroom and Blender – L4

Module V: Mixed Reality in Education - Applications Number of hours 8
Virtual Reality in Education-VR Applications for Primary schools high schools, in-service professional training, Augmented Reality in Education-AR Applications for Primary schools high schools, in-service professional training.
Learning Outcomes:
After completion of this unit, the student will be able to:
1. understand the application of AR/VR in education – L2
2. analyse various case studies for education – L4
3. analyse an AR/VR application for primary school education – L4

Text Books(s)

2. Zeynep Tacgin, Virtual and Augmented Reality: An Educational Handbook , Cambridge Scholars, 2020, ISBN (10): 1-5275-4813-9
3. Pangilinan, Erin, Steve Lukas, and Vasanth Mohan. Creating augmented and virtual realities: theory and practice for next-generation spatial computing. " O'Reilly Media, Inc.", 2019.

Reference Book(s)

1. Grigore C. Burdea, Philippe Coiffet , Virtual Reality Technology, Wiley 2016
2. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.

Course Outcomes:

1. know how AR/VR systems work and the applications of VR – L1
2. understand the design and implementation of the hardware that enables AR/VR systems to be built – L2
3. understand the system of human vision and its implication on perception and rendering – L2
4. Understand the concepts of motion and tracking in AR/VR systems – L3

19ECS474: Introduction to Cloud Computing

LTPC
2 1 0 3

Module I 8 Hrs

Understanding Cloud Computing: Cloud origins and influences, basic concepts and terminology. Fundamental Concepts and Models: Roles and boundaries, cloud characteristics, cloud delivery models, cloud deployment models.

Module II 8 Hrs

Cloud Enabling Technology: Data center technology, virtualization technology, web technology, multitenant technology, service technology.

Module III 8 Hrs

Cloud Infrastructure Mechanisms: Logical network perimeter, virtual server, cloud storage device, cloud usage monitor, resource replication.

Module IV 8 Hrs

Fundamental Cloud Architectures: Workload distribution architecture, resource pooling architecture, dynamic scalability architecture, elastic resource capacity architecture, service load balancing architecture, cloud bursting architecture, elastic disk provisioning architecture, redundant storage architecture.

Module V 8 Hrs

Cloud Delivery Model Considerations: The cloud provider perspective: Building IaaS environments, equipping PaaS environments, optimizing SaaS environments.

Text Book(s)

1. Thomas Erl, Ricardo Puttini, Zaigham Mahmood ,Cloud Computing: Concepts, Technology & Architecture, Prentice Hall, 2013.

References

1. John W. Rittinghouse, James F.Ransome, Cloud Computing: Implementation, Management and Security, CRC Press, 2012.
2. Anthony T.Velte, Toby J Velte Robert Elsenpeter, Cloud Computing a practical approach, , Mc Graw Hill,2010.
3. Michael Miller, Cloud Computing: Web,Based Applications That Change the Way You Work and Collaborate Online, Que Publishing, 2008.
4. Haley Beard, Cloud Computing Best Practices for Managing and Measuring Processes for On demand Computing, Applications and Data Centers in the Cloud with SLAs, Emereo Pty Limited, 2008.
5. Gautam Shroff, Enterprise Cloud Computing: Technology, Architecture, applications, Cambridge University Press, 2010.
6. Ronald L. Krutz,Russell Dean Vines A Comprehensive Guide to Secure Cloud Computing, 2010.

19EEC475: Microcontrollers and Interfacing

L	T	P	C
2	**1**	**0**	**3**

The knowledge on Microcontroller based embedded system design is much essential in the field of automation. This course begins with the detailed discussion of the architecture and on-chip resources of 8051 followed by complete instruction set and assembly language programming. Further, this course covers C programming for 8051 which is the common platform that any designer would use to program a microcontroller. Concepts of interfacing peripherals like LCD, keypad DAC, ADC and sensors to 8051 are also discussed in the course.

Course Objectives:

- To explain the detailed architecture of 8051 microcontrollers and on chip resources.
- To familiarize with 8051 Instruction set and addressing modes.
- To get acquainted with the C programming model of 8051 microcontroller.
- To explain the functionality of serial communication, timers and other peripherals
- To design an embedded system using 8051 microcontroller.

UNIT-I **10L**

The 8051 Microcontroller: Microcontrollers and embedded processors, overview of the 8051 family, 8051 architecture-on chip resources, internal and external memory configuration, 8051 register banks, PSW, clock generator, other special function registers and their purpose, 8051 pin description.

Learning Outcomes*:*

After completion of this unit, the student will be able to

- state architectural differences between microprocessors and microcontrollers (L1).
- describe the features of 8051 and compare features of family of 8051 (L2).
- understand the purpose of on chip resources and register banks (L2).
- illustrate the structure and purpose of different SFRs.(L3)
- interpret the functionalities of different pins of 8051(L4)

UNIT-II **8L**

8051 assembly language programming: Addressing modes, Instruction set: arithmetic instructions and programs, signed number concepts, logic and compare instructions, rotate instructions and data serialization, BCD, ASCII and other application programs, branch instructions-JUMP, LOOP, CALL instructions and programs.

Learning Outcomes:

After completion of this unit, the student will be able to

- demonstrate the purpose of different types of instructions supported by 8051 (L2).
- interpret the operations of arithmetic, logical, branch and other instructions (L2).
- construct assembly language programs to access SFRs & other on-chip resources (L3).
- estimate the execution time of an assembly language program (L6).

UNIT-III **8L**

8051 programming in C: Data types and time delay in 8051 C, I/O programming in 8051 C, logic operations in 8051 C, accessing code ROM space in 8051 C, data serialization using C.

Learning Outcomes*:*

After completion of this unit, the student will be able to

- identify the data types that are used for different variables (L1).
- apply time delay functions to generate different amount of delays (L3).
- demonstrate 8051 C program to perform logical operations (L3).
- develop 8051 C program to send data serially (L3).

UNIT-IV **8L**

Timers, serial port, Interrupts programming in C: Programming 8051 timers, counter programming, basics of serial communication, 8051 connections to RS232, serial port programming in assembly and C, 8051 interrupts, interrupt priority and interrupt programming in C.

Learning Outcomes*:*

After completion of this unit, the student will be able to

- explain the functions of timers, serial communication and interrupts of 8051 (L1).
- develop C programs for serial communication and delay generation (L3).
- state different sources of interrupts supported by 8051 and their importance in embedded applications (L1).

UNIT-V **8L**

Interfacing: LCD interfacing, keyboard interfacing, ADC, DAC and sensor interfacing, 8051 interfacing to external memory.

Learning Outcomes*:*

After completion of this unit, the student will be able to

- explain the functions of different pins, control signals of LCD (L2).
- discuss the basic operation of keyboard and describe the key press and detection mechanisms with key de bouncing (L2).
- illustrate the features and basic operations of DAC, ADC, and temperature sensor (L3).
- demonstrate the interfacing and LCD, 4X4 keypad, ADC, DAC and sensors with the 8051 (L5).

Text Book:

Mazidi and Mazidi, The 8051 Microcontroller and Embedded Systems – Using Assembly and C, 2nd Edition, Pearson Education, 2002.

References:

1. Kenneth J Ayala, "The 8051 Micro Controller Architecture, Programming and applications.
2. Raj kamal, Microcontrollers - Architecture, Programming, Interfacing and System Design- 2e- Pearson education.

Course Outcomes:

After successful completion of this course, the student will be able to

- explain the detailed architecture of 8051 micro controllers and on chip resources (L1).
- write 8051 Instruction sets and addressing modes (L1)
- illustrate the C programming model of 8051 microcontroller (L3).
- explain the functionality of serial communication, timers and other peripherals (L1).
- develop the on chip hard ware for the embedded system using 8051 microcontroller (L3).

19EEI473: VIRTUAL INSTRUMENTATION

L	T	P	C
2	1	0	3

Preamble:

The evolution and pervasiveness of PCs as cost-effective computing platforms, recently joined by workstations with more powerful software tools, has resulted in a virtual explosion in data acquisition, signal processing and control systems from laboratory to industry including field applications. The emphasis of this course is to discuss a number of new technologies and challenges of virtual instrumentation systems in terms of applications in the areas including control systems, power systems, networking, robotics, communication, and artificial intelligence.

Course Objectives:
1. To understand the basics of Virtual Instrumentation (VI) and Data Acquisition Systems
2. To learn and implement the basic LabVIEW programming concepts
3. To interface the data acquisition systems to VI environment
4. To build the relation between the communication networking devices and VI
5. To apply the concepts and build models of VI in various engineering fields

Unit-I 6 hours

Introduction: Virtual Instrumentation – Definition, flexibility, Block diagram and Architecture of Virtual Instruments, Virtual Instruments versus Traditional Instruments Data flow techniques, graphical programming in dataflow, Review of Popular software's in virtual Instrumentation.

Learning Outcome: student will be able to
- Understand the basics of Virtual Instrumentation.
- Differentiate between VI & TI
- Review popular software related to VI
- Outline the concepts related to data flow techniques & graphical programming.
- Explain the basic block diagram and architecture of VI

Unit-II 10 hours

VI Programming Techniques: VI, sub-VI, Loops, structures, charts, arrays, clusters, graphs, formula node, math-script, local and global variable, strings, file I/O-execution control, Instrument drivers.

Learning Outcome: student will be able to
- Investigate the concepts related to VI programming techniques.
- Formulate the different variables and strings in VI
- Outline the concept related to Instrument drivers
- Memorize the file I/O execution control
- Examine the strings related to VI

Unit-III 8 hours

Data Acquisition in VI: Introduction to data acquisition, signal conditioning, classes of signal conditioning, field wiring and signal measurement, ground loops, A/D, D/A converters, plug-in DAQ boards, Analog input/output cards, Digital Input/output card, counter and timer I/O boards, Isolation techniques, Opto-isolation, Data acquisition modules with serial communication.

Learning Outcome: student will be able to
- Understand the concepts of Introduction to data acquisition system
- Appraise the different signal conditioning & classes of VI
- Investigate the cards of Analog & digital inputs in VI
- Demonstrate the counter & timer I/O boards and Isolation techniques
- Develop the data acquisition modules with serial communication system.

Unit-IV 8 hours

Communication networked modules: Introduction to PC Buses, Local bus: ISA, PCI, RS232, RS422, RS485, Interface Bus – USB, PCMCIA, VXI, SCXI, PXI. Instrumentation buses: Modbus – GPIB - Networked bus – ISO/OSI Reference model, Ethernet, and VISA

Learning Outcome: student will be able to

- Examine the basics of PC buses
- Discuss the various local Buses of VI
- Recognize the concepts of Instrumentation Buses
- Interface the various types of buses related to communication networking modules
- Memorize the various Reference models of communication modules

Unit-V **8 hours**

LabVIEW tools and Applications: Signal Processing and analysis, Control design and simulation tools, digital filter design tools, sound and vibration tools, spectral measurements, System Identification tools, Embedded Module, Biomedical startup kit

Learning Outcome: student will be able to

- State the concepts of signal processing analysis in VI
- Design and simulate the LAB view tools.
- Examine the performance of digital filter tools in VI
- Sketch the various Embedded module for its Applications
- Familiarize the basic Biomedical startup kit

Text Books:

1. LabVIEW based advanced Instrumentation System, S Sumathi, P Surekha, Springer Science Elsevier 2007.
2. Virtual Instrumentation using LabVIEW, Jovitha Jerome, PHI 2010.

References:

1. LabVIEW Graphical programming, Gary Jhonson, Mc Graw Hill, Newyork, 1997.
2. LabVIEW for everyone, Lisa K.Wells and Jeffrey Travis, Prentice Hall, NewJersey, 1997.
3. Practical Data Acquisition for Instrumentation and Control Systems, John Park and Steve Mackay, Elsevier Publications.

Course Outcomes:

After the completion of the course the student will be able to

1. Explain the difference between virtual instrument and conventional instruments
2. Apply the concepts of LabVIEW programming
3. Interface the DAQ to LabVIEW environment
4. Use the Communication networking devices in Virtual Instrumentation
5. Implement the VI models for different applications

19EEI475: MEDICAL INSTRUMENTATION

L	T	P	C
2	1	0	3

This course is designed to make the student acquire an adequate knowledge of the physiological systems of the human body and relate them to the parameters that have clinical importance. The fundamental principles of equipment that are actually in use at the present day are introduced.

Course Objectives:

- To explain the human physiological systems and bio-signals.
- To study various electrodes and transducers used in medical field.
- To introduce the student, various sensing and measurement of physiological parameters.

- To familiarize with the functions of patient monitoring systems.
- To understand various medical imaging techniques and their applications.

UNIT -I **8L**

Physiological systems and Bio-signals: Physiological systems of the human body, functional structure of the cell, electrical activity of cells: resting and action potentials, functioning of the heart, physiological signal amplifiers.

Learning Outcomes:

After completion of this unit, the student will be able to

- describe the physiological systems of the human body (L2).
- explain the functional structure of cell (L2).
- distinguish between resting and action potentials (L2).
- summarize the function of heart (L2).
- design physiological signal amplifiers (L5).

UNIT -II **9L**

Electrodes, Sensors, and Transducers: Introduction to electrodes, half-cell potential, electrode paste, electrode material, various types of electrodes: surface electrodes, micro electrodes, needle electrodes depth electrodes, inductive, capacitive, resistive and temperature transducers.

Learning Outcomes:

After completion of this unit, the student will be able to

- state the role of an electrode (L1).
- estimate the half cell potential (L2).
- categorize various electrode materials used in electrodes (L4).
- analyze various types, functions of electrodes and transducers (L4).

UNIT -III **8L**

Measurement of Physiological parameters: Measurement of blood pressure, blood flow and cardiac output – Plethysmography, respiration rate, temperature, ECG, EEG, EMG, safety measures medical instrumentation.

Learning Outcomes:

After completion of this unit, the student will be able to

- explain the process involved in BP, cardiac output and respiration rate measurements (L2).
- analyze ECG, EEG, EMG signals (L4).
- interpret safety measures taken in medical instrumentation (L2).

UNIT -IV **8L**

Patient Monitoring Systems and Medical assist devices: Intensive cardiac care units and central monitoring systems, patient monitoring through biotelemetry, pacemakers, defibrillators.

Learning Outcomes:

After completion of this unit, the student will be able to

- explain the functioning of ICCU and central monitoring systems (L1).
- integrate patient monitoring through biotelemetry (L5).
- describe the function of pacemakers and defibrillators (L2).

UNIT -V **9L**

Medical Imaging Systems: X-ray machines, principles of computer tomography (CT), CT number scale scanning systems, detector arrays, principles of nuclear magnetic resonance (NMR) and MR imaging, T1 and T2 based imaging, basic MRI system.

Learning Outcomes:

After completion of this unit, the student will be able to

- explain the principles of X-RAY machines and CT (L2).
- interpret the CT number scale scanning systems (L2).
- describe the principles of NMR and MRI systems (L2).

Text Books:

1. Leslie Cromwell, Fred J Weibell, and Erich A. Pfeiffer, Biomedical Instrumentation and Measurements, PHI/Pearson Education, 2003.
1. RS Khandpur, Hand Book of Biomedical Instrumentation, TMH, 2003.

References:

1. K.KirkShung, Benjamin Tsui and Michael. B. Smith, Principles of Medical Imaging, Academic Press Inc., New York.
2. Joseph J Carr, John M.Brown, Introduction to Biomedical Equipment Technology, 4th Edition, Pearson Education, Singapore, 2001.
3. M.Arumugam, Bio-Medical Instrumentation, Anuradha Agencies, 2003.

Course Outcomes:

After successful completion of the course, the student will be able to

- understand the functioning of various physiological systems of human body (L1).
- identify various electrodes and transducers used in different physiological measurements (L4).
- summarize the process involved in the measurement of various physiological parameters (L2).
- explain various units in patient monitoring systems and their importance (L2).
- distinguish different medical imaging techniques (L4).

19EHS403: Organizational Behavior

L T P C
3 0 0 3

Module I:

Introduction; Definition of Organization Behavior and Historical development, Environmental Context (Information Technology and Globalization), Diversity and Ethics, Design and Cultural, Reward Systems. The Individual: Foundation of individual behavior, Ability

Module II:

Learning: Definition, Theories of Learning, Individual Decision Making, classical conditioning, operant conditioning, social Making, learning theory, continuous and intermittent reinforcement. Perception: Definition, Factors influencing perception, attribution theory, selective perception, projection, stereotyping, Halo effect.

Module III:

Motivation: Maslow's Hierarchy of Needs, Mc. Gregory's theory X and Y, Herzberg's motivation Hygiene theory, David Mc Cleland three needs theory, Victor vroom's expectancy theory of motivation.

Module IV:

Values and attitudes: Definitions – values, Attitudes: Types of values, job satisfaction, job involvement, professional Ethics, Organizational commitment, cognitive dissonance. Conflict Management: Definition of conflict, functional and dysfunctional conflict, stages of Conflict process.

Module V:

Leadership: Definition, Behavioral theories – Blake and Mouton managerial grid, Contingency theories – heresy - Blanchard's situational theory, Leadership styles – characteristics, Transactional, transformation leaders. The Organization: Mechanistic and Organic structures, Minitberg's basic elements of organization, Organizational Designs and Employee behavior, organization development – quality of work life (QWL)

Text Books(s)

1. Stephen P Robbins -Organizational Behaviour, Pearson Education Publications,ISBN– 81–7808–561-5, 9th Edn. 2012.

2. Fred Luthans -Organizational Behaviour, Mc Graw Hill International Edition,ISBN–0–07–20412–1, 11th Edn. 2006.

Reference Book(s)

1. Hellriegel, Srocum and woodman, Thompson Learning -Organization Behaviour, Prentice Hall India, 9th Edition -2001.

2. Aswathappa -Organizational Behavior, Himalaya Publishers. 2001.

3. VSP Rao and others -Organizational Behaviour, Konark Publishers 2002.

4. Organizational Behaviour- (Human behaviour at work) John Newstron / Keith Davis 9th Edition 2002.

5. Paul Henry and Kenneth H. Blanchard -Management of Organizational Behaviors, Prentice Hall of India, 1996