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GITAM

(DEEMED TO BE UNIVERSITY)

(Estd. u/s 3 of the UGC Act, 1956)

VISAKHAPATNAM * HYDERABAD * BENGALURU

Accredited by NAAC with 'A+' Grade

REGULATIONS AND SYLLABUS

of

Bachelor of Technology

in

Electronics and Communications Engineering (ECE)

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

Vision

To become a global leader in higher education.

Mission

To impart futuristic and comprehensive education of global standards with a high sense of discipline and social relevance in a serene and invigorating environment.

Quality Policy

To achieve global standards and excellence in teaching, research, and consultancy by creating an environment in which the faculty and students share a passion for creating, sharing and applying knowledge to continuously improve the quality of education.

VISION AND MISSION OF THE SCHOOL

VISION

To become a global leader in holistic engineering education and research

MISSION

1. To impart a strong academic foundation and practical education through a flexible curriculum, state-of-the-art infrastructure, and best learning resources
2. To actively pursue academic and collaborative research with industries and research institutions, both in India and abroad
3. To build a congenial and innovative eco system by enabling the latest technologies, thus helping the students, to solve the challenges of societal importance
4. To provide our students with the appropriate leadership, management, communication skills and professional ethics for career success and to continuously impact the global lives

B Tech (Electronics and Communication Engineering) Programme

VISION

To excel in higher education by imparting quality teaching and research and to meet the challenges in Electrical, Electronics and Communication Engineering

MISSION

1. To impart technical skills, value-based education to students, to enable them to face the demands of the industry
2. To create innovative and instructional learning methods to hone the skills for solving problems of society
3. To carry out research through constant interaction with R & D organizations and industry
4. To motivate the students to develop expertise in multidisciplinary technologies for a sustainable growth

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO 1 To impart knowledge of mathematics and science concepts as tools to device and deliver efficient solutions to problems of Electronics & Communication Engineering

PEO 2 To inculcate analytical ability in the students to keep pace with changing technologies and to imbibe skill and research culture to meet the industrial and societal needs

PEO 3 To provide a platform for the graduate to be successful in technical and professional careers or develop as an entrepreneur

PEO 4 To instill teamwork, leadership, and communication skills in the student with professional, ethical, and human values to be responsible citizen of the society

Mapping of the Mission of the School with the PEOs

	PEO1	**PEO2**	**PEO3**	**PEO4**
M1	H	M	L	L
M2	L	H	M	L
M3	M	L	M	L
M4	L	L	H	H

H – High, M – Medium, L – Low

Programme Outcomes

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

PO1 ENGINEERING KNOWLEDGE: Apply the knowledge of Mathematics, Science, Engineering Fundamentals, and an Engineering specialization to the solution of Complex Engineering problems.

PO2 PROBLEM ANALYSIS: Identify, formulate, research literature, and analyze Complex Engineering problems reaching substantiated conclusions using first principles of Mathematics, Natural Sciences, and Engineering Sciences.

PO3 DESIGN/DEVELOPMENT OF SOLUTIONS: Design solutions for Complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 CONDUCT INVESTIGATIONS OF COMPLEX PROBLEMS: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 MODERN TOOL USAGE: Create, select, and apply appropriate techniques, resources, and Modern Engineering and IT tools including prediction and modeling to Complex Engineering activities with an understanding of the limitations.

PO6 THE ENGINEER AND SOCIETY: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the Professional Engineering practice.

PO7 ENVIRONMENT AND SUSTAINABILITY: Understand the impact of the Professional Engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 ETHICS: Apply ethical principles and commit to Professional Ethics and responsibilities and norms of the engineering practice.

PO9 INDIVIDUAL AND TEAMWORK: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 COMMUNICATION: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 PROJECT MANAGEMENT AND FINANCE: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.

PO12 LIFELONG LEARNING: Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Program Specific Outcomes (PSO)

Upon successful completion of BTech ECE Programme, student will be able to

PSO 1 design and develop electronic, communication and signal processing systems for engineering applications in the fields of consumer electronics, embedded, wireless communication, networking, and allied interdisciplinary areas.

PSO 2 demonstrate the use of modern tools and techniques for solving contemporary real-world problems in electronics and communication systems

PSO 3 research and devise appropriate technologies for implementation of the electronics and telecommunication systems as an entrepreneur/researcher with professional ethics & concern for societal wellbeing

B.Tech Electronics and Communication Engineering

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

1. ADMISSION

1.1 Admission into B. Tech. in Biotechnology 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 2019-20 academic year, based on guidelines of the statutory bodies in order to promote:

- Activity based learning
- Student centered learning
- Cafeteria approach
- Students to choose courses of their choice
- Learning at their own pace
- 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 NCC/NSS/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. Sixty (60) marks for semester-end Examinations.

		Semester End Examinations Total	60 100	
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 conducted for 30 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 Retotaling 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 viva-voce 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 examinationsduring 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 50% 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	$\geq$8.0*
First Class	$\geq$ 6.5
Second Class	$\geq$ 5.5
Pass Class	$\geq$ 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.

Department of Electrical, Electronics and Communication Engineering
B.Tech Electronics and Communication Engineering
(w.e.f. 2019-20 admitted batch)

Semester I

S. No	Course Code	Course Title	Category	L	T	P	A	C	Remarks
1.	19EMA101	Engineering Mathematics I (Calculus and Algebra)	BS	3	0	0		3	Common toall except BT
2.	GEL131	Communicative English	HS	2	0	2		3	Common to all
3.	19EPH131/ 19ECY131	Engineering Physics/Engineering Chemistry	BS	3	0	3		4.5	Common to all
4.	19EID131/ 19EEE131	Problem Solving and Programming / Basic Electrical and Electronics Engineering	ES	3	1	3		5.5	Common to all
5.	19EME121/ 19EME131	Workshop / Engineering Graphics	ES	0/1	0	3		1.5/ 2.5	Common to all
6.	19EMC181X	NSS/NCC/NSO/ YOGA	MC	0	0	2		0	Common to all
						Total		**17.5/18.5**	

Semester II

S. No	Course Code	Course Title	Category	L	T	P	A	C	Remarks
1.	19EMA102	Engineering Mathematics II (ODE, PDE and Multivariable Calculus)	BS	3	0	0		3	Common with EEE, ME, CE and AE
2.	19ECY131/ 19EPH131	Engineering Chemistry / Engineering Physics	BS	3	0	3		4.5	Common to all
3.	19EEE131/ 19EID131	Basic Electrical and Electronics Engineering / Problem Solving and Programming	ES	3	1	3		5.5	Common to all
4.	19EID132/ 19EID134	Design Thinking /AI tools	ES	2	0	2		3	Common to all
5.	19EME131/ 19EME121	Engineering Graphics / Workshop	ES	1/0	0	3		2.5/ 1.5	Common to all
6.	19EEC122	Electronics Workshop	PC	0	0	3		1.5	
7.	19EMC181X	NSS/NCC/NSO/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 Title	Category	L	T	P	A	C	Remarks
1.	19EMA203	Engineering Mathematics III (Complex Variables and Transform Techniques)	BS	3	0	0		3	Common with EEE
2.	19EID134/ 19EID132	AI Tools / Design Thinking	ES	2	0	2		3	Common to all
3.	19EEC231	Network Theory and Analysis	PC	3	0	2		4	
4.	19EEC233	Electronic Devices and Amplifier Circuits	PC	3	0	3		4.5	Common with EEE
5.	19EEC235	Signals and Systems	PC	2	0	2		3	Common with EEE
6.	19EEC237	Electromagnetic Waves	PC	2	0	2		3	
7.	19EMC281/ 19EMC282	Constitution of India / Environmental Sciences	MC	3	0	0		0	Mandatory Course
8.	19EHS221	Comprehensive Skill Development II	HS	0	0	0	6	1	Common to all
						Total		**21.5**	

Semester IV

S. No	Course Code	Course Title	Category	L	T	P	A	C	Remarks
1.	19EMA204	Engineering Mathematics IV (Probability Theory and Random Processes)	BS	3	0	0		3	Branch specific
2.	19EID232 /19EID234	Internet of Things/ Life Sciences for Engineers	ES/BS	2	0	2		3	Common to all
3.	19EEC232	Digital Logic Design	PC	3	0	3		4.5	Common with EEE
4.	19EEC234	Analog Circuits	PC	3	0	3		4.5	Common with EEE
5.	19EEC236	Analog and Digital Communications	PC	3	0	3		4.5	
6.	19EEC238	Control System Engineering	PC	2	0	2		3	
7.	19EMC282/ 19EMC281	Environmental Sciences / Constitution of India	MC	3	0	0		0	Mandatory Course
8.	19EEC292	Comprehensive Skill Development III	PW	0	0	0	6	1	Common to all
							Total	**23.5**	

Semester V

S. No	Course Code	Course Title	Category	L	T	P	A	C	Remarks
1.	19EEC331	Antenna Analysis and Synthesis	PC	3	0	2		4	
2.	19EEC333	Digital Signal Processing	PC	3	0	3		4.5	
3.	19EID234 /19EID232	Life Sciences for Engineers/Internet of Things	BS/ES	2	0	2		3	Common to all
4.	19EEC3XX	Programme Elective I	PE	2/3	0	2/0		3	Program specific
5.	19ZOE3XX	Open Elective I	OE	3	0	0		3	
6.	19EYY3XX	Interdisciplinary Elective I	ID	2	1	0		3	
7.	19EEC391	Comprehensive Skill Development IV	PW	0	0	0	6	1	Common to all
						Total		**21.5**	

Semester VI

S. No	Course Code	Course Title	Category	L	T	P	A	C	Remarks
1.	19EEC332	Microprocessors and Microcontrollers	PC	3	0	3		4.5	Common with EEE
2.	19EEC334	Introduction to VLSI Design	PC	3	1	3		5.5	
3.	19EEC3XX	Programme Elective II	PE	2/3	0	2/0		3	Program specific
4.	19EEC3XX	Programme Elective III	PE	2/3	0	2/0		3	Program specific
5.	19ZOE3XX	Open Elective II	OE	3	0	0		3	
6.	19EHS302	Engineering Economics and Management	HS	3	0	0		3	
7.	19EMC382	Engineering Ethics	MC	3	0	0		0	Common to all
8.	19EEC392	Comprehensive Skill Development V	PW	0	0	0	6	1	
						Total		**23**	

Semester VII

S. No	Course Code	Course Title	Category	L	T	P	A	C	Remarks
1.	19EEC431	Communication Networks	PC	3	0	2		4	
2.	19EYY4XX	Interdisciplinary Elective II	ID	2	1	0		3	
3.	19EEC4XX	Program Elective IV	PE	2/3	0	2/0		3	Program specific
4.	19EEC4XX	Program Elective V	PE	2/3	0	2/0		3	Program specific
5.	19EHS403	Organizational Behavior	HS	3	0	0		3	
6.	19EEC491	Project Phase I	PW	0	0	2		1	
7.	19EEC493	Internship*	PW					1	
8.	19EEC495	Comprehensive Skill Development VI	PW	0	0	0	6	1	Common to all
						Total		**19**	

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

Semester VIII

S. No	Course Code	Course Title	Category	L	T	P	A	C	Remarks
1.	19EYY4XX	Interdisciplinary Elective III	ID	2	1	0		3	
2.	19EEC4XX	Program Elective VI	PE	2/3	0	2/0		3	
3.	19EEC492	Project Phase II	PW	0	0	12		6	
4.	GSS115	Gandhi for 21st Century	PW					1	Online Course
5.	HSMCH102	Universal Human Values 2: Understand Harmony	HS	2	1	0		3	
						Total		**16**	

Total Number of Credits

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	**17.5/ 18.5**	**23/22**	**21.5**	**23.5**	**21.5**	**23**	**19**	**16**	**165**

Category and Credits

Category	Category Code	Courses	Credits GITAM	Credits suggested by AICTE
Humanities & Social Sciences	HS	Communicative English	14	12
		HS1 and HS2 (elective)		
		Comprehensive Skill Development II &III		
		Universal Human Values 2		
Basic Sciences	BS	Engineering Physics	24	25
		Engineering Chemistry		
		Mathematics (4 Courses)		
		Life Sciences for Engineers		
Engineering Sciences	ES	Problem Solving and Programming	24	24
		Basic Electrical and ElectronicsEngineering		
		AI Tools		
		Engineering Graphics		
		Workshop		
		Design Thinking and ProductInnovation		
		Internet of Things		
Open Electives	OE	OE1, OE2	6	
Interdisciplinary Electives	ID	ID1 – ID3	9	18
Program Electives	PE	PE1 – PE6	18	18
Program Core	PC	PC1 – PC15	55	48
Project	PW	Venture Discovery	15	15
		Gandhi for 21st Century		
		Internship		
		Comprehensive Skill Development IV – VII		
		Project Phase I		
		Project Phase II		
Mandatory	MC	Environmental Science, Constitution of India, Engineering Ethics	-	-
			165	**160**

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

S. No	Course Code	Course Title	Category	L	T	P	C	Remarks
1.	19EMA102	Engineering Mathematics II (ODE, PDE andMultivariable Calculus)	BS	3	0	0	3	Offered for ECE, EEE, ME,CE and AE
2.	19EMA104	Engineering Mathematics II (Probability and Statistics)	BS	3	0	0	3	Offered for CSE and IT
3.	19EMA106	Mathematics for Biotechnology II	BS	3	0	0	3	Offered for BT

Engineering Mathematics-III

S. No	Course Code	Course Title	Category	L	T	P	C	Remarks
1.	19EMA201	Engineering Mathematics III (Applications of PDE, Complex Variables and Transform Techniques)	BS	3	0	0	3	Offered for ME,CE AndAE
2.	19EMA203	Engineering Mathematics III (Complex Variables and Transform Techniques)	BS	3	0	0	3	Offered for ECE and EEE
3.	19EMA205	Engineering Mathematics III (Discrete Mathematical Structures)	BS	3	0	0	3	Offered for CSE and IT
4.	19EMA207	Mathematics for Biotechnology III	BS	3	0	0	3	Offered for BT

Engineering Mathematics-IV

S. No	Course Code	Course Title	Category	L	T	P	C	Remarks
1.	19EMA202	Engineering Mathematics IV (Numerical Methods, Probability and Statistics)	BS	3	0	0	3	Offered for CE, ME and EEE
2.	19EMA204	Engineering Mathematics IV (Probability Theory and Random Processes)	BS	3	0	0	3	Offered for ECE
3.	19EMA206	Engineering Mathematics IV (Number Theory and Applications)	BS	3	0	0	3	Offered for CSE and IT
4.	19EMA208	Mathematics for Biotechnology IV	BS	3	0	0	3	Offered for BT

Engineering Physics

S.No	Course Code	Course Title	Category	L	T	P	C	Remarks
1.	19EPH131	Engineering Physics	BS	3	0	3	4.5	Offered for ECE, CSE, EEE and IT
2.	19EPH133	Applied Physics	BS	3	0	3	4.5	Offered for AE, CE and ME
3.	19EPH135	Physics for Biotechnology	BS	3	0	3	4.5	Offered for BT

Engineering Chemistry

S. No	Course Code	Course Title	Category	L	T	P	C	Remarks
1.	19ECY131	Engineering Chemistry	BS	3	0	3	4.5	Offered for ECE, CSE, EEE and IT
2.	19ECY133	Chemistry of Materials	BS	3	0	3	4.5	Offered for AE, CE and ME
3.	19ECY135	Chemistry for Biotechnology	BS	3	0	3	4.5	Offered for BT

OPEN ELECTIVES

Open Elective I

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

Open Elective II

S. No.	Course Code	Course Title	Category	L	T	P	C
1.	19EOE302	German for Beginners	OE	3	0	0	3
2.	19EOE304	Chinese for Beginners	OE	3	0	0	3
3.	19EOE306	Analytical Essay Writing	OE	3	0	0	3
4.	19EOE308	Indian Economy	OE	3	0	0	3
5.	19EOE310	Public Administration	OE	3	0	0	3
6.	19EOE312	Environmental Management	OE	3	0	0	3
7.	19EOE327	Professional Communication	OE	3	0	0	3
8.	19MOE301	Basics of Finance	OE	3	0	0	3
9.	19LOE301	Fundamentals of Cyber Law	OE	3	0	0	3
10.	19EOE313	Personality Development	OE	3	0	0	3
11.	19MOE305	Basics of Marketing	OE	3	0	0	3
12.	GEL345	Work Place Communication – Basic	OE	3	0	0	3
13.	GEL347	Work Place Communication – Advanced	OE	3	0	0	3

INTERDISCIPLINARY ELECTIVES

Interdisciplinary Elective I

S. No.	Stream	Course Code	Course Title	Category	L	T	P	C
1	Professional Courses	19EEE373	Fundamentals of Power Electronics	ID	2	1	0	3
2		19EEI373	Measurements and Instrumentation	ID	2	1	0	3
3	Computer Oriented Courses	19EIT371	Programming with C	ID	2	1	0	3
4		19ECS477	Fundamentals of Data Structures	ID	2	1	0	3
5		19ECS371	Introduction to Database Management Systems	ID	2	1	0	3
6		19ECS472	Introduction to Augmented Reality and Virtual Reality	ID	2	1	0	3
7	Management Courses	19EHS405	Operations Research	ID	2	1	0	3
8		19EHS375	Business Ethics and Corporate Governance	ID	2	1	0	3
9		19EME346	Project Management and Optimization	ID	2	1	0	3

Interdisciplinary Elective II

S. No.	Stream	Course Code	Course Title	Category	L	T	P	C
1	ProfessionalCourses	19EEI371	Sensors and Signal Conditioning	ID	2	1	0	3
2		19EME361	3D Printing	ID	2	1	0	3
3	Computer Oriented Courses	19ECS375	Introduction to Programming with Java	ID	2	1	0	3
4		19ECS344	Introduction to Machine Learning	ID	2	1	0	3
5		19ECS471	Introduction to Operating Systems	ID	2	1	0	3
6		19ECS476	Introduction to Big Data	ID	2	1	0	3
7	Management Courses	19EHS475	Entrepreneurship Development	ID	2	1	0	3
8		19ECE371	Disaster Management	ID	2	1	0	3

Interdisciplinary Elective III

S. No.	Stream	Course Code	Course Title	Category	L	T	P	C
1	Professional Courses	19EEI475	Medical Instrumentation	ID	2	1	0	3
		19EEI473	Virtual Instrumentation	ID	2	1	0	3
2		19EEI471	Robotics and Automation	ID	2	1	0	3
3		19EEI472	Introduction to MEMS	ID	2	1	0	3
4	Computer Oriented Courses	19ECS478	Introduction to Data Science	ID	2	1	0	3
5		19ECS475	Introduction to Web Technologies	ID	2	1	0	3
6		19ECS474	Introduction to Cloud Computing	ID	2	1	0	3
7	Management Courses	19EME349	Total Quality Management	ID	2	1	0	3
8		19EME357	Supply Chain Management	ID	2	1	0	3

Programme Electives

Electives Stream	Programme Elective I (V sem)	Programme Elective II (VI sem)	Programme Elective III(VI sem)	Programme Elective IV(VII sem)	Programme Elective V(VII sem)	Programme Elective VI(VIII sem)
Communication Engineering	Information Theory and Coding	Wireless Communication Networks	Fiber Optic Communications	Satellite Communications	Global Positioning Systems	Software Defined Networks
Signal Processing	DSP Processors and Architectures	Real Time Signal Processing	Digital Image Processing	Digital Signal Compression	Biomedical Signal Processing	Speech Processing
VLSI Design	Digital System Design	DSP Design with FPGAs	ASIC Design	Digital Integrated Circuit Design	Analog IC Design	Fundamentals of Semiconductor Devices
Microwaves	Transmission lines and Waveguides	Microwave Engineering	RF Circuit Design	Microwave Antennas	Radar Systems	EMI and EMC Techniques
Embedded Systems	Computer Organization and Design	ARM System Development	Software Defined Radio	IoT Architecture	TV Technology	Embedded Systems
Sensors &IoT	Wireless Sensor networks and IoT	RFID Enabled Sensors and Applications	Fiber optic sensors and applications	Sensors and Transducers for Remote Applications	IoT in Health Care	MEMS and Nanosensors

Program Elective I

S. No.	Stream	Course Code	Course Title	Category	L	T	P	C
1	Communication Engineering	19EEC341	Information Theory and Coding	PE	2	0	2	3
2	Signal Processing	19EEC343	DSP Processors and Architectures	PE	2	0	2	3
3	VLSI Design	19EEC345	Digital System Design	PE	2	0	2	3
4	Microwaves	19EEC347	Transmission lines and Waveguides	PE	3	0	0	3
5	Embedded Systems	19EEC349	Computer Organization and Design	PE	3	0	0	3
6	Sensors &IoT	19EEC351	Wireless Sensor Networks and IoT	PE	2	0	2	3

Note: The faculty has to design the activity for each Program Elective.

Program Elective II

S. No.	Stream	Course Code	Course Title	Category	L	T	P	C
1	Communication Engineering	19EEC342	Wireless Communication Networks	PE	3	0	0	3
2	Signal Processing	19EEC344	Real Time Signal Processing	PE	3	0	0	3
3	VLSI Design	19EEC346	DSP Design with FPGAs	PE	2	0	2	3
4	Microwaves	19EEC348	Microwave Engineering	PE	2	0	2	3
5	Embedded Systems	19EEC350	ARM System Development	PE	2	0	2	3
6	Sensors &IoT	19EEC352	RFID Enabled Sensors and Applications	PE	2	0	2	3

Note: The faculty has to design the activity for each Program Elective.

Program Elective III

S. No.	Stream	Course Code	Course Title	Category	L	T	P	C
1	Communication Engineering	19EEC362	Fiber Optic Communications	PE	2	0	2	3
2	Signal Processing	19EEC364	Digital Image Processing	PE	2	0	2	3
3	VLSI Design	19EEC366	ASIC Design	PE	2	0	2	3
4	Microwaves	19EEC368	RF Circuit Design	PE	2	0	2	3
5	Embedded Systems	19EEC370	Software Defined Radio	PE	2	0	2	3
6	Sensors &IoT	19EEC372	Fiber Optic Sensors and Applications	PE	2	0	2	3

Note: The faculty has to design the activity for each Program Elective.

Program Elective IV

S. No.	Stream	Course Code	Course Title	Category	L	T	P	C
1	Communication Engineering	19EEC441	Satellite Communications	PE	3	0	0	3
2	Signal Processing	19EEC443	Digital Signal Compression	PE	3	0	0	3
3	VLSI Design	19EEC445	Digital Integrated Circuit Design	PE	2	0	2	3
4	Microwaves	19EEC447	Microwave Antennas	PE	2	0	2	3
5	Embedded Systems	19EEC449A	IoT Architecture	PE	2	0	2	3
6	Sensors and IoT	19EEC451	Sensors and Transducers for Remote Applications	PE	2	0	2	3

Note: The faculty has to design the activity for each Program Elective.

Program Elective V

S. No.	Stream	Course Code	Course Title	Category	L	T	P	C
1	Communication Engineering	19EEC461	Global Positioning Systems	PE	2	0	2	3
2	Signal Processing	19EEC463	Biomedical Signal Processing	PE	2	0	2	3
3	VLSI Design	19EEC465	Analog IC Design	PE	2	0	2	3
4	Microwaves	19EEC467	Radar Systems	PE	3	0	0	3
5	Embedded Systems	19EEC469	TV Technology	PE	3	0	0	3
6	Sensors &IoT	19EEC471	IoT in Health Care	PE	2	0	2	3

Note: The faculty has to design the activity for each Program Elective.

Program Elective VI

S. No.	Stream	Course Code	Course Title	Category	L	T	P	C
1	Communication Engineering	19EEC442	Software Defined Networks	PE	2	0	2	3
2	Signal Processing	19EEC444	Speech Processing	PE	2	0	2	3
3	VLSI Design	19EEC446	Fundamentals of Semiconductor Devices	PE	2	0	2	3
4	Microwaves	19EEC448	EMI and EMC Techniques	PE	3	0	0	3
5	Embedded Systems	19EEC450	Embedded Systems	PE	2	0	2	3
6	Sensors &IoT	19EEC452	MEMS and Nanosensors	PE	3	0	0	3

Note: The faculty has to design the activity for each Program Elective.

COMPREHENSIVE SKILL DEVELOPMENT

S. No	Course Code	Course Title	Category	L	T	P	A	C	Semester	Content
1	19EHS122	Comprehensive Skill Development I	HS	0	0	0	6	1	II	Verbal + Soft skills + Quantitative Aptitude and Reasoning (50%) Coding (50%)
2	19EHS221	Comprehensive Skill Development II	HS	0	0	0	6	1	III	Verbal + Soft skills + Quantitative Aptitude and Reasoning (50%) Coding (50%)
3	19EEC292	Comprehensive Skill Development III	PW	0	0	0	6	1	IV	Verbal + Soft skills + Quantitative Aptitude and Reasoning (50%) Coding (50%
4	19EEC391	Comprehensive Skill Development IV	PW	0	0	0	6	1	V	Verbal + Soft skills + Quantitative Aptitude and Reasoning (50%) Coding (50%)
5	19EEC392	Comprehensive Skill Development V	PW	0	0	0	6	1	VI	Verbal + Soft skills + Quantitative Aptitude and Reasoning (50%) **Domain Skills** (50%)
6	19EEC495	Comprehensive Skill Development VI	PW	0	0	0	6	1	VII	Verbal + Soft skills + Quantitative Aptitude and Reasoning (50%) **Domain Skills** (50%)

19EMA101: ENGINEERING MATHEMATICS I

CALCULUS AND ALGEBRA

(Common to all branches of Engineering except Biotechnology)

L	T	P	C
3	0	0	3

This course is designed for the students of all B.Tech programmes except for Biotechnology as a prerequisite for the core programmes. The course imparts concepts of calculus and matrix algebra that are essential in applications in solving engineering problems.

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.

Unit I: Matrices **10 L**

Rank of a matrix by echelon form, solving system of homogeneous and non-homogeneous linear equations, eigenvalues, eigenvectors and their properties, Cayley-Hamilton theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton theorem, diagonalization of a matrix, quadratic forms and nature of the quadratic forms, reduction of quadratic form to canonical forms by orthogonal transformation.

Learning Outcomes:

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

- solve system of homogeneous and non-homogeneous linear equations (L3).
- find the eigenvalues and eigenvectors of a matrix (L3).
- identify special properties of a matrix (L3).

Unit II: Mean Value Theorems **6 L**

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:

After completion 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: Multivariable Calculus **8 L**

Partial derivatives, total derivatives, chain rule, change of variables, Jacobian, maxima and minima of functions of two variables, method of Lagrange multipliers.

Learning Outcomes:

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

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

Unit IV: Multiple Integrals I **8 L**

Double integrals, change of order of integration, double integration in polar coordinates, area enclosed by plane curves.

Learning Outcomes:

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

- apply double integrals in cartesian and polar coordinates (L4).
- calculate the areas bounded by a region using double integration techniques (L3).

Unit V: Multiple Integrals II **8 L**

Evaluation of triple integrals, change of variables (cartesian, cylindrical and spherical polar co-ordinates), volume as triple integral.

Learning Outcomes:

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

- apply multiple integrals in cartesian, cylindrical and sphericalgeometries (L3).
- evaluate volumes using triple integrals (L4)

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 R. Hass, Thomas' Calculus, 13/e, Pearson Publishers, 2014.
3. Glyn James, Advanced Modern Engineering Mathematics, 4/e, Pearson Publishers, 2011.

Course Outcomes:

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

- utilize the techniques of matrix algebra 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)

GEL131: COMMUNICATIVE ENGLISH

(Common to all)

L	T	P	C
2	0	2	3

The course is a unified approach to enhance language skills of the learners with an aim to hone their social skills and increase their employability. It 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 students to develop listening skills for better comprehension

of academic presentations, lectures and speeches.

- To hone the speaking skills of students 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 students with effective strategies of paragraph and essay writing, and formal correspondence such as email, letters and resume.
- To provide students with the critical impetus necessary to forge a path in an academic environment, on the job, and in an increasingly complex, interdependent world.
- To enable learners to understand the universality of human experience in literary texts and have a more significant insight into human values.

Unit I **14 L**

Reading: "Of Studies" by Francis Bacon. **Writing:** Principles of writing: clarity, simplicity, brevity, single focus, organization of thoughts. **Grammar, Vocabulary & Pronunciation:** Sentence Structure: use of phrases & clauses in sentences; punctuation, word formation, word families: nouns, verbs, adjectives adverbs. **Listening & Speaking (English Language Laboratory & Activity Lab):** Introduction to Phonetics: Vowels, Introducing Oneself.

Learning Outcomes

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

- write with clarity, simplicity and brevity (L3).
- understand the importance of knowledge in terms of its practical application towards the individual and the society (L2).
- use phrases, clauses and punctuation appropriately (l3).

- apply the right parts of speech in a sentence (L3).
- recognize and utter vowel sounds in words correctly (L1).
- learn how to create a commendable impression through the right usage of words and expressions (L2).
- introduce themselves effectively in different social and professional contexts (L3).

Unit II **14 L**

Reading: "Scientist in Training: The Oxford Years" Stephen Hawking's Biography. **Writing:** Note Making- organizing techniques: providing a suitable title, headings and sub headings; methods of sequencing. **Grammar, Vocabulary & Pronunciation:** Articles, standard abbreviations. **Listening & Speaking (English Language Laboratory & Activity Lab):** Introduction to Phonetics: Consonants; JAM (Just – A – Minute speaking sessions)

Learning Outcomes:

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

- think and perform against all odds and try to be successful (L3).
- comprehend and organize thoughts in a concise and meaningful way for making notes (L2).
- record and review information and develop time management skills (L5).
- use articles appropriately in writing (L3).
- use abbreviations in Note Making (L3).
- recognize and utter consonant sounds in words correctly (L1).
- organise thoughts and articulate relevant ideas in a sequential manner (L3).
- speak spontaneously on a given topic (L6).

Unit III **14 L**

Reading: "The Teenage Years' by Sarah Gray. **Writing :** Paragraph Writing-Organization : topic sentence, supporting sentences, the concluding sentence, creating coherence. **Grammar, Vocabulary & Pronunciation:** Tense; prefixes & suffixes. **Listening & Speaking (English Language Laboratory & Activity Lab):** Listening for intonation, stress and rhythm & pronunciation; Common everyday situations: conversations and dialogues.

Learning Outcomes:

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

- know how to become strong and wise with growing age (L5).
- understand and appreciate poetry for its diction, tone, rhythm, structure and be creative (L5).
- use pre-writing strategies to develop ideas and produce drafts of different types of paragraphs (L3).
- write a paragraph using appropriate cohesive devices (L3).
- use correct tense forms and appropriate structures in speech and written communication (L3).
- use prefixes and suffixes for effective communication (L1).

- select the requisite listening skills such as critical/evaluative / selective /empathetic or sympathetic / appreciative listening as per the context (L5).
- apply different listening skills needed for personal and professional situations (L3).
- take part in every day conversations confidently and comfortably (L3).

Unit IV **14 L**

Reading: "Unlock Your Own Creativity" by Robert Von Oech. **Writing:** Paraphrasing -techniques of paraphrasing: Replacement of words and phrases, change of sentence structures. **Grammar, Vocabulary & Pronunciation:** Subject-verb agreement; Synonyms. **Listening & Speaking (English Language Laboratory & Activity Lab):** Listening comprehension: listening for the main idea, listening for specific information; Discussion in pairs and small groups.

Learning Outcomes:

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

- understand different dimensions of the term 'creativity' and can realize that they can be the pioneers of creativity by germinating new ideas on the fertile soil of soft thinking (L6).
- paraphrase short academic texts using apt strategies and avoid plagiarism (L3).
- construct grammatically correct sentences with proper subject-verb agreement (L3).
- enrich their vocabulary (L1).
- understand the significance of proper pronunciation (L1).
- speak using right intonation, stress and rhythm (L3).
- participate in group discussions and learn to speak clearly using suitable discourse markers (L3).
- comprehend and relate the importance of group dynamics for success (L4).

Unit V **14 L**

Reading: "A Talk on Advertising" by Herman Wouk Reading Comprehension: skimming & scanning. **Writing :** Writing Essays -writing introduction , body and conclusion. **Grammar, Vocabulary & Pronunciation :** Prepositions, antonyms. **Listening & Speaking (English Language Laboratory & Activity Lab):** Listening to discussions: focus on language devices; group discussions.

Learning Outcomes:

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

- deal with the web of overwhelming advertisements (L2).
- experience unique style of expressing in English (L6).
- apply different reading skills to comprehend any given passage (L3).
- produce a well organized essay with adequate supporting evidences (L3).
- use prepositions of time, place and position (L3).
- comprehend short lectures / speeches and summarize the content with clarity and precision (L2).
- identify important points in a discussion (L1).

- contribute valid ideas to a discussion with clarity and precision (L3).

Text Book(s) :

1. Avenues: Course Book I for Enhancing English Language and Communication Skills by Orient BlackSwan Private Limited, India, 2019.

References:

1. C Muralikrishna and Sunita Mishra, Communication Skills for Engineers, Dorling Kindesley Pearson Education, India, 2014.
2. Mamta Bhatnagar and Nitin Bhatnagar, Communicative English for Engineers and Professionals, Dorling Kindesley Pearson Education, India, 2010.
3. Adair, John. Effective Communication. London: Pan Macmillan Ltd., 2003.
4. Andrea J. Rutherford, Basic Communication Skills for Technology, 2nd Edition, Pearson India, 2001.

Course Outcomes

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

- communicate confidently in English in social and professional contexts with improved skills of fluency and accuracy (L6).
- write grammatically correct sentences employing appropriate vocabulary suitable to different contexts (L3).
- comprehend and analyze different academic texts (L4).
- effectively handle academic writing tasks such as paragraph writing, précis writing, paraphrasing and essay writing (L3).
- effectively handle formal correspondence like e-mail drafting and letter writing (L3).
- think critically, analytically, creatively and express ideas and content meaningfully (L6).

19EPH131: ENGINEERING PHYSICS (ECE, CSE, EEE and IT)

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

This course is designed with fundamentals of electromagnetism and properties of materials for advanced courses in their respective engineering branches. It introduces electromagnetic theory with relevant mathematical tools, optical fibers and their propagation characteristics, properties of dielectric and magnetic materials. It also introduces principles of semiconductors and some widely used semiconductor devices for various applications.

Course Objectives:

- To introduce mathematical principles to estimate forces, fields and waves.
- To familiarize students with electromagnetics in modern communication systems.
- To impart knowledge concerning the electrical behaviour of dielectric materials.
- To demonstrate the properties of magnets.
- To introduce semiconductor physics and devices.

Unit-I: Basics of Electromagnetics **9 L**

Electrostatic field: Coulomb's law and Gauss' law, derivation of Coulombs law from Gauss' law, applications of Gauss' law (line charge, thin sheet of charge and solid charged sphere), Gauss' law of electrostatics in dielectric medium, divergence and curl of electric fields, electric potential, relation between potential and force, Poisson's and Laplace equations.

Magnetostatic field: Biot–Savarts' law, divergence and curl of magnetic fields, Faraday's and Ampere's laws in integral and differential form, displacement current, continuity equation, Maxwell's equations.

Learning outcomes:

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

- apply Coulomb's and Gauss' laws to electric field configurations from charge distributions (L3).
- apply the Biot-Savarts' law to derive magnetostatic field distributions (L3).
- use vector calculus to describe electromagnetic phenomena (L2).
- relate the law of conservation of charge to continuity equation (L3).
- evaluate the Maxwell's equations, Maxwell's displacement current and correction of Ampere's law (L2).

Unit II: Fiber Optics **7 L**

Introduction, advantages of optical fibers, principle and structure, acceptance angle, numerical aperture, modes of propagation, classification of fibers, fiber optic communication, importance of V-number, fiber optic sensors (Temperature, displacement and force), applications.

Learning outcomes:

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

- apply the principle of propagation of light in optical fibers (L3).
- explain the working and classification of optical fibers (L2).
- analyze propagation of light through optical fibers based on the concept of modes (L4).
- summarize applications of optical fibers in medical, communication and other fields (L2).

Unit III: Dielectric and Magnetic Materials **10 L**

Dielectric materials: Introduction, electric polarization, dielectric polarizability, susceptibility and dielectric constant, types of polarizations (qualitative treatment only), frequency dependence of polarization, Lorentz (internal) field (quantitative), Clausius-Mossotti equation.

Magnetic materials: Introduction, magnetic dipole moment, magnetization, magnetic susceptibility and permeability, origin of permanent magnetic moment, classification of magnetic materials, Weiss theory of ferromagnetism (qualitative), domain theory, hysteresis, soft and hard magnetic materials.

Learning Outcomes:

After completing this unit the students will be able to

- explain the concept of dielectric constant and polarization in dielectric materials (L2).
- interpret dielectric loss, Lorentz field and Claussius- Mosotti relation (L2).
- classify the magnetic materials (L2).
- explain the phenomenon of hysteresis for a ferromagnetic material and summarize the properties of hard and soft magnetic materials (L3).

Unit IV: Semiconductor physics **8 L**

Introduction, origin of energy band, intrinsic and extrinsic semiconductors, mechanism of conduction in intrinsic semiconductors, generation and recombination, carrier concentration in intrinsic semiconductors, variation of intrinsic carrier concentration with temperature, n-type and p-type semiconductors, carrier concentration in n-type and p-type semiconductors.

Learning outcomes:

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

- outline the properties of semiconductors (L2).
- interpret expressions for carrier concentration in intrinsic and extrinsic semiconductors (L3).
- assess the variation of carrier concentration in semiconductors with temperature (L4).

Unit – V: Semiconductor devices **8 L**

Drift and diffusion currents in semiconductors, Hall effect and its applications, magnetoresistance, p-n junction layer formation and V-I characteristics, direct and indirect band gap semiconductors, construction and working of photodiode, LED, solar cell.

Learning Outcomes:

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

- explain the drift and diffusion currents and formation of junction layer(L2).
- state Einstein's relations (L1).
- explain Hall effect and its applications (L3).
- illustrate and interpret the V-I characteristics of a p-n junction diode(L2).
- describe applications of p-n junction diodes in photodiodes, LEDs and solar cells (L3).

Text Book(s):

1. David J. Griffiths, "Introduction to Electrodynamics"- 4/e, Pearson Education, 2014.
2. Charles Kittel "Introduction to Solid State Physics", Wiley Publications, 2011.

References:

1. M.N. Avadhanulu, P.G.Kshirsagar "A Text book of Engineering Physics", 11/e, S. Chand Publications, 2019.
3. Gerd Keiser "Optical Fiber Communications"- 4/e, Tata Mc Graw Hill, 2008.
4. S.O. Pillai, "Solid State Physics" 8/e, New Age International, 2018.
5. S.M. Sze, "Semiconductor devices-Physics and Technology" - Wiley, 2008.

Course Outcomes:

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

- apply the fundamental laws of electricity and magnetism to currents and propagation of EM waves (L2).
- identify the mechanisms of polarization in dielectrics and magnetic materials, conduction in semiconductors and propagation of light in optical fibers. (L3).
- explain the principles of physics in dielectrics, magnetic materials and semiconductors useful to engineering applications (L2).
- summarize magnetic hysteresis curve (L2).
- analyze dielectric loss and carrier concentration in semiconductors (L4).
- classify solids and calculate conductivity of semiconductors (L4).
- demonstrate the functioning of solar cell, photodiode and loss mechanisms in optical fibers (L2).

Engineering Physics Laboratory (ECE, CSE, EEE, EIE and IT)

List of Experiments:

1. To determine the magnetic field along the axis of a circular coil carrying current.
2. To determine the numerical aperture of a given optical fiber and hence to find its acceptance angle.
3. To determine magnetic susceptibility by Gouy's method.
4. To determine the Hall coefficient using Hall effect experiment.
5. To determine the resistivity of semiconductor by Four probe method.
6. To determine the energy gap of a semiconductor.

7. To study the characteristics of PN Junction diode.
8. To study magnetic hysteresis loop (B-H curve).
9. To determine the dielectric constant of a substance by resonance method.
10. To determine hysteresis loss by CRO.
11. To study the characteristics of Photodiode.
12. To study the characteristics of Solar Cell.

References:

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

Learning Outcomes:

After completion of this unit the student will be able to

- utilize four probe set up and measure resistance (L3).
- determine the susceptibility of a paramagnetic substance (L5).
- understandthe characteristics of photodiode, p-n junction diode and solar cell (L2).
- demonstrate the importance of dielectric material in storage of electric field energy in the capacitors (L2).
- assess the intensity of the magnetic field of circular coil carrying current with varying distance (L5).
- evaluate the acceptance angle of an optical fiber and numerical aperture and loss (L5).
- determine hysteresis losses by B-H curve and measure magnetic parameters using hysteresis loop (L5).
- identify the type of semiconductor i.e., n-type or p-type using Hall effect (L3).
- determine the band gap of a given semiconductor (L5).

19ECY131: ENGINEERING CHEMISTRY (ECE, CSE, EEE and IT)

L	T	P	C
3	0	3	4.5

This course enables the students to gain knowledge on various aspects of renewable energy resources, electrochemical energy systems, construction of batteries, technological importance machining and etching, polymers, nano-materials, molecular machines and switches. The knowledge gained in this course can be applied to the latest problems in the above areas.

Course Objectives:

- To acquaint with electrochemical energy systems and their applications.
- To impart knowledge on the basic concepts of battery technology.
- To familiarize the students with various sources of renewable energy and their harnessing.
- To demonstrate the construction of photovoltaic cells.
- To introduce different types of nano-materials.
- To expose the students to latest instrumental techniques such as scanning electronic microscope (SEM) & transmission electron microscope (TEM).

Unit I: Electrochemical Energy Systems 9L

Introduction Origin of electrode potential, Electrode Potentials, Measurement of Electrode Potentials, Nernst Equation for a single electrode, EMF of a cell, Types of Electrodes or Half Cells Hydrogen and Calomel electrode, Electrochemical Cell, Galvanic Cell vs Electrolytic Cell, Electrochemical conventions, Types of Ion Selective Electrodes- glass membrane electrode, polymer membrane electrodes, solid state electrodes, gas sensing electrodes (classification only), Concentration Cells.

Learning Outcomes:

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

- list the different types of electrodes (L1).
- illustrate the construction of concentration cells (L2).
- explain the significance of electrode potentials (L2).
- compare different types of cells and batteries (L2).
- classify the ion selective electrodes (L2).

Unit II: Battery Technology 8L

Basic concepts, battery characteristics, classification of batteries, Important applications of batteries, Classical batteries-dry/Leclanche cell, Modern batteries-zinc air, lithium cells-Li MnO_2 cell- challenges of battery technology. Fuel cells Introduction - classification of fuel cells – hydrogen and oxygen fuel cell, propane and oxygen fuel cell- Merits of fuel cell.

Learning Outcomes:

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

- classify batteries into different types (L2).
- explain the concept involved in the construction of lithium cells (L2).
- compare the merits of different fuel cells (L2).
- identify the significance of batteries (L3).
- apply the redox principles for construction of batteries and fuel cell (L3).

Unit III: Renewable Sources of Energy **8L**
Introduction- sources of renewable energy

Solar energy – Introduction - Physical and Chemical properties of Silicon- Production of Solar Grade Silicon from Quartz - Doping of Silicon- p and n type semi conductors- PV cell / solar cell- Manufacturing of Photovoltaic Cells using Chemical Vapor Deposition Technique-applications of solar energy.

Learning Outcomes:

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

- list different renewable sources of energy. (L1).
- explain how photovoltaic cells convert light into energy. (L1).
- compare p and n type semi conductors. (L2).
- illustrate the construction of PV cell. (L2).

Unit IV: Metal Finishing **9L**

Technological importance of metal finishing, methods of metal finishing, manufacturing of electronic components, electrochemical techniques of forming, machining and etching, electrolytic cell, principle of electroplating, nature of electrodeposits, electroplating process, Electroplating of chromium, gold etc. Electroless plating of copper, nickel.

Learning Outcomes:

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

- explain the electrochemical techniques of forming (L2).
- extend it to electroless plating of some metals (L2).
- identify different methods of metal finishing (L3).
- apply the methods of metal finishing in the manufacture of electronic components (L3).

Unit V: Polymers, Nanomaterials and Molecular Machines & Switches **8L**

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

Nanomaterials: Introduction to nanomaterial: nanoparticles, nanocluster, carbon nanotube (CNT) and nanowires. Chemical synthesis of nanomaterials: sol-gel method. Characterization: Principle and applications of scanning electron microscope (SEM) and transmission electron microscope (TEM).

Molecular machines & Molecular switches: Rotaxanes and Catenanes as artificial molecular machines; Molecular switches – cyclodextrin-based switches

Learning Outcomes:

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

- explain the concepts of artificial molecular machines and molecular switches (L3).
- identify different types of polymers (L3).
- distinguish between thermoplastic and thermo setting resins (L4).
- compare nanoclusters and nanowires (L4).

Text Book(s):

1. P.C. Jain and M. Jain, Engineering Chemistry, 15/e, Dhanapat Rai & Sons, Delhi, 2014.
2. B.K. Sharma, Engineering Chemistry, Krishna Prakashan, Meerut.
3. O G Palanna, Engineering Chemistry, Tata McGraw Hill, 2009.

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. N.Krishna Murthy and Anuradha, A text book of Engineering Chemistry, Murthy Publications, 2014.
5. K. Sesha Maheshwaramma and Mridula Chugh, Engineering Chemistry, Pearson India Edn services, 2016.

Course Outcomes:

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

- list various sources of renewable energy (L1).
- compare different types of cells (L2).
- explain the merits of fuel cells (L2).
- identify suitable methods for metal finishing (L3).
- distinguish between nanoclusters and nanowires, polymers, molecular machines & switches (L4).

Engineering Chemistry Laboratory (CSE, IT, ECE & EEE)

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

Course Objectives:

- To familiarize the students with the basic concepts of Engineering Chemistry lab.
- To train the students on how to handle the instruments.
- To demonstrate the digital and instrumental methods of analysis.
- To expose the students in practical aspects of the theoretical concepts.

List of Experiments

1. Determination of Mohr's salt by potentiometric method
2. Determination of strength of an acid by pH metric method
3. Determination of conductance by conductometric method
4. Determination of viscosity of a liquid
5. Determination of surface tension of a liquid
6. Determination of sulphuric acid in lead-acid storage cell
7. Determination of chromium (VI) in potassium dichromate
8. Determination of copper in a copper ore
9. Determination of Zinc by EDTA method.
10. Estimation of active chlorine content in Bleaching powder
11. Preparation of Phenol-Formaldehyde resin
12. Preparation of Urea-Formaldehyde resin
13. Thin layer chromatography
14. Preparation of TiO2/ZnO nano particles
15. SEM analysis of nano materials

Text books

1. Mendham J, Denney RC, Barnes JD, Thosmas M and Sivasankar B Vogel's Quantitative Chemical Analysis 6/e, Pearson publishers 2000.
2. N.K Bhasin and Sudha Rani Laboratory Manual on Engineering

Chemistry 3/e, Dhanpat Rai Publishing Company 2007.

Course Outcomes:

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

- explain the functioning of the instruments such as pH, Conductometric and Potentiometric methods (L2).
- identify different ores (Cr & Cu) and their usage in different fields (industry, software devices, electronic goods) (L3).
- experiment with the physical parameter of organic compounds (L3).
- compare the viscosities of oils (L4).
- list the preparation of polymers and nano materials (L4).

19EID131: PROBLEM SOLVING AND PROGRAMMING

(Common to all)

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.

a. Construct flowcharts tocalculate 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.

4. 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

5. Construct flowcharts with procedures to

a. generate first N numbers in the Fibonacci series

b. generate N Prime numbers

6. Design a flowchart to perform Linear search on list of N unsorted numbers (Iterative and recursive)

7. 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. Reema Thareja, 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

(Common to all)

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 introduce 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**

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

After completion of this unit 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**

DC Machines: Constructional features, induced EMF and torqueexpressions, 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:

After completion of this unit, 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**

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:

After completion of this unit, 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 (L5).
- describe torque and torque slip characteristics (L1).
- estimate losses and efficiency of three Phase Induction Motors (L2).

Unit IV: **12L**

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:

After completion of this unit, 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 (L2).
- describe the construction and operation of n-channel and p-channel MOSFETs (L1).
- explain the use of MOSFET as an amplifier and bidirectional switch(L2).

Unit V: **10L**

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:

After completion of this unit 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).

Basic Electrical and Electronics Engineering Laboratory List of 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.

Text Book(s):

1. D.P.Kothari, I.J.Nagrath, Basic Electrical and Electronics Engineering,

1/e, McGraw Hill Education (India) Private Limited, 2017.

2. B.L.Theraja, Fundamentals of Electrical Engineering and Electronics, 1/e, S.Chand Publishing,New Delhi, 2006.
3. Adel S. Sedra and Kenneth C. Smith, Microelectronic Circuits 6/e, 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.

Course Outcomes:

After completion of this 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).
- demonistrate the operation and applications of various electronic devices (L2).
- construct Inverting and Noninverting configurations of Op-amp (L3).

19EME121: WORKSHOP

(Common to all)

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

The objective of this course is to expose students common tools in engineering. This course enables the students to gain hands on experience and skills necessary to perform basic 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-fitb) 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 (L2).
- develop different parts with metal sheet in real time applications (L3).
- demonstrate fitting operations in various applications (L3).
- preform soldering and brazing operations (L3).
- select different types of electric circuits in practical applications (L3).

19EME131: ENGINEERING GRAPHICS

(Common to all)

L	T	P	C
1	0	3	2.5

This 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 utility of drafting and modeling packages in orthographic and isometric drawings.
- Train the usage of 2D and 3D modeling softwares.
- Impart 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 **2L**

Projection of points, lines and planes: 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. **2L**

Projections of solids: Projections of regular solids inclined to one and both the reference planes. **1L**

Sections of solids: Sectional planes and sectional view of right regular solids- prism, cylinder, pyramid and cone. True shapes of the sections. **1L**

Development of surfaces: Development of surfaces of right regular solids-prism, cylinder, pyramid, cone and their sectional parts. **1L**

Computer Aided Drafting:

Introduction to AutoCAD: 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. **1L**

Orthographic Projections: Systems of projections, conventions and application to orthographic projections. **3L**

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

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.

Course Outcomes:

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

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

9EMC181A : 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 [1] 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 the activities of National Service Scheme, concept of social Service and principles of health, hygiene and sanitation.

UNIT I **2Hours**

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 variousNSSFunctionaries.

UNIT II **2Hours**

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

UNIT III **2Hours**

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 mediain theN.S.S activities.

UNIT IV **4hours**

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 Disasters Management, Home nursing, First Aid. **Civil Self Defense:** Civil Defense services, aims and objectives of civil defense, Need for self defence training

UNIT V **10hours**

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):

1) National Service Scheme Manual (Revised) 2006, Government of India, Ministry of Youth Affairs and Sports, New Delhi
2) NSS Diaries
3) Sanjay Bhattacharya, 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 hours**

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 hours**

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 hours**

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 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 hours**

Social awareness and community development: Basics of social service, weaker sections of our society and their needs, social/ rural development projects – menrega , sgsy , nsap etc, 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 harassment act 2012.

UNIT V **5 hours**

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)

L	T	P	C
0	0	2	0

National Sports Organization 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. Dhama Prakash Jyoti, 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, Ardha Padmasan, 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 Satyananda Saraswathi - Asana, Pranayama, Mudra & Bandha. Bihar School of Yoga, Munger
3. B.KS.Iyenger - The Illustrated Light on Yoga. Harper Collins, New Delhi.

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 (L3).

19EMA102: ENGINEERING MATHEMATICS-II ODE, PDE AND MULTIVARIABLE CALCULUS (AE, CE, ECE, EEE and ME)

L	T	P	C
3	0	0	3

This course is designed to impart knowledge on ordinary, partial differential equations and vector calculus to understand the 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: Linear Differential Equations of Higher Order **8 L**

Definitions, complete solution, operator D, rules for finding complimentary function, inverse operator, rules for finding particular integral, method of variation of parameters.

Learning Outcomes:

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

- classify the solutions of linear differential equations (L4).
- 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: Equations Reducible to Linear Differential Equations and Applications **8 L**

Cauchy's and Legendre's linear equations, simultaneous linear equations with constant coefficients, Applications: Mass-Spring system and L-C-R Circuit.

Learning Outcomes:

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

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

Unit III: Partial Differential Equations **8 L**

Formation of partial differential equations, solutions of first order linear partial differential equations, Charpit's method, solutions to homogenous and non-homogenous linear partial differential equations.

Learning Outcomes:

After completion of this unit the student will be able to

- apply a range of techniques to find solutions of partial differential equations (L3).

- identify the basic properties of partial differential equations (L3).

Unit IV: Multivariable Calculus (Vector Differentiation) 8 L

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:

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

- illustrate the physical interpretation of gradient, divergence and curl (L3).
- apply operator del to scalar and vector point functions (L3).

Unit V: Multivariable Calculus (Vector Integration) 10 L

Line integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Gauss divergence theorem (without proof).

Learning Outcomes:

After completion 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 Gauss divergence theorem in evaluation of line, surface and volume 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. Dennis G. Zill and Warren S. Wright, Advanced Engineering Mathematics, 4/e, Jones and Bartlett Publishers, 2011.
2. Michael Greenberg, Advanced Engineering Mathematics, 2/e, Pearson, 2016.
3. George B. Thomas, Maurice D. Weir and Joel R. Hass, Thomas' Calculus, 13/e, Pearson Publishers, 2014.
4. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002.

Course Outcomes:

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

- solve the differential equations related to various engineering fields (L3).
- identify methods of solution for partial differential equations (L3).
- interpret the physical meaning of gradient, divergence and curl (L4).
- determine the work done against a force field, circulation and flux using vector calculus (L4).

19EID132: DESIGN THINKING

(Common to all)

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:

- To familiarize product design process
- To introduce the basics of design thinking
- To bring awareness on idea generation
- 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):

- Pahl, Beitz, Feldhusen, Grote – Engineering Design: a systematic approach, Springer, 2007
- Christoph Meinel and Larry Leifer, Design Thinking, Springer, 2011
- Aders Riise Maehlum - Extending the TILES Toolkit – from Ideation to Prototyping
- http://www.algarytm.comA/it-executives-guide-to-design-thinking:e-book.
- 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/@salisuw y/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-Buildcustommodelsusingthevisualtoolfor Objectrecognitionandsentimentanalysisthatcan 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 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.

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)

19EEC122: ELECTRONICS WORKSHOP (ECE)

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

This workshop will enable the student to know the basics of electronic components and devices, their identification and selection for a given cir- cuit. This lab makes the student to operate and use electronic devices, wire and fabricate various circuits on his own. The testing of the circuits wired / fabricated can be tested with the knowledge of various sources and power supplies introduced. Mini project is carried out towards end of the lab, which will inculcate good practice of hands on experience and experiential learning.

Course Objectives:

- to introduce and make use of Active and Passive electronic compo- nents.
- to impart knowledge of regulated power supplies, function generators and CRO and their applications.
- to enable wiring / soldering practice simple electronic circuits using various components on breadboard / PCB.
- to teach students about Diode as a switch, transistor as a switch and hardware components of a simple computer.
- to introduce solar panels and their wiring.
- to introduce hardware components like SMPS, switches, ports, input and output devices of a simple computer.
- to wire and test a mini project.

List of Experiments:

1. Study of resistance color codes, identification of active and passive electronic components.
2. Study and use of bread board trainer kit.
3. Study of multimeter and CRO.
4. Study of function generator and regulated power supply.
5. Soldering of electronic components on PCBs.
6. Function of diode as a switch.
7. Study of battery types, specifications, construction and ratings.
8. Voltage measurement using solar panel.
9. Design of battery charger using microcontroller.
10. Study of computer system hardware.
11. Mini project

Course Outcomes:

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

- decode the resistance / inductance / capacitance values & tolerances (L4).
- understand and use RPS, voltmeter, ammeter, multimeter, function generator and CRO (L4).
- study and use breadboard for various circuit wiring (L5).
- fabricate simple circuits on a PCB and test them (L6).
- understand various hardware parts of a computer (L2).
- complete a mini project and test it (L6).

19EHS122: COMPREHENSIVE SKILL DEVELOPMENT – 1

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 **- 3 Hours per week**

A. Verbal and Soft Skills

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

	Verbal and Soft Skills	
Unit	Module/ Topics	Hrs
1.	Self-Awareness and Self-Regulation	4
2.	Social Awareness & Relationship Management	4
3.	Conflict Management	3
4.	Team Work	4
	Total	15

B. Quantitative Aptitude and Reasoning

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

	Quantitative Aptitude and Reasoning	
Unit	**Module/ Topics**	**Hrs**
1.	Verbal Reasoning [Coding decoding, Blood relations, Ranking, Directions, Group Reasoning (Puzzle Test)]	6
2.	Analytical Reasoning [Cubes, Counting of Geometrical Figures)	2
3.	Logical Deductions [Venn diagrams, Syllogisms, Data Sufficiency]	4
4.	Puzzles [Puzzles from books i. Puzzles to puzzle you by Shakunthala devi	3

	ii. More puzzles by Shakunthala devi iii. Puzzles and Teasers by George Summers]	
	Total	**15**

Part-2 **- 3 Hours per week**

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. sentation of graphs, Breadth First Search, Depth First Search, Dynamic Programming.

Scheme of Evaluation

Internal Assessments by Assignments , Quizzes(multiple Choice questions). All the Students are expected to do at least 5 problems in each topic and they should submit the content written by them in each topic for final evaluation.

Type of Assessment	No.of Marks
At least 5 problems in each topic	15
Assignments	15
Content writing	10
Quizzes	10
Total	**50**

Late Work

Each homework is due in the beginning of the class meeting (that is, at 6:00pm) on the due date. If homework is submitted within seven days after this deadline, the grade will be reduced by 50%. Submission more than seven days after the deadline will not be accepted. If you have a serious reason for requesting an extension, such as illness or family emergency, you should discuss it with one of the instructors as soon as the problem arises, and definitely before the submission deadline.

References:-

The course does *not* have a required textbook. You may optionally use the following textbook and URLs to look up standard algorithms:

1. Data Structures and Algorithms made easy by Narasimha Karumanchi
2. Data Structure and Algorithmic Thinking with Python by Narasimha Karumanchi
3. Algorithm Design Techniques: Recursion, Backtracking, Greedy, Divide and Conquer and Dynamic Programming by Narasimha Karumanchi
4. Coding Interview Questions by Narasimha Karumanchi
5. Competitive Programming in Python- 128 Algorithms to develop your Coding Skills by Cristhop Durr & Jill-Jen Vie.
6. Guide to Competitive Programming: Learning and Improving Algorithms Through Contests (Undergraduate Topics in Computer Science) *by* Antti Laaksonen
7. https://www.geeksforgeeks.org/competitive-programming-a-complete-guide/
8. https://www.codechef.com/certification/data-structures-and-algorithms/prepare
9. https://codeforces.com/
10. https://leetcode.com/

VDC111: VENTURE DISCOVERY

L	T	P	C
0	0	4	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 solution that meets their customers' needs and generate revenue for the business.

COURSE OBJECTIVES

- 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.

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
12111	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 Entrepreneurship, 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

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

	COURSE Outcomes	**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

19EMA203: ENGINEERING MATHEMATICS-III COMPLEX VARIABLES & TRANSFORM TECHNIQUES

(Common to EEE & ECE)

L	T	P	C
3	0	0	3

Preamble :*This course is designed to familiarize the students with complex variables,complex integraton, fourier series expansions of periodic functions and Laplace, Z-transforms to understand the applications in engineering.*

Course Objectives:

- To explain the concepts of complex analysis and their applications.
- To demonstrate the concept of Laplace and inverse Laplace transforms.
- To teach Fourier series and Fourier transforms of functions.
- To teach Z-transforms and its applications.

Unit I: Complex Variables **10 L**

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

Learning Outcomes:

After completion of this unit student 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)
- Analyze the Taylor and Laurent expansions of simple functions, determining the nature of the singularities and calculating residues (L4)
- make use of the Cauchy residue theorem to evaluate certain integrals (L3)

Unit II: Laplace transforms **9L**

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:

After completion of this unit student 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: Fourier series **6 L**

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

Learning Outcomes:

After completion of this unit student 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: Fourier transforms **8 L**

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

Learning Outcomes:

After completion of this unit student able to

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

Unit V: Z-Transforms **9L**

Definition of Z-transform, elementary properties, linearity property, damping rule, shifting u_n to the right and left, multiplication by n, initial value theorem, final value theorem, inverse Z-transform, convolution theorem, solution of difference equations using Z-transforms.

Learning Outcomes:

After completion of this unit student able to

- summarize the properties of Z-transforms (L3)
- find Z and inverse Z-transformations for different functions (L3)
- solve difference equations by using Z-transforms (L3)

Text Books:

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.

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 be able to apply integral expressions for the forwards and inverse Fourier transform to a range of non-periodic waveforms (L3)
- solve discrete time systems using Z transform techniques (L3)

19EEC231: NETWORK THEORY AND ANALYSIS

L	T	P	C
3	0	2	4

This course aims to develop the basic concepts of network analysis, which are the pre-requisites for all the electronics engineering courses. The course deals with understanding various network reduction techniques such as source transformation, network theorems and apply these techniques to simplify different complex R-L-C networks. Design techniques of resonant circuits is imparted. Analysis and synthesis of two-port networks are dealt. Transient Response of complex electrical systems and design of stable system is also elaborated.

Course Objectives:

- To impart knowledge about solving different complex circuits using various network reduction techniques such as source transformation, network theorems.
- To explain the analysis AC and DC transient response for complex R-L-C circuits.
- To familiarize AC steady state response for complex R-L-C series and parallel circuits and to analyze the circuits.
- To distinguish between series and parallel resonance and design resonant circuits.
- To acquaint the students with evaluation of two port network parameters.

Unit I: **8L+6P**

Introduction: Ohms law, Kirchoff's laws, series and parallel circuits, source transformations, delta-wye conversion, linearity and superposition theorem with simple examples, Thevenin's and Norton's theorem with simple examples, maximum power transfer theorem with simple examples. mesh, super mesh analysis, nodal, super node analysis.

Learning outcomes:

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

- define circuit laws(L1).
- apply circuit laws on electrical networks(L3).
- apply transformation techniques, mesh and nodal analysis to circuits (L3).
- analyze electrical networks using network theorems(L4).
- evaluate load resistance using network theorems(L4).

Unit II: **9L+3P**

Time domain analysis of circuits: transient analysis of first order and second order systems, initial and final conditions in networks. dc transients: source free and forced response of RL, RC and RLC circuits analysis using Laplace transform.

Learning outcomes:

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

- analyze the transient behavior of electrical circuits (L3).
- determine the response of source free circuits (L3).
- analyze the forced response of RC /RL /RLC circuits (L3).
- apply Laplace transform to analyze RC / RL /RLC circuits (L3).

Unit III: **9L+9P**

Sinusoidal Steady-State Analysis: sinusoids, sinusoidal functions and complex functions, instantaneous power, average power, effective values of current and voltage, apparent power and power factor, complex power, phasors, phasor relationships for R, L and C and steady state analysis of RL, RC and RLC circuits.

Learning outcomes:

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

- analyze sinusoidal or AC response of RC/RL /RLC series/parallel circuit (L4).
- determine real and reactive power and power factor in AC circuits (L3).
- demonstrate different states of the circuits using phasor relationships (L3).

Unit IV: **8L+6P**

Resonance: series resonance, parallel resonance, bandwidth, selectivity, quality factor.

Learning outcomes:

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

- differentiate between series and parallel resonance (L1).
- design RLC resonant circuits for different frequencies (L3)
- evaluate Q factor, current and voltage variations across each component with respect to frequency (L4).

Unit V: **8L+6P**

Two Port Networks: impedance parameters, admittance parameters, hybrid parameters and transmission parameters, relationships between parameters.

Learning outcomes:

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

- determine Z,Y, h and ABCD parameters of two port networks(L3)
- explain the relationship between parameters (L2).
- determine the parameters of interconnected two port networks (L3).

Network Theory and Analysis Laboratory

List of Experiments:

1. Experimental verification of Kirchhoff's voltage and current laws
2. Experimental verification of network theorems (Thevenin's, Norton's, Superposition and Maximum power transfer Theorem).
3. Study of CRO and measurement of sinusoidal voltage, frequency and power factor.
4. To study the step response of RL, RC & RLC circuits.
5. Experimental determination of time constant of series R-C electric circuits.
6. Experimental determination of frequency response of RLC circuits.
7. Design and Simulation of series resonance circuit.
8. Design and Simulation of parallel resonant circuits.
9. Determination of two port network parameters.
10. For the given network function, draw the pole zero diagram and hence obtain
11. The time domain response. Verify the result analytically. V(s) = 5(s+5) / (S +2) (S + 7)

Text Book(s):

1. M.E.VanValkenburg, Network Analysis, 3/e , Pearson Education, 1974
2. A. Sudhakar, Shyammohan S.Palli, Circuits & Networks: Analysis and Synthesis, 3/e, Tata McGraw Hill Publication, 2006.

References:

1. William H Hayt, Jack E Kimmerly and Steven M.Durbin, Engineering Circuit Analysis, 8/e, Tata McGraw Hill, 2013.
2. A.Chakrabarti, Circuit Theory: Analysis & Synthesis, 3/e, Dhanpat Rai & Co, 2013.

Course Outcomes:

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

- analyze basic AC and DC circuits using nodal, mesh analysis and network theorems, retransformation and several methods of simplifying networks (L5).
- understand the concept of graphical solution to transient electrical network in time domain analysis and apply Laplace Transform for steady state and transient analysis (L4).
- analyze sinusoidal or AC response of circuits and determine power and power factor of circuits(L5)

- distinguish between series resonance and parallel resonance concepts and performance parameters (L2)
- derive two port network parameters Z, Y, ABCD, h and their interrelationships and determine for different network functions (L6).

19EEC237: ELECTROMAGNETIC WAVES

L	T	P	C
2	0	2	3

The concept of electromagnetism is evolved from static electric and magnetic fields when time is added as fourth dimension. Electromagnetism is the principle with which all electrical machines function. Electromagnetism is used as a mode of propagation of energy at very frequencies. This is a foundation course for understanding the concept of wave transmission in free space or in any media carrying data / message / voice / audio from transmitter to receiver.

Course Objectives:

- To demonstrate the concepts of static electric and magnetic fields and their importance in electromagnetics.
- To impart the knowledge of basic characteristics of an electromagnetic field.
- To explain the principle of transmission of energy using electromagnetic wave.
- To familiarize the electromagnetic fields and mechanism of transmission of energy in free space / dielectric medium.

Unit I: **8L**

Electrostatics: Coulomb's law, electric field intensity, field due to a line charge, electric flux density, Guass's law, electric potential, potential gradient, energy stored, Laplace's and Poison's equations.

Learning Outcomes:

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

- explain the concept of static electric field and Electric Potential (L2).
- Interpret Laplace and Poisson's equations for static electric field (L2).
- apply Guass's Law to determine electric field of given charge distribution (L3).
- derive electric potential due to charge distribution and relate to electric field (L3).
- determine energy stored in any charge distribution / electric field (L3).

Unit II: **8L**

Magnetostatics: steady current, Biot-Savart's law, static magnetic field due to line current, magnetic flux density, Ampere's circuital law, Lorentz force equation, magnetic vector potential, energy stored.

Learning Outcomes:

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

- identify magnetic field at a point due to current element(L1).

- apply Biot-Savart's law for magnetic field due to line current(L3).
- calculate flux per unit area(L3).
- evaluate magnetic field around a closed loop(L3).
- determine energy stored in a magnetic field region(L4).

Unit III: **10l**

Time-varying fields and Maxwell's equations: time varying fields, Faraday's law of electromagnetic induction, displacement current, Maxwell's equations in point form and integral form, boundary conditions of electromagnetic fields, polarization, magnetization.

Learning Outcomes:

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

- determine how time varying electric and magnetic fields are generated by charges (L3).
- explain the generation of electric current in a conductor in the presence of changing *magnetic* field(L4).
- describe the relation between electric and magnetic field with Maxwell's equations(L2).
- explain the propagation of EM Wave with direction and magnitude(L2).
- describe the concept of magnetization (L2).

Unit IV: **8L**

Uniform Plane Wave: wave equation**,** wave propagation in free space, wave propagation in conductor and dielectrics, poynting theorem, skin effect, wave polarization, direction cosines.

Learning Outcomes:

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

- state mathematical representation of EM wave(L1).
- explain wave propagation in different media(L2).
- determine the power flow through a selected surface(L3).
- calculate depth of penetration of wave through conductor(L2).
- analyze the significance of polarization(L4).

Unit V: **10L**

Plane Waves at Boundaries and in Dispersive Media: reflection of uniform plane waves by perfect conductor – normal and oblique incidence, standing wave ratio, reflection and transmission of uniform plane waves by perfect dielectric – normal and oblique incidence.

Learning Outcomes:

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

- explain standing waves formation (L2)
- calculate the reflected wave characteristics for normal and oblique incidence (L3).
- determine the reflection of uniform plane wave for oblique incidence(L4).

Textbook(s):

1. William H. Hayt, Engineering Electromagnetics, 8/e, Tata McGraw Hill, 2012.

2. Matthew N.O. Sadiku, Elements of Electromagnetics, 4/e, Oxford University Press, 2014.

References:

1. E. C. Jordan, EM Waves and Radiating Systems, PHI, 2/e Prentice Hall, 2012
2. David K. cheng, Field and Wave Electromagnetics, 2/e, Pearson Education, 1989.
3. Electromagnetics with Applications, J.D. Kraus, D. A. Fleish, 5/e, McGraw Hill, 1999.

Course Outcomes:

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

- apply vector calculus to understand the behavior of static electric fields in standard configurations. (L3)
- apply vector calculus to understand the behavior of static magnetic fields in standard configurations. (L3)
- describe and analyze electromagnetic wave propagation in free-space, conductor and dielectric media. (L2)
- justify the concept of electromagnetic waves in terms of transporting energy or information (L6)
- describe the reflection of plane wave at normal and oblique incidence in free space and dispersive media (L4).

19EEC233: ELECTRONIC DEVICES AND AMPLIFIER CIRCUITS

L	T	P	C
3	0	3	4.5

This course familiarizes the student with structure, operation, modeling and design of semiconductor devices and circuits. Laboratory experiments of this course includes hardware experiments, SPICE simulations and end-to-end circuit design using EDA/PCB design software. Study of these basic circuits is helpful to train the student to designamplifier circuits, digital switches and balanced amplifiers.

Course Objectives:

- To introduce the physical construction of bipolar junction transistors (BJTs) and metal oxide field effect transistors (MOSFETs).
- To impart the knowledge on design and simulation of current mirror circuits.
- To familiarize the analysis of the input impedance, output impedance, voltage gain and bandwidth of MOSFET amplifier configurations.
- To explain the analysis and design of differential amplifiers.
- To expose the student to semiconductor technology evolution, amplifier design principles and circuit analysis techniques.

Unit I: **8L + 6P**

Bipolar Junction Transistors: device structure and physical operation, current-voltage characteristics, the BJT as an amplifier and as a switch, BJT circuits at dc, biasing in BJT amplifier circuits, small-signal operation and models.

Learning Outcomes:

After completion of this unit the student will be able to

- describe the device structure, physical operation and current-voltage characteristics of a BJT (L1).
- derive the small signal parameters of a BJT at a given operating point (L2).
- appreciate the use of BJT in an amplifier and logic gates as switch (L3).

Unit II: **8L + 9P**

MOS Field-Effect Transistors: device structure and physical operation, current-voltage characteristics, MOSFET circuits at dc, the MOSFET as an amplifier and as a switch, biasing in MOS amplifier circuits, small signal operation and models.

Learning Outcomes:

After completion of this unit the student will be able to

- explain the device structure, physical operation and current-voltage characteristics of MOSFET (L2).
- make use of MOSFET as a transconductor in an amplifier and switch in a logic gates (L3).
- estimate the small signal parameters of a MOSFET at a given operating point (L3)

Unit III: **8L+6P**

IC Design Philosophy: comparison of the MOSFET and the BJT, IC biasing-current sources, current mirrors and current-steering circuits, current-mirror circuits with improved performance.

Learning Outcomes

After completion of this unit the student will be able to

- compare the relative merits and demerits of MOSFETs and BJTs in terms of transconductance, output resistance, intrinsic gain and transition frequency (L2).
- design a MOSFET current sink/source for desired current, voltage headroom, output current and output resistance (L5).
- analyze the voltage headroom, output resistance of cascode current mirror and Wilson current mirror (L4).

Unit IV: **8L + 9P**

Single Stage MOSFET Amplifiers: basic MOSFET amplifier configurations, MOSFET internal capacitances and high frequency model, frequency response of the CS amplifier, discrete circuit MOS Amplifiers.

Learning Outcomes:

After completion of this unit the student will be able to

- describe the dominant pole approach, open circuit time constants method for estimating 3dB frequency of amplifiers (L2).
- estimate the input impedance, output impedance and voltage gain of common source/common gate and common drain amplifiers using small signal models (L3).
- design a source follower circuit for given output impedance or required level shift (L4).
- analyze the 3dB frequency of MOSFET amplifier circuits using open circuit time constants method (L4).

Unit V : **8L + 6P**

Differential Amplifiers: the MOS differential pair, small-signal operation of the MOS differential pair, other non-ideal characteristics of MOS differential amplifier, the MOS differential amplifier with active load.

Learning Outcomes:

After completion of this unit the student will be able to

- explain single ended signaling and differential signaling and compare their merits/demerits (L2).

- demonstrate a MOS differential pair(L2).
- estimate the differential mode gain, common mode gain and CMRR using small signal analysis (L3).
- analyze the source of offset voltages in MOS differential pairs (L4).

Electronic Devices and Amplifier Circuits Laboratory

List of Experiments:

1. Current-Voltage Characteristics of BJT / Measurement of scale current & common emitter current gain.
2. Measurement of small signal parameters (g_m, r_o, r_π, r_e) of BJT at a given operating point Ic.
3. Design, Simulate and Implement BJT amplifier and Inverter logic gateCurrent-Voltage Characteristics of MOSFET / Measurement of threshold voltage.
4. Measurement of small signal parameters (g_m, r_o, g_{mb}) of MOSFET at a given operating point (I_d,V_{ds}).
5. Design and simulation of basic NMOS current mirror, cascode NMOS current mirror and current steering circuit.
6. Design, Simulation and Implementation of Common Source Amplifier for Gain, Power dissipation requirements.
7. Design, Simulation and Implementation of Common Drain Amplifier (Voltage Buffer) for Gain, Output Impedance, Level Shift requirements.
8. Analysis and Verification of Basic NMOS Differential Pair for Gain, Input Common Mode Range, Maximum Input differential voltage requirements.
9. Design, Simulation and Implementation of Differential Amplifier with active current mirror load for gain, power dissipation CMRR requirements.
10. Design, Simulation and PCB fabrication of BJT Astable Multivibrator Circuit.

Text Book(s):

1. Adel S. Sedra, Kenneth C. Smith, Arun N. Chandorkar, Microelectronic Circuits, 6/e, Oxford University Press, 2013.

References:

1. Behzad Razavi, Fundamentals of Microelectronics, 2/e, Wiley Student Edition, 2013.
2. Robert L. Boylestad, Louis Nashelsky, Electronic Devices and Circuits Theory, 10/e, Pearson Education, 2009.
3. Dharma Raj Cheruku, B T Krishna, Electronic Devices and Circuits, 2/e, Pearson Education, 2008.

Course Outcomes:

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

- describe the device structure/physical operation, analyze BJT/MOSFET circuits using their large signal and small signal models (L1).
- distinguish between discrete component circuit design and integrated circuit design and appreciate the relative merits and demerits of BJT and MOSFET devices (L2).
- design current mirror circuits given the output resistance, voltage headroom and output current requirements (L5).
- derive the low frequency and high frequency characteristics of common source, common gate, common drain amplifiers (L4).
- analyze and design differential amplifier circuits for gain and linearity requirements (L4/L6).

19EEC235: SIGNALS AND SYSTEMS

L	T	P	C
2	0	2	3

Signals contain information about the behavior or nature of some phenomenon and are functions of one or more independent variables. A system processes the signal for producing desired behavior. Signal processing plays an extremely important and continually growing role in areas of science and technology such as communications, aeronautics and astronautics, acoustics, seismology, biomedical engineering and speech processing. This course introduces the basic concepts and mathematical tools required for signal processing.

Course Objectives:

- To explain the mathematical representation /classification of continuous-time and discrete-time signals and systems
- To provide an understanding of characterization of linear-time invariant systems using impulse response and convolution function.
- To familiarize the application of Fourier series, Fourier transform and their properties to continuous-time and discrete time signals and systems.
- To impart the knowledge of Laplace and Z-transform and their properties to analyze continuous-time and discrete-time signals respectively.

Unit I: **8L**

Signals and Systems: continuous-time and discrete-time signals, transformations of the independent variable, exponential and sinusoidal signals, the unit impulse and unit step functions, continuous-time and discrete-time systems, basic system properties.

Learning Outcomes:

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

- express continuous and discrete time signals and systems in mathematical form (L1).
- perform mathematical operations on the signals covering dependent and independent variable(L1).
- classify continuous and discrete time signals and systems based on their properties (L3).

Unit II: **7L**

Linear Time Invariant Systems: discrete-time lti systems: the convolution sum, continuous time lti systems: the convolution integral, properties of linear time-invariant systems.

Learning Outcomes:

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

- represent continuous - time and discrete - time signals in terms of impulses (L1).

- find output response of continuous time and discrete time LTI systems using convolution integral and convolution sum (L2).
- analyze the property of a continuous time and discrete time system based on the impulse response of the system(L3).

Unit III: **11L**

Fourier analysis of Continuous Time Signals and Systems: Fourier series representation of continuoustime periodic signals, convergence of the Fourier series, properties of continuous-time Fourier series (CTFS).

Representation of Aperiodic signals: the continuous-time Fourier transform (CTFT), the Fourier transform for periodic signals. properties of the continuous-time Fourier transform, systems characterized by linear constant-coefficient differential equations.

Learning Outcomes:

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

- compute the Fourier series and Fourier Transform for periodic and aperiodic signals (L2).
- apply the properties of CTFT to compute the Fourier transform of a broader class of signals (L3).
- analyze continuous time LTI systems using Fourier Transforms (L4).

Unit IV: **(8L)**

Fourier analysis of Discrete Time Signals and Systems: representation of aperiodic signals: the discrete-time Fourier transform, properties of the discrete-time Fourier transform, the Fourier transform for periodic signals, systems characterized by linear constant-coefficient difference equations.

Learning Outcomes:

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

- compute the Fourier Transform (DTFT) of discrete - time aperodic and periodic signals (L2).
- apply DTFT and its properties to broader class of discrete time signals (L3).
- analyze LTI systems using DTFT (L4).

Unit V: **8L**

Analysis of Continuous time and Discrete time signals using Laplace Transform and Z Transform: The Laplace Transform: the region of convergence (roc) for Laplace transforms, the inverse Laplace transform, properties of the Laplace transform.

The Z-Transform: The region of convergence for the z-transform, the inverse-z transform, properties of the z-transform.

Learning Outcomes:

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

- apply Laplace Transform and Z Transform equations and their properties to continuous time/ discrete time signals (L3).

- explain ROC of Laplace - Transform/ Z - Transform(L2).
- construct continuous time and discrete time signals from their transforms (L3).

Text Book(s):

1. Alan V. Oppenheim, S. Willsky with S.Hamid Nawab, Signals and Systems, 2/e, Pearson Education, 1997.

References:

1. Bhagawandas P. Lathi, Linear Signals and Systems, Oxford University Press, 2009
2. Simon Haykin, Barry Van Veen, Signals and Systems, 2/e, Wiley Student Edition, 2007.

Course Outcomes:

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

- describe the mathematical model of continuous - time/discrete - time signals and systems and perform mathematical operations on signals (L2).
- determine the output response of continuous time/ discrete time LTI system using convolution integral and convolution sum(L2).
- analyze the characteristics of linear – time invariant systems(L4).
- derive the frequency domain representation of signals and systems using transform techniques(L3).
- determine the output response of LTI systems using CTFT and DTFT(L2).

19EMC281: CONSTITUTION OF INDIA (Elective)

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 andpowers, 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 andcouncil, 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 **8L**

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 commis-sion (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 impart knowledge 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 this unit 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 this unit the student will be able to

- learn how 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 this unit 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: **9L**

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, 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 this unit 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 this unit 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).

Text Book (s):

1. AnubhaKaushik 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 MeeraAsthana, 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).

Course Outcomes:

After the completion of this 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).

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 **3 Hours per week**

A. Verbal and Soft Skills:

Communication Skills, Presentation Skills, Decision Making and Problem-Solving, Group Discussion.

Unit	**Module/ Topics**	**Hrs**
1.	Communication Skills	4
2.	Presentation Skills	4
3.	Decision Making and Problem-Solving	3
4.	Group Discussion	4
	Total	**15**

B. Quantitative Aptitude and Reasoning

Puzzles, Numbers, Arithmetic, Data Interpretation.

Unit	**Module/ Topics**	**Hrs**
1.	Non-Verbal Reasoning	5
2.	Data Sufficiency	2
3.	Analytical Reasoning	3
4.	Puzzles	5
	Total	15

Unit	Module/ Topics	Hrs
1.	Numbers [Number System, Divisibility rules, Remainders, LCM & HCF]	3
2.	Numerical Computation and Estimation-1 [i. Chain Rule ii. Ratio Proportions iii. Partnerships & Averages iv. Percentages v. Profit-Loss, and discounts vi. Mixtures]	6
3.	Data Interpretation [Pie diagrams, Line Graph, Bar Graph, Tabular forms, and Caselets]	3
4.	Progressions and Series	3
	Total	15

Part-2 **3 Hours per week**

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.

Scheme of Evaluation

Internal Assessments by Assignments, Quizzes (multiple Choice questions). All the Students are expected to do at least 5 problems in each topic and they should submit the content written by them in each topic for final evaluation.

Type of Assessment	No.of Marks
At least 5 problems in each topic	15
Assignments	15
Content writing	10
Quizzes	10
Total	**50**

Late Work

Each homework is due in the beginning of the class meeting (that is, at 6:00pm) on the due date. If homework is submitted within seven days after this deadline, the grade will be reduced by 50%. Submission more than seven days after the deadline will not be accepted. If you have a serious reason for requesting an extension, such as illness or family emergency, you should discuss it with one of the instructors as soon as the problem arises, and definitely before the submission deadline.

References:-

The course does *not* have a required textbook. You may optionally use the following textbook and URLs to look up standard algorithms:

1. Data Structures and Algorithms made easy by Narasimha Karumanchi
2. Data Structure and Algorithmic Thinking with Python by Narasimha Karumanchi
3. Algorithm Design Techniques: Recursion, Backtracking, Greedy, Divide and Conquer and Dynamic Programming by Narasimha Karumanchi
4. Coding Interview Questions by Narasimha Karumanchi
5. Competitive Programming in Python- 128 Algorithms to develop your Coding Skills by Cristhop Durr & Jill-Jen Vie.
6. Guide to Competitive Programming: Learning and Improving Algorithms Through Contests (Undergraduate Topics in Computer Science) *by* Antti Laaksonen
7. https://www.geeksforgeeks.org/competitive-programming-a-complete-guide/
8. https://www.codechef.com/certification/data-structures-and-algorithms/prepare
9. https://codeforces.com/
10. https://leetcode.com/

19EMA204: ENGINEERING MATHEMATICS-IV

PROBABILITY THEORY AND RANDOM PROCESSES

L	T	P	C
3	0	0	3

Unit I: Probability **8 L**

Probability introduced through sets and relative frequency, joint and conditional probability, independent events, combined experiments, Bernoulli trials.

Unit II: Random Variable **9 L**

Introduction, random variable concept, distribution function, density function, the Gaussian random variable, other distribution and density examples, conditional distribution and density functions. **Operation on One Random Variable:** Introduction, expectation, moments, functions that give moments, transformations of a random variable.

Unit III: Multiple Random Variables **9 L**

Vector random variables, joint distribution and density functions, properties, conditional distribution and density, statistical independence, distribution and density of a sum of random variables, central limit theorem. **Expected Value of a Function of Random Variables:** Joint moments about the origin, joint central moments, jointly Gaussian random variables - two random variables case, N random variable case.

Unit IV: Random Process-I **8 L**

Temporal characteristics - the random process concept, stationary and statistical independence, correlation functions, Gaussian random processes, Poisson random process.

Unit V: Random Process-II **8 L**

Spectral characteristics, the power spectrum: Properties, relationship between power spectrum and autocorrelation function, the cross-power density spectrum: Properties, relationship between crosspower spectrum and cross-correlation function.

Text Books

1. Peyton Z. Peebles, Probability, Random Variables and Random Signal Principles, 4/e, Tata McGraw Hill, 2002.
2. Athanasios Papoulis, S. Unnikrishna Pillai, Probability, Random Variables and Stochastic Processes, 4/e, Tata McGraw Hill, 2002.

References

1. Simon Haykin, Communication Systems, 4/e, Wiley Student Edition, 2006.
2. Henry Stark, John W. Woods, Probability and Random Processes with Application to Signal Processing, 3/e, Pearson Education, 2002.

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

- Introduce the fundamental concepts of IoT and physical computing
- Expose the student to a variety of embedded boards and IoT Platforms
- Create a basic understanding of the communication protocols in IoT communications.
- Familiarize the student with application program interfaces for IoT.
- Enable students to create simple IoT applications.

UNIT I 5 L

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, the 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

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, the 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

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, the 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**

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, the student will be able to

- identify the role and services provided by different protocols in communicating devices (L2)
- describe the format of HTTP protocol for encapsulating sensor data in IoT systems(L3)
- distinguish between and identify the use of different application layer protocols (L3)

UNIT V **5 L**

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, ReaLTime Reactions, Polling, Comet, Other Protocols, MQ Telemetry Transport, Extensible Messaging and Presence Protocol, Constrained Application Protocol.

Learning Outcomes:

After completion of this unit, the 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)
- judge the security issues in Real time applications. (L5)

INTERNET OF THINGS LABORATORY

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 Things, Wiley Publications, 2012.

References

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.

Web Sources

https://www.arduino.cc/

https://www.raspberrypi.org/

Course Outcomes:

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

- choose the sensors and actuators for an IoT application(L1)
- select protocols for a specific IoT application(L2)
- utilize the cloud platform and APIs for IoT application(L3)
- experiment with embedded boards for creating IoT prototypes(L3)
- design a solution for a given IoT application(L6)

19EID232: INTERNET OF THINGS
(with effect from 2021-22 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.

19EID234: LIFE SCIENCES FOR ENGINEERS

(Common to all)

L	T	P	C
2	0	2	3

Life sciences have been introduced in to curriculum of all engineering branches. Students in engineering programs should be aware of fundamentals of biology so as to relate to their field. This course is a critical application area for engineering analysis and design, emphasizing concepts, technology, and the utilization of living things. Further it is important to know how living things work and act.

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 (L4).
- 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 (L3).
- 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 (L2).
- differentiate the mitosis and meiosis (L4).
- explain the medical importance of gene disorders (L2).
- Identify DNA as a genetic material in the molecular basis of information transfer (L3).

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).

Lab Experiments (Virtual or Field Experiments)

1. Microscopy, Mendel's laws, mapping, interactions, - 4 lab experiments
2. 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.

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 (L3).
- apply thermodynamic principles to biological systems. (L3)
- analyze biological processes at the reductionistic level (L4).
- appreciate the potential of recombinant DNA technology (L2).

19EEC238: CONTROL SYSTEMS ENGINEERING

L	T	P	C
2	0	2	3

In everyday life many applications of control like control of temperature in air conditioners, water level maintenance, steering of car course etc., a never ending list are encountered. These controls may be manual or automatic. Human body is an excellent example of automatic control system. Control system engineering deals with set of devices that control the behavior of other devices or systems to achieve desired results. This course introduces the student to the principles and applications of control systems in everyday life.

Course Objectives:

- To expose various concepts of block diagram reduction techniques.
- To create mathematical modeling of the system.
- To demonstrate stability of the system in time domain.
- To impart knowledge on stability of the system in frequency domain.
- To get acquainted with state variable analysis.

UNIT I: **8L**

Introduction: Concepts of control systems, different examples of control systems, open loop and closed loop control systems and their differences, block diagram representation of systems considering electrical systems as examples, block diagram algebra, representation by signal flow graph, reduction using Mason's gain formula, feedback characteristics, effects of feedback.

Learning Outcomes:

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

- outline concepts of control systems (L1).
- contrast the difference between open loop and closed loop systems (L1).
- apply the different block diagram reduction techniques to a given block diagram (L3).
- apply Masons gain formula for obtaining transfer functions (L3).
- analyze effect of feedback on performance of a system (L4).

UNIT II: **9L**

Mathematical Modeling and Control System Components: Introduction to mathematical modeling of physical systems, impulse response and transfer functions, equations of electrical networks, modeling of translational and rotational mechanical systems, time response of first and second order systems with standard input signals, time domain specifications, steady state error and error constants.

Learning Outcomes:

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

- explain the impulse response and transfer functions (L1).
- categorize steady state error and error constants based on input (L1).
- analyze the time response of second order system for different signals (L4).
- develop equations of different time domain specifications (L4).
- model different components of a system using Laplace transform method (L4).
- model different components of an electrical and mechanical system using Laplace transform method (L4).

UNIT III: **8L**

Concept of stability, Routh Hurwitz criterion, construction of root locus, correlation between time and frequency responses, determination of frequency domain specifications, effects of P, PI, PD and PID Controllers.

Learning Outcomes:

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

- explain the concept of stability and their definitions (L1).
- apply Routh Hurwitz criterion for checking the stability of a system based on characteristic equation (L3).
- analyze effect of PID controllers on performance of system (L4).
- relate time and frequency responses specifications (L5).
- develop equations of different frequency domain specifications (L6).
- construct root locus of given system and check its stability (L6).

UNIT IV: **8L**

Stability of control systems from Bode plots, polar plots and Nyquist plots, all pass and minimum phase systems, numerical examples.

Learning Outcomes:

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

- explain all pass and minimum phase systems (L1).
- construct Bode plots of given system and check its stability (L6).
- construct polar plots of given system and check its stability (L6).
- Construct Nyquist plots of given system and check its stability (L6).

UNIT V: **9L**

State Variable Analysis: State, state variables, state variable representation, transfer function form to state variable form (diagonal form), state variable form to transfer function form, transfer function form to canonical form.

Learning Outcomes:

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

- explain the concept of state and state variables (L3).
- model different components of a mechanical/electrical system in state variable form (L4).
- translate transfer function form to State variable form and state variable form to transfer function form (L6).
- translate an equation in State variable form to transfer function form (L6).
- translate an equation in transfer function form to canonical form (L6).

Textbooks:

1. Benjamin C. Kuo, Automatic Control Systems, 7/e , Prentice Hall of India, 1997.
2. M. Gopal, Control Systems Engineering, 3/e, Wiley Eastern Ltd., TMH, 2008.

References:

1. Ogata, Modern Control Engineering , 2/e, Prentice Hall of India, 2011.
2. R.C. Sukla, Control Systems, 3/e, Dhanpatrai and Sons,1998.

Course Outcomes:

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

- solve numerical on block diagrams reduction techniques (L3).
- represent the mathematical model of a given system (L2).
- determine the response of different order systems for various step inputs (L4).
- analyze the stability of the system (L4).
- comprehend solution of state equation (L3).

19EEC232: DIGITAL LOGIC DESIGN

L	T	P	C
3	0	3	4.5

Digital Logic Design is an introductory course which provides the basic concepts used in the design and analysis of digital circuits. A digital circuit is constructed using logic gates which are the basic building blocks. This course deals with the design of various combinational and sequential circuits used in the present day world. This course is a prerequisite to many other courses like Digital Communications, Computer Organization, Digital System design, Digital IC design, etc.

Course objectives:

- To introduce number systems, conversion used for representing numbers in computational structures
- To familiarize the implementation of simple logical operations using Combinational circuits
- To acquaint the student with the design of combinational and sequential logic circuits with practical design examples
- To expose different types of memories used in digital systems
- To impart the design of synchronous and asynchronous digital systems.

Unit I: **8L+6P**

Binary Systems: digital systems, binary numbers, number base conversions, octal and hexadecimal numbers, complements, signed binary numbers, binary codes, binary logic. **Boolean Algebra and Logic Gates:** basic definitions, axiomatic definition of boolean algebra, basic theorems and properties of boolean algebra, boolean functions, canonical and standard forms, digital logic gates.

Learning outcomes:

After completion of this unit the student will be able to

- identify the symbols of different logic gates and write their truth tables (L1).
- convert a number into different base representations (L2).
- construct the given Boolean function using logic gates (L3).

Unit II: **8L+3P**

Simplification of Boolean functions

the map method, four-variable map, five-variable map, product of sums simplification, don't-care conditions, NAND and NOR implementation, exclusive-OR function.

Learning outcomes:

After completion of this unit the student will be able to

- determine the simplified Boolean expression using map method (L3).
- construct digital circuits using only NAND/NOR logic gates (L3).
- design parity generator and checker circuits using exclusive-OR function (L5).

Unit III: **10L+9P**

Combinational Logic: combinational circuits, analysis procedure, design procedure, binary adder-subtractor, decoders, encoders, multiplexers. **Memories: r**andom-access memory, memory decoding, error detection and correction, read-only memory.

Learning outcomes:

After completion of this unit the student will be able to

- analyze the truth table of a given combinational logic circuit (L3).
- design combinational circuit from the given specifications (L5).
- correct the bit error in the given data word using Hamming code (L5).

Unit IV: **8L+3P**

Synchronous Sequential Logic: sequential circuits, latches, flip-flops, analysis of clocked sequential circuits, state reduction and assignment, design procedure.

Learning outcomes:

After completion of this unit the student will be able to

- explain the operation of latches and flip flops (L2).
- analyze the behavior of sequential circuits (L4).
- evaluate a clocked sequential circuit from its state diagram (L6).

Unit V: **8L+6P**

Registers and Counters: registers, shift registers, ripple counters, synchronous counters, ring counter.

Digital Integrated circuits: special characteristics, complementary MOS(CMOS), CMOS transmission gate circuits.

Learning outcomes:

After completion of this unit the student will be able to

- differentiate asynchronous and synchronous counters (L4).
- design Synchronous and Ripple counters using D, JK and T flip-flops (L5).
- construct multiplexer and D-latch using CMOS transmission gates circuits (L5).

Text Book(s):

1. Michael D. Ciletti, M. Morris Mano, Digital Design, 4/e, Pearson Education, 2007.

References:

1. Zvi Kohavi, Switching and Finite Automata Theory, 2/e, Tata McGraw-Hill, 2008.
2. John F. Wakerly, Digital Design Principles and Practices, 4/e, Pearson Education, 2008.
3. Frederick J. Hill and Gerald R. Peterson, Introduction to Switching Theory and Logic Design, 3/e, John Willey and Sons, 1981.
4. Charles Roth, Jr., Larry Kinney, Fundamentals of Logic Design, 7/e, Cengage Learning, India, 2013.

Digital Logic Design Laboratory

List of Experiments:

1. Verification of Truth Tables of Logic gates and implementation of Basic gates using Universal Gates
2. Implementation of the given Boolean functions using logic gates in both SOP and POS form.
3. Simplification of the given Boolean function using K-map and implement using logic gates.
4. Realization and verification of Full adder and Full Subtractor using logic gates.
5. Implementation of the given function using decoder and logic gates.
6. Implementation of the given function using Multiplexer and logic gates.
7. Verification of State Tables of SR, D, JK and T-Flip-Flops.
8. Verify the operation of Shift Registers using D flip-flops.
9. Design and Verify the operation of 4-bit and Mod-N Ripple Counters using JK flip-flops.
10. Mini Project.

Course Outcomes:

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

- convert any number into different base representations(L2).
- simplify logic expressions using Boolean laws and realize using basic and universal logic gates(L3).
- design combinational circuits for the given specifications(L4).
- design synchronous sequential circuits for the given specifications (L4).
- differentiate asynchronous and synchronous counters and implement Multiplexers and D flip flops using CMOS technologies(L3).

19EEC234: ANALOG CIRCUITS

L	T	P	C
3	0	3	4.5

This course equips the student with design principles of electronic system building blocks including amplifiers , oscillators, negative feedback based operational amplifiers .Laboratory experiments of this course shall include hardware experiments, SPICE simulations and end-to-end circuit design using EDA/PCB design software. Skills learnt in this course shall help the student in improving existing circuits using negative feedback, building power Amplifiers, op-amp signal processing circuits etc.

Course Objectives

- To acquaint the studentswith the advantages and techniques of different negative feedback circuit configurations.
- To introduce the basic principles of oscillator circuits and design/simulate discrete component and op-amp oscillator circuits.
- To impart knowledge on analysis of the linearity, power efficiency and power dissipation of different output stages/power amplifiers.
- To explain the configuration and use of operational amplifier in designing several signal processing building blocks.
- To familiarize the analysis and classification of different ADC/DAC architectures based on working principle, conversion time and resolution characteristics.

Unit I: **8L + 3P**

Feedback Amplifiers: the general feedback structure, properties of negative feedback, basic feedback topologies, the series-shunt feedback amplifier, the series-series feedback amplifier, shunt-shunt and shunt-series feedback amplifiers, determining loop gain.

Learning Outcomes:

After completion of this unit the student will be able to

- summarize the basic building blocks of negative feedback systems and list their properties (L2).
- classify the different negative feedback topologies and identify/quantify the improvement in their characteristics (L2).
- determine the input impedance, output impedance, gain and bandwidth of feedback amplifiers (L4).
- identify the kind of feedback configuration employed in a given circuit (L3).

Unit II: **8L + 9P**

Oscillators: basic principles of sinusoidal oscillators, op amp RC oscillator circuits, LC and crystal oscillators.**Power amplifiers:** Classification of output stages, classA output stage, class B output stage, class AB output stage,class C output stage.

Learning Outcomes:

After completion of this unit the student will be able to

- explain Barkhausen's criteria for sustained oscillations (L2).
- explain the operation of RC phase shift and op-amp RC oscillators (L1).
- identify the usage of RC, LC and Crystal oscillators (L3).
- classify different output stages based on linearity, power efficiency and conduction angle (L2).
- analyze the transfer function, signal waveforms and power efficiency of Class A/B/AB output stages (L4).

Unit III: **10L + 9P**

Operational Amplifiers: The ideal op-amp, the inverting and non-inverting configuration, difference and instrumentation amplifiers, summing, scaling and averaging amplifiers, integrators, differentiators, logarithmic amplifiers, V/I and I/V converters, Comparator, regenerative comparator, Astable and Monostable multivibrators, Triangular wave generator.

Learning Outcomes:

After completion of this unit the student will be able to

- list the characteristics of ideal Op-amp (L1).
- draw the op-amp inverting and non-inverting configurations and analyze them for their closed loop gain under ideal and non-ideal conditions (L2).
- describe the use of Op-amp in building analog signal processing blocks (L3).
- summarize the characteristics of comparators and analyze the Op-amp based comparators (L2).

Unit IV: **8L + 9P**

IC Timers (555): Introduction, Description of functional diagram, Monostable operation, Astable operation. **Active Filter Design:** LPF, HPF, BPF, BEF, all-pass filters. **Voltage Regulators:** Fixed voltage Regulators, Adjustable voltage Regulators.

Learning Outcomes:

After completion of this unit the student will be able to

- describe the architecture and list the operating modes of 555 timer (L1).
- design an active low- pass,high-pass,band-pass filter for given specifications(L5).
- describe the characteristics of voltage regulators and corresponding Opamp based circuits (L2).

Unit V: **8L + 6P**

Data Converters: Introduction, DAC characteristics, digital to analog conversion process, voltage output DACs, multiplying DAC, 8-bit digital to analog converter DAC-08. **Analog to Digital Converters**: ADC characteristics, integrating ADC, successive approximation ADC, Flash converters: Principle of operation, conversion time.

Learning Outcomes:

After completion of this unit the student will be able to

- list the characteristics and operation of DACs and ADCs (L1).
- classify different DAC and ADC configurations(L2).
- explain the operation of voltage output and multiplying DACs (L1).
- describe the principle of operation of flash converters and analyze its conversion time (L1).

Analog Circuits Laboratory

List of Experiments

1. Feedback Amplifier - calculation of gain, input resistance, output resistance with and without feedback, frequency response characteristic.
2. Design and Implementation of Two stage RC Coupled amplifier.
3. Oscillators (Colpitts, RC phase-shift, Wein-bridge)
4. Class A power amplifier.
5. Class B Push - pull power amplifier.
6. Tuned voltage amplifier.
7. Analysis and simulation of RC differentiator/integrator
8. Bistable/Monstable/Astablemultivibrators with 555 timer
9. Operational Amplifier Circuits (Adders, Integrators, Differentiators, Filters).
10. Op-amp based AM/FM Modulator/Demodulator Circuits.
11. Data Converters
12. Active Filter Design

Text Book(s):

1. Adel S. Sedra, Kenneth C. Smith, Arun N. Chandorkar, Microelectronic Circuits, 6/e, Oxford University Press, 2013.
2. D Choudhury Roy, Shail B. Jain, Linear Integrated Circuits, New Age International, 2003.
3. Ramakanth Gayakward, Op-Amps and Linear Integrated Circuits, 4/e, Pearson Education, 2007.

References:

1. Behzad Razavi, Fundamentals of Microelectronics, 2/e, Wiley Student Edition, 2013.
2. R.F Coughlin, F.F Driscoll, Op-Amps and Linear Integrated Circuits, 6/e, Pearson Education, 2008.
3. S. Salivahanan, V.S. KanchanBhaskaran, Linear Integrated Circuits, Tata Mc- Graw Hill, 2008.
4. Sergio Franco, Design with Operational Amplifiers and Analog Integrated Circuits, 3/e, Tata Mc-Graw Hill, 2002.

Course Outcomes:

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

- analyze the characteristics of different negative feedback amplifier configurations (L4).
- choose and design negative feedback circuits to improve the characteristics of given open loop amplifier (L3).
- describe the basic principle of sinusoidal oscillators and identify the usage of different oscillator circuits (L1).
- design active filters for the given design specification (L5).
- describe different DAC/ADC architectures and their design issues (L2).

19EEC236: ANALOG AND DIGITAL COMMUNICATIONS

L	T	P	C
3	0	3	4.5

This is an introductory course on communications which starts from the necessity of modulation in communication of signals. Fundamental concepts of both analog and digital modulation schemes are discussed and elaborated. Mathematical treatment of communication systems which enable one to implement them in practice is introduced. Possible errors in modulations are explored and methods for minimizing the same are discussed.

Course objectives:

- To introduce the need for modulation to communicate signals
- To familiarize the different modulation schemes and their tradeoffs
- To impart knowledge on the characterization, generation and detection of various modulation schemes
- To provide an understanding of the various digital modulation schemes and their trade off to characterize the bit error performance.
- To explain characteristics of superhetrodyne and to implement to a generalized receiver as a building block.

Unit I: **8L+3P**

Amplitude Modulation Systems: generation and detection of AM, Power relations, Spectral Characteristics, generation and detection of DSBSC, SSB, VSB, Frequency division multiplexing.

Learning Outcomes:

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

- identify the necessity of modulation to communicate signals (L1).
- distinguish the various modulation schemes like AM, DSBSC, SSB,VSB (L2).
- demonstrate the various modulation schemes for the generation and detection models (L3).
- formulate the power requirements and bandwidth of the modulation schemes (L4).
- summarize the applications of various modulation schemes with power and bandwidth constraints (L2).

Unit II: **8L+3P**

Angle Modulation systems: properties of angle modulation, representation of FM and PM signals, NBFM, WBFM, transmission bandwidth of FM systems, generation of FM, detection of FM using PLL, receiver characteristics, super heterodyne receivers.

Learning Outcomes:

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

- differentiate linear and non linear modulation schemes (L2).
- distinguish the frequency modulation and phase modulation (L4).
- demonstrate the NBFM and WBFM for the generation and detection models(L4).
- estimate bandwidth of the NBFM and WBFM (L4).
- explain the characteristics and demonstrate the Super heterodyne receiver (L2).

Unit III: **8L+15P**

Analog to Digital Conversion: sampling process, pulse modulation schemes- pulse amplitude, pulse width, pulse position modulation. pulse code modulation (PCM), differential pulse code modulation, delta modulation, time division multiplexing.

Learning Outcomes:

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

- explain the sampling theorem (L2).
- distinguish various pulse modulation schemes like PAM, PWM, PPM (L4).
- demonstrate the PCM, DPCM and DM with block diagrams (L2).
- explain the use of time division multiplexing (L2).

Unit IV: **9L+9P**

Baseband Transmission Of Digital Data: intersymbol interference, nyquist criterion, digital band pass modulation schemes- amplitude shift keying, phase shift keying, frequency shift keying, QPSK, M-ary digital modulation schemes.

Learning Outcomes:

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

- interpret the baseband transmission of digital data (L2).

- explain the phenomenon of the Intersymbol interference (L2).
- describe various digital modulation schemes ASK, PSK, FSK, QPSK (L2).
- categorize the applications of various digital modulation schemes (L4).

Unit V: **9L+6P**

Noise in Digital communications: BER, detection of a single pulse in noise, optimum detection of BPAM, BPSK, BFSK, comparison of BER performance of various digital modulation schemes.

Learning Outcomes:

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

- identify the noise in digital communication systems (L2).
- formulate the BER in digital communication systems (L4).
- demonstrate the various binary modulation schemes detection BPAM, BPSK, BFSK models (L5).
- formulate the power requirements and bandwidth of the digital modulation schemes (L4).
- evaluate the performance of BER in digital modulation schemes (L4).

Analog and Digital Communications Laboratory

List of Experiments:

1. AM/ DSBSC/ SSB Modulation and Demodulation.
2. Frequency Modulation and Demodulation.
3. Sampling and reconstruction of analog signals.
4. Generation and detection of PAM, PWM, PPM.
5. Time division multiplexing and demultiplexing.
6. PCM transmission
7. Differential PCM
8. Generation of ASK signals and detection.
9. Generation of PSK signals and detection.
10. Generation of FSK signals and detection
11. Simulation of Analog Modulation schemes using SIMULINK/ LABVIEW/MULTISIM
12. Simulation of Digital modulation schemes using MATLAB/LABVIEW/MULTISIM.

Text Book(s):

1. Simon Haykin, Michael Moher, Introduction to Analog and Digital Communications, 2/e Wiley, 2007.
2. P. Rama Krishna Rao, Analog Communication 1/e, Tata McGraw Hill, 2011.

References:

1. Taub H, Schilling D, Principles of Communication Systems, Tata McGraw Hill, 2010.
2. Simon Haykin, Communication Systems 4/e, Wiley, 2001
3. Kennedy,david, Electronic Communication System 4/e, Tata McGraw Hill,2012.

Course outcomes:

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

- explain the time domain and frequency domain description of different AM modulations schemes and compare them (L2).
- describe the characteristics of FM and PM schemes and functional operation of super heterodyne receiver(L2).
- explain the basic concepts of digital communications and distinguish various pulse modulation schemes(L2)
- describe various digital modulation schemes and their applications(L2)
- evaluate BER in digital modulation schemes and comparison (L4).

19EEC292: 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 **- 3 Hours per week**

A. Verbal and Soft Skills:

Vocabulary Builder, Reading Comprehension, Fill-in-the-Blanks, General Usage

Unit	Module/ Topics	Hrs
1.	Vocabulary Builder	4
2.	Reading Comprehension	4
3.	Paragraph Jumbles	3
4.	General Usage	4
	Total	**15**

B. Quantitative Aptitude and Reasoning

Puzzles, Arithmetic, Geometry, Mensuration.

Unit	Module/ Topics	Hrs
1.	Numbers	3
2.	Arithmetic	6
3.	Data Interpretation	3
4.	Puzzles	3
	Total	15

Unit	Module/ Topics	Hrs
1.	Numerical Computation and Estimation-2. [i. Time and Work, ii. Pipes and Cisterns, iii. Time and Distance, iv. Problems on trains, Boats and Streams, v. Races and Games of skill, vi. SI & CI]	6
2.	Geometry [i. Lines and Angles ii. Triangles iii. Quadrilaterals & Polygons iv. Circles]	4
3.	Mensuration [i. 2-Dimensional Mensuration (Triangles, Quadrilaterals and Circles), ii. 3-Dimentional Mensuration (Cubes, Cuboids, Cylinder, Cone, Sphere)]	3
4.	Data Sufficiency on Quantitative Reasoning	2
	Total	15

Part-2 **- 3 Hours per week**

Coding: -Medium Level problem solving techniques:

Permutations and Combination, Probability, Hash Tables, Heap, Greedy Method, Backtracking

Scheme of Evaluation

Internal Assessments by Assignments, Quizzes (multiple Choice questions). All the Students are expected to do at least 5 problems in each topic and they should submit the content written by them in each topic for final evaluation.

Type of Assessment	No.of Marks
At least 5 problems in each topic	15
Assignments	15
Content writing	10
Quizzes	10
Total	**50**

Late Work

Each homework is due in the beginning of the class meeting (that is, at 6:00pm) on the due date. If homework is submitted within seven days after this deadline, the grade will be reduced by 50%. Submission more than seven days after the deadline will not be accepted. If you have a serious reason for requesting an extension, such as illness or family emergency, you should discuss it with one of the instructors as soon as the problem arises, and definitely before the submission deadline.

References:-

The course does *not* have a required textbook. You may optionally use the following textbook and URLs to look up standard algorithms:

1. Data Structures and Algorithms made easy by Narasimha Karumanchi
2. Data Structure and Algorithmic Thinking with Python by Narasimha Karumanchi
3. Algorithm Design Techniques: Recursion, Backtracking, Greedy, Divide and Conquer and Dynamic Programming by Narasimha Karumanchi
4. Coding Interview Questions by Narasimha Karumanchi
5. Competitive Programming in Python- 128 Algorithms to develop your Coding Skills by Cristhop Durr & Jill-Jen Vie.
6. Guide to Competitive Programming: Learning and Improving Algorithms Through Contests (Undergraduate Topics in Computer Science) *by* Antti Laaksonen
7. https://www.geeksforgeeks.org/competitive-programming-a-complete-guide/
8. https://www.codechef.com/certification/data-structures-and-algorithms/prepare
9. https://codeforces.com/
10. https://leetcode.com/

19EEC331: ANTENNA ANALYSIS AND SYNTHESIS

L	T	P	C
3	0	2	4

In today's world, all modes of communications are more or less tending towards wireless. Any wireless device is to be equipped with antenna, which converts the energy suitably for radiation into free space or vice versa. Concepts of radiation and various types of antenna based on various classifications are introduced in this course. Synthesis of antennas, that is, building an antenna array for generating a desired radiation pattern is also presented.

Course Objectives:

- To introduce the basic characteristics and fundamental parameters of antennas.
- To familiarize the concepts of wire antennas.
- To acquaint the student with knowledge of high frequency antennas.
- To impart knowledge about types of antenna arrays and their analysis and synthesis.
- To introduce antennas for mobile communications.

Unit I: **15L**

Characteristics of Antennas: Introduction, types of antennas, radiation mechanism, current distribution on a thin wire antenna, fundamental parameters of antenna, Friis transmission equation and radar range equation, introduction to auxiliary vector potentials.

Learning Outcomes:

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

- state basic fundamental parameters of an antenna (L1).
- explain radiation mechanism of a single wire and a two wire tapered line (L2).
- examine current distribution on a thin wire antenna (L2).
- estimate amount of power received by antenna (L2).
- explain vector potentials (L2).

Unit II: **12L**

Wire Antennas: Infinitesimal dipole, small dipole antenna, half wavelength dipole, region of separation, ground effects, image theory.

Learning Outcomes:

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

- explain field components of infinitesimal dipole (L2).
- outline field components of small and half wave length dipole (L2).
- demonstrate field distribution with respect to distance (L2).
- illustrate how earth surface affects the electromagnetic wave between two antennas (L2).

Unit III: **14L**

Aperture Antennas: Introduction, introduction to rectangular wave guides, E-plane sectoral horn, H-plane sectoral horn, pyramidal horn antenna, parabolic reflector antenna.

Learning Outcomes:

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

- define different frequency band designations (L1).
- explain radiation pattern of aperture antennas (L2)
- demonstrate field in a rectangular wave guide and different types of horn antennas (L2).
- outline the functionalities of parabolic reflector antenna (L2).

Unit IV: 8L

Antenna Arrays: Introduction, two element array, N element linear array, uniform amplitude and spacing, directivity, super directivity.
Antenna Synthesis: Introduction, continuous sources, Schelkunoff polynomial method.

Learning Outcomes:

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

- identify how to improve the strength and directivity of antenna (L1).
- analyze N element linear array with uniform amplitude and spacing (L4).
- synthesize an antenna array for the radiation pattern with a good control over the nulls and side lobe amplitudes (L5).

Unit V: 12L

Antennas for Mobile Communication: Introduction to microstrip antenna, rectangular patch, quality factor, bandwidth, and efficiency, introduction to smart antennas.

Learning Outcomes:

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

- explain the parameters of microstrip antenna (L2).
- estimate quality factor and bandwidth (L2).
- identify the requirement of smart antennas in various applications (L2).

Text Book:

Contantine A. Balanis, Antenna Analysis and Design, 3/e, Wiley Publications, 2009.

Reference:

A.R. Harish, M. Sachidananda, Antennas and Wave Propagation, 1/e, Oxford University Press, 2007.

List of Experiments:

1. Design and measure all the antenna parameters and polarization of half wave dipole antenna (Using HFSS)
2. Design and measure all the antenna parameters and polarization of quarter wave monopole antenna (Using HFSS)
3. Design and measure all the antenna parameters and polarization of a horn antenna (Using HFSS)
4. Design an N-element linear array and plot its antenna radiation pattern and measure the antenna parameters (Using MATLAB)
5. Design an N-element broadside and end fire array and plot their radiation pattern (Using MATLAB)
6. Design a linear array for given specifications using schelkunoff polynomial method (Using MATLAB)
7. Design and measure all the antenna parameters and polarization of microstrip patch antenna (Using HFSS)
8. Design and measure all the antenna parameters of microstrip patch antenna array (Using HFSS)
9. Case study

Course Outcomes:

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

- explain the radiation mechanism of an antenna and its fundamental parameters and observe practically the radiation pattern of antennae(L2).
- distinguish the wired antennas based on their field components(L2).
- examine the radiation pattern of aperture antennas theoretically and practically(L3).
- explain how to improve the strength and directivity of antenna using antenna arrays (L2).
- identify the requirement of microstrip and smart antenna in applications(L2).
- design micro strip antenna using simulation software (L6).

19EEC333: DIGITAL SIGNAL PROCESSING

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

Unprecedented developments in the interpersonal communications and on demand entertainment is enabled with the Digital Signal Processing (DSP) engineering. DSP is the heart of digital revolution that brought music players, mobile phones, etc. into every walk of common man life. It unified the electronics, communications and computer science. All electronic systems today use powerful DSP concepts as their foundations. A thorough understanding of digital signal processing fundamentals and techniques is imparted in this course.

Course Objectives:

- To introduce the frequency analysis of discrete time LTI systems.
- To identify different hardware structures for IIR systems.
- To explain the numerical computation of DFT / FFT along with their properties and applications.
- To explore the design of FIR filters and design of IIR filters.
- To provide an understanding of the features of DSP Processors and compare with general purpose microprocessors.

Unit I: **8L+12P**

Transform Analysis of Discrete Time LTI Systems: Frequency response of LTI systems. **System Functions for Systems Characterized by Linear Constant Coefficient Difference Equations**: Stability, causality, impulse response for rational system functions. **Structures for IIR Discrete Time Systems**: Direct, parallel and cascade form.

Learning Outcomes:

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

- obtain the system function and frequency response of systems described by difference equations using z transform and DTFT (L2).
- analyze the discrete time LTI systems in frequency domain (L4).
- construct the direct form, cascade and parallel form structures or block diagram representation of IIR systems (L5).

Unit II: **8L+6P**

The Discrete Fourier Transform (DFT): Representation of periodic sequences. The discrete Fourier series, Fourier representation of finite duration sequences, the discrete Fourier Transform (DFT), computation of DFT, properties of the DFT, circular convolution and linear convolution using DFT, overlap-add method, overlap-save method.

Learning Outcomes:

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

- explain the properties of discrete time Fourier transform (L2).
- apply DTF equations to discrete time periodic signals and apply discrete Fourier transform equations to finite duration discrete time signals (L3.)
- calculate the circular convolution, linear convolution and block convolution of two discrete time sequences (L5.)

Unit III: **8L**

Fast Fourier Transform (FFT): Radix-2 decimation-in-time and decimation-in-frequency FFT algorithms, inverse FFT.

Learning Outcomes:

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

- understand the development of Radix-2 DIT and DFT FFT algorithms (L1).
- apply DIT and DIF algorithms to finite duration discrete time sequences (L3).
- distinguish between DIT and DIF algorithms (L4).

Unit IV **9L+6P**

Design of IIR Filters: Design of analog prototypes from digital filter specifications using Butterworth and Chebyshev approximations, design of IIR filters from analog filters, Butterworth filters and Chebyshev filters design using impulse invariance, bilinear transformation.

Learning Outcomes:

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

- understand the design of Butterworth and Chebyshev IIR filters (L1).
- derive the expression for order, poles and transfer function of low pass analog Butterworth and Chebyshev filters(L4).
- design digital IIR Butterworth and Chebyshev filters using impulse invariance and bilinear transformation (L5).

Unit V: **9L+15P**

Design of FIR Filters: Linear discrete time systems with generalized linear phase, design of linear phase FIR filters using window functions (rectangular, Hamming, Hanning, Blackman and Kaiser) frequency sampling technique. **Basic Architecture of DSP Processors**: DSP architecture for signal processing, Harvard architecture, pipelining, hardware multiplier and accumulator.

Learning Outcomes:

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

- distinguish between the four types of linear phase FIR filters (L2).
- explain about the Harvard architecture of DSP processors (L2).
- interpret pipelining in DSP processors and hardware multiplier and accumulator(L2).
- design linear phase FIR filters using different window functions like rectangular, Hamming, Hanning, Blackman and Kaiser window and frequency sampling methods (L5).

Text Books:

1. A.V. Oppenheim, R. W. Schafer, Discrete Time Signal Processing, 2/e, Prentice Hall of India, 2004.
2. Ifeachor E.C, Jervis B.W, Digital Signal Processing – A Practical Approach, 2/e, Pearson Education, 2002.

References:

1. Sanjay K. Mitra, Digital Signal Processing- A Computer Based Approach, 4/e, Tata Mc Graw Hill Publications, 2011.
2. J. G. Proakis and D. G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, 4/e, Pearson Education, 2007.

List of Experiments:

Using MATLAB/Octave Software:

1. Generation of discrete time signals in time domain.
2. Implementation of discrete time systems in time domain.
3. Frequency analysis of discrete time signals using DTFT.
4. Frequency analysis of discrete time systems using DTFT
5. Discrete Fourier transform (DFT) and properties
6. FIR filter design.
7. IIR filter design.

Using TMS320C6478 LCDK Kit

8. Study of TMS320C6478 DSK and code composer studio.
9. Sinusoidal waveform generation.
10. FIR filter implementation on LCDK Kit.
11. IIR filter implementation on LCDK Kit.
12. Mini project on DSP (Example: DTMF generation and detection using correlation processing/FFT).

Course Outcomes:

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

- list the advantages of digital signal processing over analog signal processing (L1).
- explain discrete time signals and generate them using MATLAB (L2).
- describe the frequency domain analysis of discrete time signals and systems and carry out the analysis using MATLAB (L2).
- realize a given IIR system function using direct form, parallel and cascade structures and compare them (L5).
- compute the DFT and IDFT of a sequence, using DFT and FFT algorithms and implement the computation, verification of properties of DFT using MATLAB (L6).
- design a digital FIR/IIR filter for given design specification and implement design using MATLAB (L5).
- list and explain the architectural highlights of DSP processors over microprocessors and implement DSP algorithms using DSK starter kit (L5).

19EEC341: INFORMATION THEORY AND CODING

L	T	P	C
2	0	2	3

This course provides a basic understanding of the measure of information, source coding, channel capacity and channel coding techniques. Source coding is used to compress the size of the data generated from digital source by reducing redundancy. Channel capacity is a much used metric for the maximum amount of traffic or signal that can move over a particular infrastructure channel. Channel coding is used for error detection and/or error correction by adding some redundant bits to source coded data in order to improve performance. This course finds wide applications in many communication and signal processing areas like cryptography, speech and waveform coding and lossless data compression.

Course Objectives:

- To introduce the principles and applications of information theory in terms of probability and entropy and practical aspects of data compression and source coding techniques.
- To explain the quantitative measure of information which may be used in order to build efficient solutions to communication engineering problems such as calculating the capacity of a communication channel with and without noise.
- To explain linear block codes, cyclic codes and convolution coding techniques for channel performance improvement against errors.
- To describe suitable error control coding technique for burst error correction.

Unit I: **8L**

Source Coding: Introduction to information theory, uncertainty and information, average mutual information and entropy, information measures for continuous random variables, source coding theorem, Huffman coding, Shannon-Fano coding, arithmetic coding, the Lempel-Ziv algorithm.

Learning Outcomes:

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

- define uncertainty and information (L1).
- calculate mutual information, average information of any discrete random variable or continuous random variable (L2).
- understand the source coding theorem (L2).
- apply any source coding technique to information generated by digital source (L3).
- evaluate the suitable source coding technique in order to achieve good efficiency (L6).

Unit II: **8L**

Channel Capacity and Coding: Channel models, channel capacity, channel coding, information capacity theorem, the Shannon limit.

Learning Outcomes:

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

- classify channel models (L3).
- distinguish the hard decision decoding and soft decision decoding (L2).
- estimate the channel capacity (L5).
- identify the necessity of channel coding (L1).
- understand the information capacity theorem, Shannon limit (L2).

Unit III: **8L**

Linear Block Codes for Error Correction: Introduction to error correcting codes, basic definitions, matrix description of linear block codes, parity check matrix, decoding of a linear block code, syndrome decoding.

Learning Outcomes:
After completion of this unit, the student will be able to
- understand matrix representation of linear block codes (L1).
- calculate Hamming weight, minimum distance of linear block codes (L6).
- determine whether the received code is error free or not using Syndrome decoding (L3).

Unit IV: **8L**
Cyclic Codes: Introduction to cyclic codes, polynomials, the division algorithm for polynomials, a method for generating cyclic codes, burst error correction, cyclic redundancy check (CRC) codes.

Learning Outcomes:
After completion of this unit, the student will be able to
- distinguish systematic and nonsystematic cyclic codes (L2).
- generate cyclic codes for the purpose of error detection (L5).
- apply methods to correct burst errors (L3).
- determine whether the received codeword is error free or not using cyclic redundancy check codes (L3).

Unit V: **8L**
Convolutional Codes: Introduction to convolutional codes, tree codes and trellis codes, polynomial description of convolutional codes, distance notions for convolutional codes, the generating function.

Learning Outcomes:
After completion of this unit, the student will be able to
- understand the convolutional codes (L2).
- construct code tree of convolutional codes (L3).
- design Trellis code (L5).
- determine distance notions for convolutional codes(L4).
- calculate the generating function (L3).

Text Book:
1. Ranjan Bose, Information Theory, Coding and Cryptography, 2/e**,** Tata McGraw- Hill, 2010.

References:
1. Simon Haykin, Communication Systems, 4/e, John Wiley and Sons, 2002.
2. Amitabha Bhatacharya, Digital Communication, Tata McGraw-Hill, 2006.
3. William Stallings, Cryptography and Network Security Principles and Practices, 3/e, Pearson Education, 2007.
4. Bruce Carlson, Paul B. Crilly, Communication Systems, 5/e, Tata McGraw Hill, 2009.
5. R.P Singh and S.D. Sapre, Communication Systems,2/e by Tata McGraw-Hill,2007

Course Outcomes:
After successful completion of the course, the student will be able to
- apply source coding techniques to improve the efficiency of information transmission (L4).
- evaluate the channel capacity of discrete memory less channels and explain information capacity theorem (L6)
- use linear block codes for error correction and error detection (L3).
- apply cyclic codes for error correction and error detection (L3).
- apply convolutional codes for error correction and error detection (L3).

19EEC343: DSP PROCESSORS AND ARCHITECTURES

L	T	P	C
2	0	2	3

Digital signal processors consist of customized hardware to efficiently manipulate digital signals used in a wide variety of applications including digital communications and scientific instrumentation. This course introduces the student to the architecture, instruction set, memory allocation and programming techniques ofa few programmable DSP processors.

Course Objectives:
- To provide an understanding of computational accuracy inDSP implementations.
- To introduce the architectural features of DSP processors.
- To familiarize the various aspects of execution control and pipelining in processors.
- To acquaint the student with the addressing modes, instruction set and programming related to TMS320C54XX processors.
- To design and implement basic digital signal processing algorithms in processors and explainabout interfacing, interrupts.

Unit I: **8L**

Computational Accuracy in DSP Implementations: Number formats for signals and coefficients in DSP systems, dynamic range and precision, sources of error in DSP implementations, A/D conversion errors, DSP computational errors, D/A conversion errors, compensating filter.

Learning Outcomes:
After completion of this unit, the student will be able to
- explain number formats for signals and coefficients in DSP systems (L2).
- explain sources of error in DSP implementations (L2).
- distinguish computational and D/A conversion errors in DSP (L2).

Unit II: **8L**

Architectures for Programmable DSP Devices: Basic architectural features, DSP computational building blocks, bus architecture and memory, data addressing capabilities, address generation unit, programmability and program execution, speed issues, features for external interfacing.

Learning Outcomes:
After completion of this unit, the student will be able to
- describe the basic architectural features of DSP devices (L2).
- explain the computational blocksand other features of DSP devices (L2).
- interpret the features for external interfacing (L2).

Unit III: **8L**

Execution Control and Pipelining: Hardware looping, interrupts, stacks, relative branch support, pipelining and performance, pipeline depth, interlocking, branching effects, interrupt effects, pipeline programming models.

Learning Outcomes:
After completion of this unit, the student will be able to
- explain the various aspects of execution control in DSP processors(L2).
- explain pipelining and related effects (L2).
- describe programming model for pipelining (L2).

Unit IV: **8L**

Programmable Digital Signal Processors: Commercial digital signal-processing devices, data addressing modes of TMS320C54XX processors, memory space, program control, instructions and programming, on-chip peripherals, interrupts and pipeline operation of TMS320C54XX processors.

Learning Outcomes:

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

- explain the addressing modes of TMS320C54XX processors (L2).
- infer on-chip peripherals, interrupts and pipeline operation related to TMS320C54XX processors (L2).
- develop programs with instructions to be executed on TMS320C54XX processors (L3).

Unit V: **8L**

Implementations of Basic DSP Algorithms & Interfacing: The Q-notation, FIR Filters, IIR Filters, interpolation filters, decimation filters, computation of the signal spectrum, Memory space organization, external bus interfacing signals, memory interface, parallel I/O interface, programmed I/O, interrupts and I/O, Direct Memory Access (DMA). A Multichannel buffered serial port (McBSP).

(Suggestion: McBSP Programming, a CODEC interface circuit, CODEC programming, A CODEC-DSP interface example).

Learning Outcomes:

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

- implement digital filters on processors (L3).
- implement interpolation and decimation filters on processors (L3).
- explain the various interfacing and interrupts related to DSP processors (L2).

Text Books:

1. Avtar Singh, S. Srinivasan, Digital Signal Processing, Cengage Learning, 2004.
2. Phil Lapsley, DSP Processor Fundamentals: Architectures and Features, IEEE Press, 1997.

References:

1. Sen M. Kuo, Real Time Digital Signal Processing, 2/e, Wiley Student Edition, 2010.
2. VenkataRamani, M. Bhaskar, Digital Signal Processors, Architecture, Programming and Applications, Tata Mc Graw Hill, 2004.
3. Jonatham Stein, Digital Signal Processing, Wiley Student Edition, 2005.

Course Outcomes:

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

- Analyze the various number formats and error’s in DSP implementations (L4).
- explain the architecture of DSP devices (L2).
- explain the concepts related to execution control and pipelining of DSP devices (L3).
- elucidate the features and write programs to be executed on TMS320C54XX processors (L2).
- implement various DSP algorithms on processors (L3).

19EEC345: DIGITAL SYSTEM DESIGN

L	T	P	C
2	0	2	3

The emphasis of this course is on the design of digital systems and the use of a hardware description language VHDL in the design process.Modeling the combinational and sequential logic circuits using basic features of VHDL is discussed and basics of the Programmable logic devices such as SPLDs, CPLDs and FPGAs are introduced in this course. This course also deals with the hardware implementation of the digital systems using programmable logic devices.

Course Objectives:

- To provide an understanding of the basic concepts of designing combinational and sequential circuits and the possible hazards in the design.
- To model combinational and sequential circuits using VHDL.
- To design and model digital circuits using different modelling techniques and also design Finite State Machines.
- To study the various programmable logic devices like SPLDs, CPLDs and FPGA.
- To familiarize how to implement functions in FPGAs

Unit I: **8L**

Review of Logic Design Fundamentals: Combinational logic, Boolean algebra and algebraic simplification, Karnaugh maps, hazards in combinational circuits, flip-flops and latches, Mealy sequential circuit design, design of a Moore sequential circuit, sequential circuit timing.

Learning Outcomes:

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

- simplify the logic function using Boolean algebra and Karnaugh maps (L3).
- design combinational and sequential logic circuits using NAND/NOR gates (L4).
- design Mealy and Moore finite state machines for the given specifications (L5).
- define setup-time, hold-time and propagation delay of memory elements (L1).
- analyze the timing characteristics of a given sequential logic circuit (L4).

Unit II: **8L**

Introduction to VHDL: Computer-Aided design, hardware description languages, VHDL description of combinational circuits, VHDL modules, sequential statements and VHDL processes, modeling flip-flops using VHDL processes, processes using wait statements, transport and inertial delays, VHDL data types and operators, VHDL libraries.

Learning Outcomes:

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

- understand the basics of VHDL (L1).
- define entity, concurrent statements and sequential statements (L1).
- distinguish between different modeling techniques (L3).
- describe a digital circuit at different levels such as behavioral, dataflow and structural (L2).

Unit III: **8L**

Design Examples for Digital Circuits: Multiplexers, BCD to 7-segmentdisplay decoder, BCD adder, 32-Bit adders, shift-and-add multiplier, array multiplier, modeling registers and counters using VHDL processes.

Learning Outcomes:

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

- describe the behavior of combinational logic circuits using VHDL processes (L2).
- describe the behavior of registers and counters using VHDL processes (L2).
- develop VHDL models of different types adder circuits (L3).
- design and model different types of multipliers using VHDL (L4).

Unit IV: **8L**

Introduction to Programmable Logic Devices: Brief overview ofprogrammable logic devices, simple programmable logic devices (SPLDs), complex programmable logic devices (CPLDs), field-programmable gate arrays (FPGAs), state machine charts, derivation of SM charts.

Learning Outcomes:

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

- explain the capabilities of different programmable logic devices (L2).
- implement the combinational and sequential logic circuits using PLD (L5).
- distinguish between different programmable logic devices (L4).
- develop the state machine charts for digital data processing(L3).

Unit V: **8L**

Designing with Field Programmable Gate Arrays: Implementingfunctions in FPGAs, implementing functions using Shannon's decomposition, carry chains in FPGAs, cascade chains in FPGAs, FPGAs and one-hot state assignment, FPGA capacity: Maximum gates versus usable gates, design translation (Synthesis), mapping, placement, routing.

Learning Outcomes:

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

- understand the shannon's expansion theorem to decompose functions (L2).
- implement Boolean functions in FPGA devices using cascade chains and carry chains (L5).
- implement Boolean functions in FPGA devices usingone-hot state assignment (L5).
- estimate the performance factors of the digital system such as delay, area and power (L4).

Text Book:

1. Charles H. Roth Jr., Lizy Kurian John, Digital System Design using VHDL, 2/e, Cengage Learning, 2008.

References:

1. Stephen Brown and Zvonko Vranesic, Fundamentals of Digital Logic with VHDL Design, 3/e, McGraw-Hill Higher Education, 2008.
2. S.Trimberger, Field Programmable Gate Array Technology, 1/e, Kluwer Academic Publications, 1994.
3. J. Bhasker, A VHDL Primer, 3/e, Prentice Hall of India, 2009.

Course Outcomes:

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

- design combinational and sequential logic circuits with the helpof K-maps using NAND/NOR/Universal gates (L4).
- design Mealy and Moore state machines for the given specifications (L5).
- explain the basics of VHDLand describe a digital circuit at different levels such as behavioral, dataflow and structural (L2).
- develop VHDL models of combinational and sequential logic circuits (L3).
- distinguish between different programmable logic devices anddevelop the state machine charts for a given digital data processing (L3).
- implement Boolean functions in FPGA devices using cascade chains, one-hot assignment etc. (L5).

19EEC347: TRANSMISSION LINES AND WAVEGUIDES

L	T	P	C
3	0	0	3

Transmission of any signal requires a medium for communication. This medium may be guided or free space. The guided media can be of many forms based on the frequency of operation. Various types of the guided media of communication are treated and elaborated in this course. Performance analysis of all types of transition lines, stripline and waveguides are presented to enable the selection of suitable line for a given application.

Course Objectives:
- To understand and analyze transmission of electrical energy using conducting medium.
- To analyze transmission lines and their parameters using Smith chart.
- To classify the guided wave solutions- TE, TM.
- To introduce strip lines and their characteristics.
- To provide an understanding of various microwave components.
- To explain the measurement of the parameters of waveguide components.

Unit I: **8L**

Transmission Lines: Transmission line parameters, transmission line equations, transmission line examples, input impedance, characteristic impedance, reflection coefficient, VSWR, RF lines.

Learning Outcomes:
After completion of this unit, the student will be able to
- list the different parameters of a transmission line (L1).
- discuss the input impedance, characteristic impedance and reflectioncoefficient of a transmission line (L2).
- determine VSWR of a transmission line (L3).

UNIT II: **8L**

Smith Chart and Applications: Graphical methods and applications, Smith chart construction, application, measurement of VSWR, impedance, reflection coefficient, quarter wave transformer, single stub matching techniques.

Learning Outcomes:

After completion of this unit, the student will be able to
- explain the construction and applications of a Smith chart (L2).
- determine VSWR, impedance, reflection coefficient of a transmission line using Smith chart (L4).
- design impedance matching circuits using quarter wave transformer and single stub (L5).

UNIT III: **8L**

Strip Lines: Introduction, microstrip line, characteristic impedance of microstrip line, losses in microstrip line, quality factor Q of micro strip line.

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

- identify the microstrip line (L4).
- explain the characteristic impedance and losses of microstrip line (L2).
- measure the Quality factor of microstrip line (L6).

UNIT IV: **8L**

Waveguides: Introduction, microwave frequencies. **Rectangular Waveguides**: Solutions to wave equations, TE Modes, TM modes, power transmission, power losses, excitation of Modes.
Cavities: Rectangular cavity resonator, Q factor of cavity resonator.

Learning Outcomes:

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

- determine solutions to wave equations(L4).
- describe TE and TM modes of transmission in a rectangular waveguide (L2).
- understand the operation of a rectangular cavity resonator and compute its quality factor (L2).

UNIT V: **8L**

Waveguide Components: Introduction to scattering parameters and their properties, wave guide tees, H-plane Tee, E-plane Tee and Magic Tee, directional coupler, Faraday rotation, ferrite devices, gyrators, isolators, circulators and their properties.

Learning Outcomes:
After completion of this unit, the student will be able to
- identify different microwave waveguide components and describe their usage (L4).
- explain the different scattering parameters and their properties (L2).
- determine the waveguide Tees scattering parameters (L3).
- describe the directional coupler parameters and properties of gyrator, isolator and circulator (L2).

Text Books:

1. R. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill, 2006.
2. Samuel Y. Liao, Microwave Devices and Circuits, 3/e, Pearson Education, India, 2003.

References:

1. M. N. O. Sadiku, Principles of Electromagnetics, 4/e, Oxford University Press, 2010.
2. John D Ryder, “Networks, lines and fields”, 2nd Edition, Prentice Hall India, 2010.
3. Gottapu Sasibhushana Rao, Electromagnetic Field Theory and Transmission Lines, Wiley, 2011.

Course Outcomes:
After successful completion of the course, the student will be able to
- discuss the input impedance, characteristic impedance and reflection coefficient of a transmission line (L2).
- analyze VSWR, input impedance, reflection coefficient of a transmission line using Smith chart and impedance matching techniques using quarter wave transformer and single stub (L3).
- describe the construction of a microstrip line and determine its parameters (L2).
- determine solutions to wave equations leading to TE and TM modes of transmission in a rectangular waveguide (L3).
- explain the operation of a rectangular cavity resonator and compute its quality factor (L5).
- identify different microwave waveguide components and determine their scattering matrix (L4).

19EEC349: COMPUTER ORGANIZATION AND DESIGN

L T P C
3 0 0 3

Module I **8 Hours**

Instruction Set Architecture: Memory locations and addresses, memory operations, instructions and instruction sequencing, addressing modes, assembly language, stacks, subroutines, additional instructions, dealing with 32-bit immediate values, CISC instruction sets, RISC and CISC styles, example programs, encoding of machine instructions.

Module II **8 Hours**

Basic Input/Output: Accessing I/O Devices, interrupts**. Software:** The assembly process, loading and executing object programs, linker, libraries, compiler, debugger, high level language for I/O tasks, interaction between assembly and c language, the operating system.

Module III **8 Hours**

Basic Processing Unit: Some fundamental concepts, instruction execution, hardware components, instruction fetch and execution steps, control signals, hardwired control, CISC-style processors. **Pipelining:** Basic concept—the ideal case, pipeline organization, pipelining issues, data dependencies, memory delays, branch delays, resource limitations, performance evaluation

Module IV **8 Hours**

Input/Output Organization: Bus structure, bus operation, arbitration, interface circuits, interconnection standards. **The Memory System:** Basic concepts, semiconductor ram memories, read-only memories, direct memory access, memory hierarchy, cache memories, performance considerations, virtual memory, memory management requirements, secondary storage.

Module V **8 Hours**

Arithmetic: Addition and subtraction of signed numbers, design of fast adders, multiplication of unsigned numbers, multiplication of signed numbers, fast multiplication, integer division, floating-point numbers and operations. **Parallel Processing and Performance**: Hardware multithreading, vector (SIMD) processing, shared-memory multiprocessors, cache coherence, message-passing multicomputers,

Text Books

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky & Naraig Manjikian, Computer Organization and Embedded Systems, 6/e, McGraw Hill Publications, 2010

Reference

1. Patterson, Hennessy, Computer Organization and Design, 4/e, Elsevier Publications, 2011.
2. Kai Hwang and A. Briggs, Computer Architecture and Parallel Processing, International Edition McGraw Hill, 2012.
3. Dezso Sima, Terence Fountain, Peter Kacsuk, Advanced Computer Architecture, Pearson Education, 2011

19EEC351: WIRELESS SENSOR NETWORKS AND IOT

L	T	P	C
2	0	2	3

The emphasis of this course is on the concepts of wireless sensor networks and IOT used widely in the present day scenario. This course provides the knowledge of architecture of wireless sensor networks and IOT architecture, challenges in them. The students are exposed to the protocols used at different layers such as physical, network and transportation layer. The emphasis will be laid on data aggregation and the advantage of integration of IOT with wireless sensor networks.

Course Objectives:

- To provide an understanding of wired and wireless sensor networks and challenges in its implementation.
- To analyze the design issues in developing protocols related to different layers of sensor networks.
- To compare the existing key MAC and network layer protocols.
- To familiarize Smart Objects and IoT Architectures.
- To explain about various IOT-related protocols.

Unit I: **8L**

Introduction: Key definitions of sensor networks, advantages of sensor networks, unique constraints and challenges, driving applications, enabling technologies for wireless sensor networks.

Learning Outcomes:

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

- define wireless sensor network (L1).
- analyze the challenges of sensor networks (L4).
- identify the enabling technologiesthat are suitable for wireless sensor networks (L1).
- examine the factors influencing WSN design (L4).

Unit II: **8L**

Architectures: Single-node architecture - hardware components, energy consumption of sensor nodes, operating systems and execution environments, optimisation goals and figures of merit, physical layer and transceiver design considerations, personal area networks (PANs), hidden node and exposed node problem, Topologies of PANs, MANETs, WANETs.

Learning Outcomes:

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

- understand the architecture and components used in WSN (L1).
- analyze the energy constraints in the design of WSN (L4).
- examine the problems associated with nodes in WSN (L4).
- describe the network topologies of WSN (L2).

Unit III:

8L

Protocols: Issues in designing MAC protocol for Ad Hoc wireless networks, design goals of a MAC protocol for Ad Hoc wireless networks and classifications of MAC Protocols, issues in designing a routing protocol for Ad Hoc wireless networks, classification of routing protocols.

Learning Outcomes:

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

- understand the issues in designing MAC protocols for wireless sensor networks(L1).
- compare the MAC layer protocols used in WSN (L4).
- describe the issues in designing routing protocols for wireless sensor networks (L2).
- compare the network layer protocols used in WSN (L4).

Unit IV: **8L**

Genesis of IoT, IoT and digitization, connected roadways, connected factory, smart connected buildings, smart creatures, convergence of IT and OT, IoT challenges

Learning Outcomes:

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

- define the concept of IOT(L1).
- explain applications of IOT in Roadways(L2).
- Explain applications of IOT in smart cities(L2).
- demonstrate the challenges in IOT (L3).

UnitV: **8L**

IoT network architecture and design, IoT architectural drivers, the one M2M IoT standardized architecture, the IoT World Forum (IoTWF) standardized architecture. Things: Sensors and actuators layer, communications network layer, applications and analytics layer, IoT data management and compute stack, edge, fog, and cloud computing

Learning Outcomes:

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

- summarize the architecture and design aspects in IOT (L2.)
- differentiate between M2M -IOT and IOTWF (L4).
- identify the sensors and actuators used in IOT (L1).
- compare the Data management in IOT (L4).

Text Books:

1. Holger Karl & Andreas Willig, Protocols And Architectures for Wireless Sensor Networks, John Wiley, 2005.
2. Feng Zhao & Leonidas J. Guibas, Wireless Sensor Networks- An Information Processing Approach, Elsevier, 2007.
3. IoT Fundamentals Networking Technologies, Protocols, and Use Cases for the Internet of Things by David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Jerome Henry, Robert Barton by Cisco Press, 2017.

References:

1. Raghavendra, Cauligi S, Sivalingam, Krishna M., ZantiTaieb, Wireless Sensor Network, Springer 1/e, 2004 (ISBN: 978,4020,7883,5).
2. Ian F. Akyildiz and Mehmet Can Vuran, Wireless Sensor Networks, John Wiley and Sond Ltd, Publication, 2010.

Course Outcomes:

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

- illustrate the concepts of network architecture and applications of Wireless Sensor Networks (L1).
- explain the architecture and components used in WSN (L2).
- analyse the protocol design issues of wireless sensor networks (L4).
- compare different routing protocols of MAC layer and network layer for wireless sensors networks (L4).
- summarize the architecture, design aspects and challenges in IOT (L2).
- describe the applications and various layers of IOT (L2).

19EOE301: JAPANESE FOR BEGINNERS
(Elective)

L	T	P	C
3	0	0	3

Unit I **9 hours**

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 hours**

Asking about business hours, shopping, time and numbers, large numbers, counters. Grammar: Pronouns and noun modifiers. Useful daily expressions.

Unit III **8 hours**

Getting around, confirming schedules (including going/coming), visiting another company (including month/week/day). Grammar: Motion verbs. Useful daily expressions.

Unit IV **8 hours**

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 hours**

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
(Elective)

L T P C
3 0 0 3

Unit I **9 hours**

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 hours**

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 hours**

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 hours**

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 hours**

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
(Elective)

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 books:

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
(Elective)

L T P C
3 0 0 3

Unit I **8 hours**

Reading the Texts: Reading for gist, chapter summaries, plot, pair work and discussions in small groups.

Unit II **8 hours**

Understanding the Texts: Basic themes, characterization-major characters, watching short videos followed by discussion, analysis and writing short reviews.

Unit III **8 hours**

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 hours**

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 hours**

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 hours**

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 hours**

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 hours**

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 hours**

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 hours**

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: PERSONALITY DEVELOPMENT

L T P C
3 0 0 3

Unit I **8 hours**

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 hours**

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 hours**

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 hours**

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 hours**

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 Books, 1995.
4. Swami Vivekananda, Personality Development, Advaita Ashrama, 1993.

*This will be supplemented by materials and activities from internet-related sources.

19EOE224: Virtual Reality

L-T-P-C

1-0-4-3

Summary

Virtual Reality extends the boundaries of the physical environment by providing a never ending real estate on which an infinite number of worlds can be built to learn, explore and visualise. In order to empower interested students by providing them with an opportunity to learn a cutting-edge technology like VR and getting skilled for industry while in university, Facebook School of Innovation powered by SV.CO, has provided a VR skill pathway offering VR 201 (Beginner), VR 301 (Intermediate) and VR 401 (Advanced) level course.

Course Objectives

The objective of this course is to introduce the students to learn about Virtual Reality and the skills required to become a Unity VR developer.

Course Outcomes

By the end of the course, the student should be:

- well versed with the concepts of VR,
- able enough to understand, articulate and criticize VR experiences/applications in sufficient detail
- able to execute the concepts into demonstrable examples,
- able to understand the requirements and the skillset to be a VR developer in the current economy.

Skills required

None (But a basic understanding of VR, Unity, and C# will be helpful)

Skills acquired

- Basic VR Developer (Oculus Platform)
- Basic Unity Developer (Wireframing/Storyboarding, Level Designing, C# Programming)

Project

Build a basic Virtual Reality application that allows the student to exercise all the fundamental knowledge gained in the course

Course Syllabus

Level 1 : Introduction to VR and Unity3D

M1: Keep it Virtual (Introduction to VR)
M2: Platforms and Paradigms
M3: Unity, Diversity (Introduction to Unity 3D)
M4: Ready Player One (Getting Started in Unity)
M5: Oh Hello World (Deploying your First App to Oculus Quest or Go)

Level 2 : Components of Unity

M1: Materials and Meshes
M2: Lights, Camera, VR
M3: I like to Move it (Animation in Unity)

Level 3 : Scripting in Unity #1

M1: Basics of C# in Unity #1
M2: Basics of C# in Unity #2

Level 4 : Scripting in Unity #2

M1: Let's Code #1
M2: Let's Code #2

Level 5 : Oculus Quest (Go) and its basics

M1: Oculus Inputs and UI Fundamentals
M2: Events and Buttons
M3: Buttons and the Joystick

Level 6 : Fundamentals of Unity Physics and Visual Effects

M1: Action, but Reaction? (Physics, Colliders, Raycast)
M2: More Controller Interactions
M3: Visual Effects

Level 7 : Design and Debug

M1: Debug.Log("This is where it breaks")
M2: VR Design
M3: Documentation and Unity Collab

Level 8 : Performance in Unity and Easter Eggs (Optional Level)

M1: Device Performance
M2: Easter egg #1
M3: Easter egg #2

Capstone Project Targets

P1: Level Design and UI
P2: Mechanics, Navigation and Deploy

Continuous Evaluation Plan (100 marks)

Milestones Based Evaluation (50 marks):

- Each level has a graded target where the students demonstrate their understanding of the content and get feedback.
- Each target is evaluated for 5 marks.
- These targets from Level 1 to 8 will contribute to the internal marks. Level 8 is optional.
- Marks received out of 35 / 40 (if Level 8 is attempted) are scaled up to 50.

Project Evaluation (50 marks):

This will have two components:

1. Capstone Project linked Targets:
    a. Students will complete extra targets from which will contribute to a mini project /capstone work.

2. Viva Q&A
    a. Students are given a small task on the spot to complete based on the course, and/or asked a few questions to check their understanding of the course by an industry expert.

Annexure (Optional)

Checklist for students in VR201 to be eligible for the startup-aligned project

1. Interest was shown to build a startup in the pre-course interest form. (Likely teamed up)
2. The 4 highest scorers of the students (team of 2) that also show continuing interest in building a startup at the end of the 6 weeks in the program get to choose the problem statements (discussed and worked with coaches/TAs to structure into outcomes) that they get to work on.
3. In case the students choose not to go with their self-described problem statement then the next in the list in terms of scores top-down gets a chance. And if nobody later during the program wishes to go with their self-described problem statement, they'll go with the problem statement given out in the program anyway.

19EOE323: INDIAN HISTORY (Elective)

L	T	P	C
3	0	0	3

Unit I **10 Hours**

Ancient Indian History and Culture (Earliest Times to 700 AD): Indusvalley 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 Hours**

Medieval Indian History and Culture: Delhi sultanate, great mughals,bahumanis, rise of south supremacy and conflicts, Pallava, Chalukya, Chola and Rasthrakutas.

Unit III **8 Hours**

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 Hours**

Impact of British Colonial Rule: Economic: Commercialization of ag-riculture, 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, introduc-tion of western education in India, the rise of print media, literature and public opinion, the rise of modern vernacular literature, progress of sci-ence, rail and road connectivity.

Unit V **8 Hours**

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 Books, 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 Books, 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 Books Design, India, 2010.

A. R. Desai, Social Background of Indian Nationalism, 6/e, Popular Prakashan, 2005

19EOE327: PROFESSIONAL COMMUNICATION
(Elective)

L T P C
3 0 0 3

Unit I **8 hours**

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 hours**

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 hours**

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 hours**

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 hours**

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.

Rizvi, M. Ashraf, Effective Technical Communication, Tata McGraw Hill, 2005. 193

19EOE321: ENVIRONMENT AND ECOLOGY (Elective)

L	T	P	C
3	0	0	3

Unit I **8 hours**

Basic Concepts: Environment types, features of environment, structureof atmosphere, earth's four spheres, ecology, ecological principles, pho-tosynthesis, components of ecosystem, carbon and oxygen cycles, nitro-gen, hydrological, sedimentary, phosphorous and energy cycles.

Unit II **8 hours**

Biomes: Terrestrial biomes, Aphine Tundra biomes, extinction of species.Bio-diversity: Biodiversity in American contents, Europe, central Asia and Africa. Categorization of species, biogeographic zones of India, biodiversity conservation, strategies, biodiversity conservation in India.

Unit III **8 hours**

Environmental Degradation and Management: Greenhouse effect andglobal 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 hours**

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 hours**

Climate Change: Evidence of global warming, consequences of climaticchange, consequences of climate change in India. Biodiversity and Leg-islation: 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.

19LOE301: FUNDAMENTALS OF CYBER LAW
(OPEN ELECTIVE FOR ENGINEERING PROGRAMMES)

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 Module) cloning–Mobile frauds - Usage of mobile software - Special reference to the relevant provisions of IT ACT 2008, India Penal Code and Evidence Act.

Textbooks:

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.

GEL244: English for Higher Education
(A Preparatory Course for Language Proficiency Tests)
Open Elective-I (Proposed)

L	T	P	C
3	0	0	3

Introduction

The course aims to provide students with the knowledge and practical skills required to take globally-recognized tests of English language proficiency. This preparatory course will enable students to achieve the required band score by providing opportunities to practise the strategies for effective use of the four language skills, in addition to application of the standard language rules. The integrated skills approach, exercises in various question/task types, and mock tests give the students ample exposure to the test conditions.

Course Objectives

- To provide comprehensive training to students for various English language proficiency tests that are prerequisite for admission into higher education programs
- To facilitate the required practice in each of the four skills, as well as language elements such as pronunciation, vocabulary and grammar
- To enable students to take the test/s with confidence by discussing, practicing, and analyzing each section/task type of the test

- *To determine students to* communicate opinions and information on everyday topics and common experiences *effectively in English.*
- To hone students writing skills through consistent guidance and practice of every subskill of writing.
- To offer a wide variety of reading topics/texts over the course, maintaining students' interest and giving a sense of meaningful progress in their reading comprehension ability.
- To enable the students to practice vocabulary and grammar in context integrating with four skills.

Unit 1: Listening

Listening for main ideas, gist and opinions; listening for specific information; understanding different accents

Task types: Form completion, table completion, pick from a list, matching, flow chart completion, note completion, multiple choice, labelling a diagram, labelling a plan, sentence completion and short answer questions.

Learning Outcomes

At the end of the unit, the learners will be able to

- comprehend the main ideas, specific information, and opinions presented in listening inputs that include short talks, conversations, transactional dialogues, and short discussions in general and academic contexts
- demonstrate ability to handle various listening comprehension tasks
- understand various native and non-native accents and respond correctly and appropriately to various questions

Unit 2: Speaking

Using appropriate vocabulary and correct grammar; demonstrate awareness of chunking while speaking; speaking about oneself; speculating and talking about the future; addressing abstract topics; paraphrasing; generalising and distancing; speculating and hypothesising; giving reasons and examples; discussing advantages and disadvantages; structuring a talk; speaking fluently for short duration on specific topics; making useful notes to respond effectively to questions asked; understanding questions and giving appropriate answers

Task Types: Responding to questions on a range of personal topics in general and academic contexts; speaking based on specific verbal prompts: giving a structured coherent talk with adequate fluency, a clear introduction and effective conclusion; participating in a discussion of abstract concepts or general topics which are thematically linked

Learning Outcomes

At the end of the unit, the learners will be able to

- respond to general questions on personal, academic and professional information using appropriate and correct language
- demonstrate adequate fluency and speak coherently on a specific topic using the given prompts
- express and justify opinions, analyse, and speculate about issues in discussions
- present abstract concepts thematically using appropriate examples and reasons

Unit 3: Reading

Skimming for main ideas/themes/topics; scanning for details and locating specific information; understanding a process or the flow of information presented; distinguishing examples from main ideas; understanding factual, inferential, analytical and extrapolative texts; understanding gist and paraphrase; identifying authors' opinions/attitude

Task types: True/false/not given, sentence completion, note completion, summary completion, table completion, flow chart completion, pick from a list, multiple choice, short answer questions, matching headings, matching information, matching features, matching sentence endings

Learning Outcomes

At the end of the unit, the learners will be able to

- understand the gist, specific information, and opinions presented in a text, and distinguish examples from main ideas
- demonstrate understanding of the author's opinions as presented in a text
- use suitable strategies to answer various question types that test comprehension

Unit 4: Writing

Paragraph writing: interpretation of graphical data such as charts and tables; essay writing: argumentative and persuasive; organising ideas in writing to achieve coherence; grouping information/ideas in paragraphs and linking paragraphs; writing suitable introduction and conclusion to the given tasks; signalling, comparing and contrasting, presenting a balanced view; selecting and summarising main features; analysing the task requirements and planning an answer; summarising information/key features/trends in a diagram/chart/table; categorising data; brainstorming for ideas; introducing arguments and maintaining a clear position using reasons and examples for support

Task types: Describing, summarising, and explaining data presented in a chart/table, describing the stages of a process or how something works; describing an object or an event; writing essays in response to a point of view, an argument, an issue, or a problem

Learning Outcomes

At the end of the unit, the learners will be able to

- demonstrate that they have had adequate practice in preparing drafts, revising, editing and rewriting in order to ensure task accomplishment
- produce descriptive/ narrative paragraphs based on their understanding of the data/information presented in various forms such as diagrams, charts, and tables
- write structured and coherent argumentative/ persuasive essays using use a range of vocabulary and correct grammar

Unit 5: Grammar and vocabulary in context

Tenses; phrasal verbs; idiomatic expressions; verb+noun collocations; collocations and phrases with *make, take, do* and *have;* negative affixes; adjectives+noun collocations; verbs and dependent prepositions; nouns and articles; discourse markers; punctuation; linking and pausing; intonation, word stress, speech rate and chunking; vocabulary to express amount extent or category, comparisons and contrasts, agreement and disagreement

Learning Outcomes

At the end of the unit, the learners will be able to

- apply knowledge of language for better comprehension of reading texts and listening inputs
- demonstrate knowledge of correct use of tense forms, prepositions, articles, adjective-noun collocations, and appropriate structures in speech and writing
- use idiomatic expressions, and phrasal verbs in suitable contexts, and draw upon a wide range of vocabulary for effective oral and written communication

- organising ideas in written and oral communication using appropriate discourse markers, and punctuation/pauses

References

Seely, John.*Oxford Guide to Effective Writing and Speaking.*Oxford University Press, (India), 2013

Rizvi, M Ashraf. *Effective Technical Communication*.Tata McGraw Hill. 2005.

Olsen, Leslie & Huckin, Thomas.*Technical Writing and Professional Communication for Non- native Speakers*.McGraw-Hill.1991

19EOE319: INTRODUCTION TO MUSIC

L T P C
3 0 0 3

Unit I **8 hours**

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 hours**

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 hours**

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 hours**

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 hours**

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.

19EEE373: FUNDAMENTALS OF POWER ELECTRONICS

L	T	P	C
2	1	0	3

The course introduces basics of power electronic devices and converters. Basic working principle, operating modes and analysis of DC-DC, DC-AC, AC-DC, and AC-AC converters would be covered.

Course Objectives:

- To study basics of power electronic devices.
- To introduce different power converter circuits-converters and inverters
- To familiarize chopper
- To acquaint with various types of AC controllers

Unit I: **10 L**

Concept of Power Electronics: Introduction, definitions, the p-n junction, basic structure of power diodes, characteristics of power diodes, Power transistors, Power MOSFETS, Insulated gate bipolar transistor, Static induction transistor, MOS controlled thyristor.

Learning outcomes:
After completion of this Unit, students will be able to

- understand is the need for power electronics converters (L1)
- explain the characteristics of p-n junction diode (L1)
- outline the characteristics of power electronic devices (L2)
- select different types of devices for application (L3)

Unit II: **8L**
Thristors: characteristics of thyristors, thyristor turn on methods, switching characteristics of thyristors, thyristor gate characteristics, two- transistor model of a thyristor, thyristor ratings, thyristor protection, firing circuits for thyristors, triac & firing circuit, types of commutation circuits.

Learning outcomes:
After completion of this Unit, students will be able to

- define the thyristor characteristics (L1)
- analyze protection circuits of SCR (Silicon Controlled rectifier) (L2)
- classify the commutation methods and circuits. (L2)
- explain the firing circuits to implement. (L3)

Unit III: **8L**

Controlled Rectifiers (Converters): 1-Phase /3-Phase, Half wave / full wave, half controlled /fully controlled converters with R, RL and RLE loads, continuous and discontinuous current operations, effects of source inductance, dual converters.

Learning outcomes:
After completion of this Unit, students will be able to

- understand AC- DC converters (L1)
- explain the operation of AC- DC converters (L2)
- examine the different AC-DC rectifiers (L5)
- consider continuous and discontinuous current operations (L5)

Unit IV: **8L**

DC- DC Converters: Types of chopper circuits, principle of operation – Quadrant I, II, III, &IV; buck, boost, buck-boost converters.

Learning outcomes:

After completion of this Unit, students will be able to

- understand DC- DC converters (L1)
- explain operation of chopper (L2)
- examine the different types of DC-DC converters (L5)
- outline the buck, boost, buck-boost converters (L5)

Unit V: **8L**

Inverters: 1-phase and 3- phase bridge inverters with R and R-L loads.
AC voltage controllers: 1- phase and 3- phase ac voltage controllers with R, RL and loads. **Cyclo- converters:** 1- phase step down and step up cyclo-converter.

Learning outcomes:

After completion of this Unit, the students will be able to

- understand DC- AC converter (L1)
- explain operation of DC- AC converter (L2)
- examine the different AC voltage controller (L3)
- analyze the operation of different types of cyclo-converters (L2)

Text Book(s):

1. M. H. Rashid, "Power Electronics - Circuits, Devices and Applications", P.H.I Private Ltd. New Delhi, Second Edition, 1994
2. Ned Mohan , "Power Electronics", 3/e, Wiley ,2006.

Reference Books:

1. Bimal K Bose, " Modern Power Electronics and AC Drives" PHI
2. R W Erickson and D Makgimovic,"Fundamental of Power Electronics" Springer, 2nd Edition.
3. André Veltman, Duco W.J. Pulle and Rik W. De Doncker, "Fundamentals of Electrical Drives", 1/e, Springer, 2007.

Course Outcomes:

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

- acquire knowledge about fundamental concepts and techniques used in power electronics (L1).
- able to analyze various single phase and three phase power converter circuits and understand their applications (L2)
- explain basic requirements for power electronics based design application (L1).
- develop skills to build, and troubleshoot power electronics circuits (L3).

19EEI373: MEASUREMENTS AND INSTRUMENTATION

L	T	P	C
2	1	0	3

The importance of measurements is well known in the field of Engineering. For any engineer it is necessary to know the fundamentals of measurements and various modern measuring instruments. The main goal of aMeasurements and Instrumentation course for engineering students is shaped by a variety of applications including control, quality assurance, performance testing, design and research.

Course Objectives:

- To provide an adequate knowledge in basic measurements.
- To study about the measurement of basic parameters
- To emphasize on various AC& DC Bridges to calibrate instruments.
- To provide sound knowledge about various techniques used for the measurement of different industrial parameters.

Unit I: **8L**

Basic Measurement Concepts: Measurement systems – Static and dynamic characteristics- types of errors- statistical analysis – units and standards of measurements.

Learning Outcomes:

After completing this unit, the student will be able to

- understand the concepts of Measurement system.(L5)
- explain static and dynamic characteristics.(L2)
- understand the concept of errors and statistical analysis.(L5)

Unit II: **9L**

Electronic Instruments: PMMC Mechanisim-DC Ammeter-DC Voltmeter-AC Voltmeters- Using Rectifiers- True RMS responding Voltmeters -Digital voltmeter-Successive-approximation DVM, Integrating DVM- Q –meter – cathode ray oscilloscopes block Diagram-Cathode Ray Tube, Measurement of Voltage, Current, Frequency and Phase.

Learning Outcomes:

After completing this unit, the student will be able to

- identify various Electronic Instruments and its specifications.(L4)
- explain principles of PMMC, Digital meters, CRO etc.(L2)
- solve the problem based on meters.(L5)

Unit III: **8L**

Bridge Measurements: D.C. Bridges- Wheatstone bridge – Kelvin double bridge- A.C bridges – Measurement of inductance – Maxwell Bridge,Hay's Bridge – Q of coil– capacitance -Schering bridge, Wien's bridge.

Learning Outcomes:

After completing this unit, the student will be able to

- understand the concept of various Bridge circuits etc.(L5)
- explain working principles of resistive, inductive and capacitive bridges.(L2)
- solve the problems based on the Bridges(L5)

Unit IV: **9L**

Measurement of Pressure and Level: Pressure -U -Tube Manometer, Bourdon Tube, Diaphragm and Bellows. Level- Sight glass, Float type, Electrical methods - Resistance type, Capacitance type -Ultrasonic level gauge.

Learning Outcomes:

After completing this unit, the student will be able to

- describe about basics of Resistive and capacitive transducers.(L2)
- understand the concept of Pressure and Level measuring devices.(L1)
- solve the problems based on the Pressure and Level measuring devices.(L5)

Unit V: **8L**

Measurement of Temperature and Flow: Temperature - RTD, Thermocouples and Thermistor. Flow - Orifice, Venturi, Rotameter and Electromagnetic Flow meter.

Learning Outcomes:

After completing this unit, the student will be able to

- understand the concept of Resistive transducers(L1)
- understand the principles of Flow measuring devices.(L1)
- solve the problems based on the Temperature and Level measuring devices.(L5)

Text Book(s):

1. Electrical and Electronic Measurements and Instrumentation by A.K. Sawhney,2002 edition
2. Principles of Industrial Instrumentation, D. Patranabis, Tata McGraw Hill, Publishing co, 2000.

References:

1. Electronic Measurements by Terman and Pettit, McGraw Hill Publications.
2. Electronic Measurements, H.S. Kalsi, TMH
3. Electronic Measurements and Instrumentation by B.H. Oliver and Cage, McGraw Hill.
4. A course in mechanical measurements and instrumentation, A. K. Sawhney&Puneet Sawhney, Dhanpat Rai & Co., 2001.

Course Outcomes:

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

- know the basic principle and operation of various instruments (L2)
- identify the role of various instruments in the process of Measurement and instrumentation (L1)
- explain how instruments are used for process control (L2)
- select instruments based on application in various fields (L4)

19EIT371: PROGRAMMING WITH C

L	T	P	C
2	1	0	3

UNIT I

Algorithm, flowchart, program development steps, structure of C program, Compilers, Linker, Preprocessor, identifiers, basic data types and sizes, Constants, variables, operators, expressions, type conversions, conditional expressions, precedence and order of evaluation. Input-output statements, statements and blocks, programming examples.

UNIT II

Control Structures: if and switch statements, loops- while, do-while and for statements, break, continue, goto and labels. Designing structured programs, Functions, basics, parameter passing, block structure, user defined functions, standard library functions, recursive functions, Comparison of Iteration and Recursion, header files, C preprocessor, storage classes- extern, auto, register, static, scope rules, example c programs.

UNIT III

Arrays: concepts, declaration, definition, accessing elements, storing elements, arrays and functions, two-dimensional and multi-dimensional arrays, applications of arrays. Pointers: concepts, initialization of pointer variables, pointers and function arguments, address arithmetic, Character pointers and functions, pointers to pointers, pointers and multidimensional arrays, dynamic memory management functions, command line arguments, c program examples.

UNIT IV

Strings: What are Strings, Arrays of Strings and Standard Library String Functions. Derived types: structures- declaration, definition and initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self referential structures, unions, typedef, bitfields, C program examples.

UNIT V

Input and output - concept of a file, , File Structure , text files and binary files, streams, standard I/O, Formatted I/O, file I/O operations, error handling, C program examples.

Text Books:

1. Computer science, A structured programming approach using C, B.A. Forouzan and R.F. Gilberg, Third edition, Thomson.

Reference Books:

1. MASTERING C, byK R Venugopal, S R Prasad published by Tata McGraw Hill
2. Programming with ANSI and Turbo C by Ashok N. Kamthane, published by PEARSON Education.
3. Let us C by Yashwant Kanetkar, published by BPB Publications.

19ECS477: FUNDAMENTALS OF DATA STRUCTURES

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

The study of data structures, a fundamental component of a computer science education, serves as the foundation upon which many other computer science fields are built. Knowledge of data structures is a must for students who wish to work in design, implementation, testing or maintenance of virtually any software system. Organization of data in an efficient way to suit the application is the major focus of the course.

Course Objectives

- To introduce various data representation methods and searching methods.
- To familiarize the student with linear data structures and operations on them.
- To demonstrate the organization of data as trees and various operations on trees.
- To teach the student various graph representations.
- To enable the student to perform graph traversal and find shortest path and minimal spanning tree for a graph
- To expose the student to common sorting techniques and their complexities.

Unit I: **10 L**

Data representation: Introduction, linear lists: array representation, linked representation.
Sparse Matrix: Representation, addition, transpose**.**
Searching: Linear search, Binary search.
Learning outcomes:
After completion of this unit, student will be able to

- summarize various ways of representing data (L2)
- explain the working of linear and binary search algorithms (L2)
- compare various data representations and search algorithms (L6)

Unit II: **8 L**

Linked lists: Single linked list, double linked list and operations on it.
Learning outcomes:
After completion of this unit, student will be able to

- discuss the pros and cons of linked lists (L2)
- describe various types of linked lists and operations on them (L2)
- compare different types of linked lists (L6)

Unit III: **10 L**

Stacks: Definition, operations: array implementation, linked list implementation and applications.
Queues: Definition, operations: array implementation, linked list implementation and applications
Learning outcomes:
After completion of this unit, student will be able to

- discuss how stacks and queues are implemented using arrays and linked lists (L2)
- explain the implementation of priority queues (L2)
- list the applications of stacks and queues (L1)

Unit IV: **8 L**

Trees: Definition, Tree properties, Binary trees: creation, operations, binary tree traversals, binary search tree.
Learning outcomes:
After completion of this unit, student will be able to

- discussthe properties of trees, binary and binary search (L2)
- explain how operations such as insertion, deletion and traversal are performed on different types of trees (L2)
- analyze the complexity of operations on different tree types (L4)

Unit V: **9 L**

Graphs: Introduction, graph representation, graph search method, Applications of Graphs: Shortest Paths, Spanning trees.

Sorting: Insertion sort, selection sort, bubble sort, quick sort, merge sort.

Learning outcomes:

After completion of this unit, student will be able to

- demonstrate different graph representations and operations (L3)
- discuss the working of common sorting algorithms (L2)
- analyze the computational efficiency of algorithms for sorting (L4)

Text Book(s):

1. Sartaj Sahni,Data Structures, Algorithms and Applications in Java, Universities Press, 2/e 2005.
2. Nell Dale, Austin Daniel T Joyce, Chip Weems, Jones and Bartlett Publishers, Object Oriented Data Structures using Java, 4/e, 2017.

References:

1. Peter Drake,Data Structures and Algorithms in Java, Pearson, 1/e, 2005.
2. Michael T. Goodrich, Roberto Tamassia, John Wiley & Sons, Inc. Data Structures and Algorithms in Java, 4/e, 2004.
3. Adam Drozdek, Data Structures and Algorithms in Java, Thomson Course Technology, Cengage Learning, 2/e, 2005.

Course Learning outcomes:

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

- explain various ways of representing data in a computer (L2)
- demonstrate operations on linear data structures (L3)
- discuss the mechanisms for creating, altering and traversing various types of trees (L2)
- explain the representations, traversals and applications of graphs (L2)
- analyze common sorting algorithms (L4)
- choose a data structure that gives the best performance for a given application (L6)

19ECS371: INTRODUCTION TO DATABASE MANAGEMENT SYSTEMS

L	T	P	C
2	**1**	**0**	**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: 10 L

Introduction to DBMS: Overview, File system vs DBMS, advantages of DBMS, storage data, queries, transaction management, DBMS structure, people who work with Databases.
Data base Design: data models, the importance of data models.
E-R model: Entities, attributes and entity sets, relationship and relationship sets, mapping cardinalities, keys, features of ER model, conceptual database design with ER model
Learning outcomes:
After completion of this unit, student 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).
- define the role of DBA and other users of DBMS (L1).
- model a given application using ER diagram (L3).

UNIT II 10 L

Relational model: Integrity constraints over relations and enforcement, querying relation data, logical database design, views, destroying/altering tables and views.
Relational Algebra and Relational Calculus
Learning outcomes:
After completion of this unit, student 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

Structured Query Language (SQL): Introduction to SQL, Basic SQL Queries: DML, DDL, DCL, TCL, Select Commands, Union, Intersection, Except, Nested Queries, Aggregate Operators, Null values, Relational set operators, SQL join operators
Learning outcomes:

After completion of this unit, student 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**

Schema Refinement and Normal Forms: Schema Refinement, Functional Dependencies, Reasoning about Functional Dependencies. Introduction to Normal Forms.

Learning outcomes:

After completion of this unit, student 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 and Concurrency Control: Introduction to Transaction Management, ACID properties, Transactions and Schedules, Concurrent Execution of Transactions, Lock-Based Concurrency Control.

Concurrency Control: 2PL, Serializability and Recoverability, Introduction to Lock Management, Lock Conversions, dealing with Deadlocks, Specialized Locking Techniques, Concurrency control without locking,

Learning outcomes:

After completion of this unit, student 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).

Text Book(s):

1. Database Management Systems, Raghu Ramakrishnan and Johannes Gehrke McGraw-Hill, 3rd Edition, 2014

References:

1. Database System Concepts, H.F.Korth and A.silberschatz McGraw-Hill, 6e, 2011
2. Fundamentals of Database Systems, RamezElmasri, Shamkant B. Navathe, Pearson Education, 7e, 2016
3. Fundamentals of Database Systems, Elmasri, Navathe, Somayajulu, Gupta, Pearson Education, 6e, 2010

Course Outcomes:

After 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.

19ECS472: INTRODUCTION TO AUGMENTED REALITY AND VIRTUAL REALITY

L	T	P	C
2	1	0	3

This course trains the students in the fundamental skills and tools required to make interactive AR/VR content that are high in demand for user engagement today. AR/VR can be utilized in the fields such as entertainment, gaming & education. VR technology uses a combination of multi-projected environments to generate realistic images, sounds and other sensations that simulate the feeling of physical presence in a virtual environment. Finally student gain will learn how to make the best use of creativity and technology to make the most stimulating, intriguing games.

Course Objectives

- Design a virtual environment and compelling virtual reality experience.
- Create compelling virtual experiences.
- To teach students the principles and multidisciplinary features of virtual reality.
- To teach students the technology for managing large scale VR environment in real time.
- To provide students with an introduction to the VR system framework and development tools.

Unit I: **10 L**

Introduction to Virtual and Augmented Reality: Defining virtual and augmented reality, Exploring the current state of virtual reality, exploring the current state of Augmented reality.

Learning Outcomes:

After completion of this unit, student will be able to

- define virtual and augmented reality (L1).
- review the various form factors for virtual and augmented reality (L2).
- compare the features of current virtual reality hardware (L2).
- survey the available types of virtual reality controllers (L4).
- express the current issues with virtual reality and Augmented reality (L6).

Unit II: **10 L**

Consuming content in virtual and augmented reality: Consuming content in Virtual reality, consuming contentin Augmented reality.

Learning Outcomes:

After completion of this unit, student will be able to

- express current consumer-based virtual reality headsets (L6).
- identify potential upcoming hardware in VR and AR (L2).
- compare current and future generations of hardware in VR and AR (L2).

Unit III: **8 L**

Creating content in Virtual and augmented reality: Evaluating your project, planning your virtual reality project, planning your augmented reality project.

Creating content for virtual and augmented reality

Learning Outcomes:

After completion of this unit, student will be able to

- evaluate virtual and augmented reality design choices (L4).
- consider ways of capturing real life content (L5).
- assess options for virtual and augmented reality development (L5).
- express current consumer-based augmented reality experiences (L6).
- decide how to distribute content (L5).

Unit IV: **8 L**

Virtual and augmented reality in the wild- Exploring Virtual Reality Use cases, exploring augmented reality Use cases

Learning Outcomes:

After completion of this unit, student will be able to

- review existing virtual reality applications(L2)
- assess virtual reality within industry segments(L5)
- predict virtual reality industry impact(L3)
- review existing augmented reality applications(L2)
- assess augmented reality within industry segments(L5)
- predict augmented reality's industry impact(L2)

Unit V: **8 L**

The future of virtual and augmented reality: Assessing the future of virtual reality, assessing the future of augmented reality

Learning Outcomes:

After completion of this unit, student will be able to

- analyze near-future changes for virtual reality(L4)
- evaluate the potential market(L5)
- predicting the impact of future updates(L3)
- evaluate augmented reality's upcoming market(L5)
- predict the impact of future updates(L3)

Textbook(s):

1. Paul Mealy, Virtual & Augmented Reality for Dummies, John Wiley and Sons Inc., 2018.

References:

1. Jason Jerald, The VR Book: Human-Centered Design for Virtual Reality, Published by Morgan & Claypool publishers and ACM Books
2. Alan B. Craig, Understanding Augmented Reality- Concepts and Applications, Newnes, 2013.

Course Outcomes

After completion of this course, student will be able to

- determine the basics of Virtual Reality (L3).
- determine the basics of Augmented Reality (L3).
- apply the Interactive and iterative design (L3).
- extend knowledge in VR and AR technologies in terms of used devices, building of the virtual environment and modalities of interaction and modelling (L2).
- extend knowledge in the main application of VR and AR technologies in medicine and surgery, cultural heritage and games (L2).
- analyze the infrastructure of Augmented Reality (L4).
- analyze the fundamental issues of virtual reality (L4).

19EHS405: OPERATIONS RESEARCH

L	T	P	C
2	1	0	3

This course is to aid decision making and improving efficiency of the system by applying advanced analytical methods. This course addresses a number of quantitative tools and techniques, and providing 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
- 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.
- Introduce basic inventory models to optimize inventory costs and Project scheduling techniques – CPM & PERT for optimum time and costs

Unit I: **10L**

Basics of Operations Research: History, definition, operations research models, phases of implementing operations research in practice.

Linear Programming: Introduction, formulation, graphical solution, simplex method, artificial variable techniques – Big M and two phase methods, duality principle, dual simplex method.

Learning Outcomes:

After completion of Unit -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 (L5).
- evaluate the optimal solution to simple linear programming problems (L6).

Unit II: **8L**

Transportation Model: Formulation, 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 Outcomes:

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

- formulate the linear programming problem as a Transportation model (L5).
- formulate the linear programming problem as an Assignment model (L5).
- evaluate the optimal solution to Transportation Problems (L6).
- evaluate the optimal solution to Assignment Problems (L6).

Unit III: **8L**

Queuing Models: Introduction, Kendall's notation, classification of queuing models, single server and multi-server models, Poisson arrival, exponential service, infinite population

Sequencing Models: Introduction, assumptions, processing n-jobs through two machines, n-jobs through three machines, n-jobs through m-machines, and graphic solution for processing 2 jobs through n machines with different order of sequence.

Learning Outcomes:

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

- define the various queuing models (L1).

- calculate Queue length & waiting time of a given queue system (L6).
- evaluate the optimal sequence of the jobs on machines for minimum cycle time (L6).

Unit IV: **9L**

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 principle, graphical method for 2xn and mx2 games, linear programming approach for game theory.

Learning Outcomes:

After completion of this unit, 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 (L6).
- analyze the players' strategies and thereby Evaluate optimal business strategies for the players (L4&L6).

Unit V: **9L**

Inventory Models: Introduction, inventory costs, Economic Order Quantity (EOQ) and Economic Batch Quantity (EBQ) models with and without shortages, 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 Outcomes:

After completion of this unit, 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 (L5).
- evaluate the optimal order/batch quantity for minimum inventory cost (L6).

- involved in a project(L5&L3).

Text Books:

1. Gupta P K. & Hira D.S., Operation Research, 6/e, S Chand Publishers, 2006.
2. Paneerselvam R., Operations Research, 2/e Prentice Hall of India, 2010.

Course Outcomes:

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

- recognize the scope of operations Research and develop the mathematical models for practical problems in industry so as to suggest the optimal resource allocation (L1,L3&L2).
- formulate and solve transportation & assignment models for optimum resources (L5&L3).
- analyze the Queue system to Predict the Queue length & waiting time(L4&L3);to propose the optimal sequence of performing jobs on machines for minimum cycle time (L5).
- Evaluate the best replacement policy of the equipment(L6);to analyze the strategic interaction between rational decision-makers(L5).
- design the inventory systems to minimize the costs(L5) ; to plan and schedule the activities

19EHS375: BUSINESS ETHICS AND CORPORATE GOVERNANCE

L	T	P	C
2	1	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: **7L**

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:

After completion 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: **9L**

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:

After completion 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: **8L**

Fairness in the workplace: Discrimination; harassment; working conditions - HSE, privacy, work-life balance; whistle blowing.

Learning Outcomes:

After completion 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: **8L**

Marketingand Ethics: Unethical issues in product, pricing and advertising; issues due to globalization.

Learning Outcomes:

After completion 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: **8L**

Corporate Governance: Stakeholder theory; role of Board; Conflict of Interest, Insider Trading; Corporate Lobbying.

Learning Outcomes:

After completion 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.

Text Book(s):

3. Richard T. DeGeorge, "Business Ethics", 7thEd., Pearson, New Delhi, 2011
4. Andrew Crane and Dirk Matten., Business Ethics. Oxford Publication, New Delhi: 2007.

References:

1. M.G. Velasquez, Business Ethics, Prentice Hall India Limited, New Delhi: 2007.
2. R.C. Sekhar., Ethical Choices in Business, Response Books, New Delhi: 2007.
3. Manikutty, S., "Being Ethical – Ethics as the foundation of Business", Random House India, Noida, 2011

Course Outcomes:

After completion of this 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).

19EME346: PROJECT MANAGEMENT& OPTIMIZATION

L	T	P	C
2	1	0	3

*This course provides an in-depth insight into the concepts, principles, formulation of projects and network techniques of project management, The appraisal techniques to evaluate the projects which could be successfully used for improving the quality of managerial decisions. The students will study this course with a generalist approach***.**

Course Objectives:

- To introduce to the basic processes of project management for instructional design projects.
- To introduce the organizational issues, methods of planning, and techniques for managing the business and creative processes that determine the success of a project.
- To learn to use project management software for organizing, scheduling and monitoring project progress.

Unit I: 8L

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 completion of this unit, the student will be able to

- understand the role of Project Management in instructional technology and project development (L2).
- applytheoretical aspects and approaches to managing technology based projects (L3).
- comprehend the importance of Social cost benefit analysis (L2).
- interpret the usage of Social cost benefit analysis, UNIDO approach (L2).

Unit II: 10L

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 completion of this unit, the student will be able to

- identify major stakeholders and organizational dynamics in a projects life cycle (L1).
- identify potential factors that impact successful project management including scope creep, budgeting, team dynamics and working with overseas development vendors (L1).
- apply knowledge and skills to create a formal project planning document (L3).

Unit III: 8L
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 completion of 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 (L6).

Unit IV: 8L

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 completion of this unit, the student will be able to

- apply theoretical aspects and approaches to managing technology based projects in network problems (L3).
- explores linear programming problems and uses them in real time environments (L6).

Unit V: 8L

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 completion of this unit, the student will be able to

- identify the technical requirements of project management using MS Project (L1).
- create and manipulate a projects specifics using Microsoft Project (L6).
- apply knowledge and skills to create a formal scheduling project (L3).

Text book(s):

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:

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

- explain the project management principles and philosophy (L2).

- understand the project environment through feasibility study (L2).
- familiarize to identify the investment opportunities and to formulate the projects. (L1).
- discuss the development of project network-Time Estimation (L1).
- outline the operation of projects under resource constrained environment and closing the projects (L4).

GSS115: GANDHI FOR THE 21ST CENTURY

The course will provide an overall understanding of Gandhi's life, his political contributions, and his basic philosophical thoughts. It also discusses how Gandhi influenced the entire world to think about non-violent resistance as a political strategy to bring and establish world peace.

Objectives

The major Objectives of the Course are;

- To provide the basic knowledge of Gandhi's life, thought and works
- To analyse the political contributions of Gandhi towards India's independence
- To examine the significance of Gandhian principles in the contemporary scenario
- To educate the students about the necessity of world peace and sustainable development
- To provide understanding about the life of eminent world leaders who were influenced by Gandhi

Learning Outcomes

After finishing the course, the students will be able to

- Understand the life and works of Gandhi
- Understand and appreciate the political contributions of Gandhi
- Analyse the contemporary issues and connect it with Gandhian solutions
- Analyse the issues related to world peace and to think about possible alternatives
- Understand and appreciate the role of eminent world leaders towards non-violent social and political transformation.

Unit-I: Introduction to the course: Gandhi's Early Childhood-Beginning of Satyagraha in South Africa-Entry to Indian Politics-Major Movements

Unit-II: Gandhi's Political Philosophy: Eleven Vows and their significance, Gandhi's Constructive Programmes and their significance, *Sarvodaya* and *Satyagraha*

Unit-III: Gandhian Way of Management: Management lessons from Gandhi, his views on education and its significance, Gandhian Economics and Sustainability

Unit-IV: Gandhi and his contemporaries-Gandhi and Tagore, Ambedkar, Subhash Chandra Bose, Muhammed Ali Jinnah, Gandhi Mandela, and Martin Luther King Jr.

Unit V: Gandhi and Ecology: Ideas from Hind Swaraj-Environmental movements and Gandhian environmentalism-World Peace and Gandhi-Conflict resolution and Gandhian principles.

Reference Books

Allen, Douglas. (2019). *Gandhi after 9/11: Creative Non-violence and Sustainability*. New Delhi: Oxford University Press.

Chandra, B. (2009). *History of Modern India*. New Delhi: Orient Blackswan.

Gandhi, M K. (1941). *Constructive Programme*. Ahmadabad: Navjivan Publishing House

Gandhi, M. K. (1948). *The Story of My Experiments with Truth*. Ahmadabad: Navjivan Publishing House.

Gandhi, M K. (1968). *Satyagraha in South Africa*. Ahmadabad: Navjivan Publishing House.

Hardiman, David. (2004). *Gandhi in His Times and Ours: The Global Legacy of His Ideas.* New York: Columbia University Press.

Journals

Gandhimarg, Gandhi Peace Foundation, New Delhi.

GITAM Journal of Gandhian Studies, GITAM University, Visakhapatnam.

19EEC391: COMPREHENSIVE SKILL DEVELOPMENT IV

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 **- 3 Hours per week**

A. Verbal and Soft Skills:

Unit	Module/ 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**

Unit	Module/ Topics	Hrs
1.	Arithmetic	9
2.	Geometry	2
3.	Mensuration	2
4.	Puzzles	2
	Total	15

B. Quantitative Aptitude and Reasoning

Unit	Module/ Topics	Hrs
1.	Combinatorics [i. Permutations & Combinations, ii. Probability]	3
2.	Cryptarithmetic & Modular Arithmetic [i. Cryptarithmetic, ii. Application of base system (7, 24) Clocks (Base 24) Calendars (Base 7)]	3
3.	Mental Ability [i. Number series ii. Letter series & Alpha numeric series iii. Analogies (Numbers, letters) iv. Classifications]	4
4.	Algebra [i. Exponents, ii. Logarithms, iii. Problems related to Equations, iv. Special Equations, v. Statistics]	5
	Total	15

Part-2 **- 3 Hours per week**

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

Scheme of Evaluation

Internal Assessments by Assignments, Quizzes (multiple Choice questions). All the Students are expected to do at least 5 problems in each topic and they should submit the content written by them in each topic for final evaluation.

Type of Assessment	No.of Marks
At least 5 problems in each topic	15
Assignments	15
Content writing	10
Quizzes	10
Total	**50**

Late Work

Each homework is due in the beginning of the class meeting (that is, at 6:00pm) on the due date. If homework is submitted within seven days after this deadline, the grade will be reduced by 50%. Submission more than seven days after the deadline will not be accepted. If you have a serious reason for requesting an extension, such as illness or family emergency, you should discuss it with one of the instructors as soon as the problem arises, and definitely before the submission deadline.

References:-

The course does *not* have a required textbook. You may optionally use the following textbook and URLs to look up standard algorithms:

1. Data Structures and Algorithms made easy by Narasimha Karumanchi
2. Data Structure and Algorithmic Thinking with Python by Narasimha Karumanchi
3. Algorithm Design Techniques: Recursion, Backtracking, Greedy, Divide and Conquer and Dynamic Programming by Narasimha Karumanchi
4. Coding Interview Questions by Narasimha Karumanchi
5. Competitive Programming in Python- 128 Algorithms to develop your Coding Skills by Cristhop Durr & Jill-Jen Vie.
6. Guide to Competitive Programming: Learning and Improving Algorithms Through Contests (Undergraduate Topics in Computer Science) *by* Antti Laaksonen
7. https://www.geeksforgeeks.org/competitive-programming-a-complete-guide/
8. https://www.codechef.com/certification/data-structures-and-algorithms/prepare
9. https://codeforces.com/
10. https://leetcode.com/

19EEC332: MICROPROCESSORS AND MICROCONTROLLERS

L	T	P	C
3	0	3	4.5

Electronic gadgets became part and parcel of a common man these days. Microcontroller is an essential heart of any electronic gadget. It is the device which is responsible for the operation the gadget whatever may be the application of use. Microprocessor is that component which drives the microcontroller. Essential features of the microprocessor as well as the microcontroller are introduced in this course. Interfacing this controller with many a number of peripherals is also treated elaborately.

Course Objectives:

- To familiarize the concepts and architecture of 16 bit microprocessor 8086.
- To explain assembly language programming of 8086 microprocessor.
- To demonstrate the architecture, instruction set and programming of 8051 microcontroller.
- To impart the knowledge of C programming to interface various peripherals like data converters, timers, serial port etc.
- To demonstrate microcontroller based embedded system.

Unit I: **17L**

The Processor 8086: Register organization of 8086, architecture of 8086, signal description of 8086, physical memory organization, I/O addressing capability.

Learning Outcomes:

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

- illustrate the architecture of 8086 (L2).
- summarize how memory of 8086 is addressed using segmentation (L2).
- explain physical memory organization of 8086 (L2).

Unit II: **8L+6P**

Instruction Set and Interrupts: Addressing modes of 8086, instruction set of 8086, assembly language programs (example programs), interrupts and interrupt service routines, interrupt cycle of 8086, non-maskable interrupt, maskable interrupt (INTR).

Learning Outcomes:

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

- interpret the addressing modes of 8086 (L2).
- develop various assembly language programs of 8086 (L3).
- illustrate the interrupt cycle of 8086 (L2).

Unit III: **7L+9P**

Introduction to Microcontroller 8051: Intel family of 8 bit microcontrollers, architecture, signal description, register set of 8051, important operational features of 8051, program status word (PSW).

Learning Outcomes:

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

- distinguish microprocessor and microcontroller (L3).
- demonstrate the architecture of 8051(L2).
- illustrate the register set and operational features of 8051 (L3).

Unit IV: **7L+6P**

Programming 8051 Timers and Serial Port: Basic registers of timer, modes of operation, programming timers in C (examples), Basics of serial communication, baud rate in 8051, SBUF, SCON, serial port programming in C (examples).

Learning Outcomes:
After completion of this unit, the student will be able to
- describe various modes of operations of 8051 timers (L2).
- develop programs of 8051 timers in C to generate time delays (L3).
- instill techniques to program 8051 serial port in C (L3).

Unit V: **7L+6P**
Interfacing of Peripherals to 8051: ADC 0808/0809 chip with 8 analog channels, programming ADC 0808/0809 in C, DAC interfacing DAC 0808, programming DAC in C.
Introduction to ARM Processor: The ARM family history, ARM family variations.

Learning Outcomes:
After completion of this unit, the student will be able to
- assess how to interface ADC and DAC to 8051 (L5).
- develop programs to interface ADC and DAC of 8051 in C (L3).
- distinguish between microcontroller and ARM processor (L4).

List of Experiments:
Experiments with Microprocessor 8086 using Assembler:
1. Arithmetic operations on 8 bit and 16 bit operands.
2. Transfer block of data from one memory location to another memory location.
3. Programs using monitor routines.
4. Compute maximum, minimum and sorting (ascending and descending).
5. Generate Fibonacci series, average of N numbers and factorial of N.

Experiments for Microcontroller 8051 using Keil-C51:
6. Arithmetic operations on 8051.
7. Transfer given string serially with suitable baud rate.
8. Generation of waveforms using timers of 8051.
9. Interface DAC with 8051 to generate waveforms.
10. Interface ADC with 8051 to read analog data and display read data.

Real Time Applications:
11. Interface traffic lights using microcontroller 8051.
12. Interface stepper motor using microcontroller 8051.

Text Books:

1. AK Ray, KM Bhurchandi, Advanced Microprocessors and Peripherals, 2/e,Tata McGraw Hill Publications, 2009.
2. Muhammad Ali Mazidi, Janice Gillispie, Mazidi, Rolin D. Mc Kinlay, The 8051 Microcontroller and Embedded Systems using Assembly and C, Second Edition, Person Education, 2002.
3. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, Janice Mazidi, ARM Assembly Language Programming &Architecture (ARM books) (Volume 1)

References:

1. Barry B. Brey, The Intel Microprocessors: Architecture, Programming and Interfacing, 8/e, Pearson Education, 2008.
2. Kenneth J. Ayala, 8086 Micro Processor: Programming and Interfacing the PC, 1/e, Delmar Cengage Learning, 2007.

3. Douglas V Hall, Microprocessors and Interfacing: Programming and Hardware, 2/e, Tata Mc Graw Hill, 2006.

Course Outcomes

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

- summarize the concepts of architecture, instruction set and addressing modes of 8086 microprocessor (L2).
- develop programs of 8086 microprocessor to perform various tasks and verify the programs with 8086 kits (L3).
- differentiate between microprocessor and microcontroller and understand the basics of 8051 microcontroller and perform experiments with microcontroller 8051 using Keil-C51 (L4).
- interpret the interfacing of microcontroller with different peripheral devices such as timers, serial port, ADC and DAC etc. and verifying it practically using trainer kits (L3).
- identify the architectural highlights of ARM processors (L4).

19EEC334: INTRODUCTION TO VLSI DESIGN

L	T	P	C
3	1	3	5.5

VLSI Design allows large number of electronic circuits to be integrated in a single small chip resulting in high speed of operation and low power dissipation. This has dramatically improved the evolution of telecommunication systems and electronic appliances. This course introduces the student to the two popular VLSI design methodologies including FPGA design and full custom IC design. FPGAs are used in the design of low-volume digital integrated circuits with reconfigurability and less design time. Full custom methodology allows high-volume design of integrated circuits with low area, high speed and ultra low-power dissipation. Further, students will be exposed to industry-standard FPGA boards and IC design tools.

Course Objectives:

- To introduce the design flow of integrated circuits using hardware description languages and programmable logic devices.
- To explain the architecture and usage of different types of programmable logic devices including PLAs, PLDs, CPLDs and FPGAs.
- To describe semiconductor technology evolution, the different steps of IC fabrication process and appreciate the role of mask layout in the design process.
- To provide an understanding of the constraints imposed by fabrication engineer and learn to prepare mask layouts as per design rules.
- To comprehend the design of combinational and sequential circuits from MOS schematic to layout.

Unit I: **20L**

Computer Aided Design: Hardware description languages, Verilog description of combinational circuits, Verilog modules, Verilog assignments, procedural assignments, modeling flip-flops using always block, delays in Verilog, compilation, simulation, and synthesis of Verilog code, Verilog data types and operators, simple synthesis examples, Verilog models for multiplexers, modeling registers, counters and finite state machines using Verilog always statements, behavioral and structural Verilog, testing a Verilog model.

Learning Outcomes:

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

- describe the design flow of integrated circuits using different VLSI design methodologies (L2).
- familiarize the role of hardware description languages in IC design flow (L2).
- explain the different Verilog operators, assignment statements and simulation semantics (L2).
- model common combinational and sequential building blocks using Verilog HDL at various abstraction levelsandmodel testbenches for verifying a design unit in Verilog (L3).
- distinguish between simulation and synthesis (L4).

Unit II: **14L**

Programmable Logic Devices: Simple programmable logic devices (SPLDs), Complex programmable logic devices (CPLDs), Field programmable gate arrays (FPGAs), implementing functions in FPGAs.

Learning Outcomes:

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

- classify different programmable logic devices based on their density, architecture and cost (L3).
- explain the internal architecture of FPGAs and their internal technological advancements (L2).

- employ different FPGA programming technologies (L3).
- list the capabilities of programmable IO blocks in FPGA(L1).
- analyze the implementation of combinational and sequential blocks in FPGA (L4).

Unit III: **11L**

IC Design Technology: Integrated Circuit (IC) era, Metal Oxide Semiconductor (MOS) and related VLSI technology, basic MOS transistors, enhancement mode transistor action, NMOS fabrication, CMOS fabrication, comparison of NMOS, CMOS, BICMOS, GaAs technologies. **Basic Electrical Properties of MOS Circuits:** Drain current vs drain-source voltage relationships, MOS transistor threshold voltage, pass transistor, NMOS inverter, CMOS inverter.

Learning Outcomes:

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

- define Moore's law (L1).
- compare NMOS, CMOS, GaAs and BiCMOS technologies in terms of speed, cost, area and power dissipation (L3).
- describe the different steps of NMOS and CMOS fabrication process and appreciate the role of mask layouts (L2).
- explain the operating regions of MOSFET for different values of Vgs and Vds (L2).
- draw the circuit diagram and explain the operation of NMOS and CMOS inverters (L3).

Unit IV: **11L**

MOS Circuit Design Process: MOS Layers, stick diagrams, design rules and layout, 2µm micron based design rules, layout diagrams, symbolic diagrams. **Scaling of MOS Circuits:** Scaling models and scaling factors, scaling factors for device parameters, limits of scaling.

Learning Outcomes:

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

- tabulate the different MOS layers available for circuit designer and their design rules (L1).
- identify different layers required to prepare the mask layout of a circuit and compose a stick diagram (L2).
- list the lambda based minimum width and minimum separation rules for different MOS layers (L1).
- distinguish between lambda based and micron based design rules and identify their relative advantages (L4).
- analyze the effect of scaling on different MOS device parameters (L4).

Unit V **17L**

Subsystem Design and Layout: Some architectural issues, switch logic, gate (restoring) logic, examples of structured design, parity generator, multiplexers, general logic function block. **Clocked sequential circuits**: Two phase clocking, charge storage, dynamic register element, dynamic shift register.

Learning Outcomes:

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

- explain the architectural issues in the design of integrated circuits at subsystem level (L2).
- design static complementary CMOS and pass transistor based combinational gates and blocks (L5).
- describe the notion of two phase clocking and charge storage mechanism in dynamic registers (L1).
- distinguish between static and dynamic logic gates (L4).
- design sequential building blocks (Flip Flops, shift registers) using static and dynamic logic gates (L5).

List of Experiments:

1. Verilog modeling, simulation and FPGA implementation of combinational logic circuits: basic gates, multiplexer, comparator, adder/substractor.
2. Verilog modeling, simulation and FPGA implementation of combinational building blocks: Multipliers,

decoders, address decoders, parity generator, ALU.

3. Verilog modeling, simulation and FPGA implementation of sequential logic circuits: D-Latch, D-Flip flop, JK-Flip flop, registers.
4. Verilog modeling, simulation and FPGA implementation of sequential building blocks: Ripple counters, synchronous counters, shift registers (serial-to-parallel, parallel-to-serial)
5. Verilog modeling, simulation and FPGA implementation of finite state machines: Mealy state machine, Moore state machine,
6. Digital system design examples: GCD processor example, arithmetic multiplier.
7. Full custom IC design flow: Schematic, symbol, simulation, layout, Design Rule Checking (DRC), layout vs. schematic (LVS), RC Extraction (RCX) and post layout simulation of CMOS inverter, NAND gate, 1-bit full adder & D-flip flop.

Text Books:

2. Charles H. Roth, Lizy Kurian John, Byeong Kil Lee, Digital Systems Design using Verilog, 1/e, Cengage Learning, 2016.
3. Douglas A, Pucknell, Kamran Eshraghian, Essentials of VLSI Circuits and Systems, 1/e, Prentice Hall, 2012.

References:

4. Kang, Leblibici, CMOS Digital Integrated Circuits, 3/e, Tata McGraw Hill, 2001.
5. Jan M. Rabaey, Digital Integrated Circuits, 2/e, Pearson Education, 2002.
6. Jackson, Hodges, Analysis and Design of Digital Integrated Circuits, 3/e, Tata McGraw Hill, 2010.
7. Gary S May, Simon M Sze, Fundamentals of Semiconductor Fabrication, 1/e, Wiley, 2004.

Course Outcomes:

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

- model combinational/sequential logic circuits and their testbenches at different levels of abstraction in Verilog (L3).
- describe and compare the architectures of different programmable logic devices (L2).
- explain the evolution of IC technology and its fabrication process (L1).
- derive the stick diagram and mask layout for a given MOS circuit (L5).
- build combination and sequential building blocks at the subsystem level using different MOS circuit styles (L5).

19EEC342: WIRELESS COMMUNICATION NETWORKS

L	T	P	C
2	0	2	3

Any sort of communication i.e., data or voice or video is wireless these days. Internet of Things (IoT) basically is dependent on wireless networks. Thus, networking is also to be wireless for ease of operation and compatibility. Networking may be limited to very small space or extending across continents. All possible networking systems and their architecture are introduced in this course. The evolution of cellular communication networks starting from 1G to 4G (LTE and LTE advanced) is also elaborated.

Course Objectives:

- To understand wireless LAN Technology.
- To study the Internet of Things and Bluetooth technology.
- To familiarize the principles of cellular networks and evolution of cellular networks.
- To explore the advancements in 4G LTE and LTE Advanced.
- To describe the mobile applications and mobile IP.

Unit I **8L**

Wireless LAN Technology: IEEE 802 architecture, IEEE 802.11 architecture and services, IEEE 802.11 medium access control, IEEE 802.11 physical layer, gigabit Wi-Fi, other IEEE standards, IEEE 802.11 wireless LAN security.

Learning Outcomes:

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

- identify the IEEE 802.11 architecture and services (L1).
- explain the IEEE 802.11 medium access control (L2).
- analyze theIEEE802.11 physical layer characteristics (L4).
- differentiate the Wi-Fi, gigabit Wi-Fi (L4).
- adapt other IEEE standards, IEEE802.11 wireless LAN security (L5).

Unit II: **8L**

Bluetooth and IEEE 802.15: The Internet of Things, Bluetooth motivation and overview, Bluetooth Specifications, Bluetooth high speed and Bluetooth smart, IEEE 802.15, ZigBee 402.

Learning Outcomes:

After completion of this unit the student will be able to

- understand the Internet of Things (L2).
- identify the Bluetooth motivation and overview, Bluetooth specifications (L1).
- demonstrate the Bluetooth high speed and Bluetooth smart (L3).
- illustrate about IEEE 802.15, ZigBee 402 (L3).

Unit III: **8L**

Cellular Wireless Networks: Principles of cellular networks, first-generation analog, second-generation TDMA, second-generation CDMA, third-generation systems.

Learning Outcomes:

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

- explain the principles of cellular networks (L2).

- describe the first-generation analog (L2).
- demonstrate second-generation TDMA (L3).
- understand the third-generation systems and differentiate 1G, 2G, and third generation systems (L2 & L3).

Unit IV: **10L**

Fourth Generation Systems and LTE-Advanced: Purpose, motivation, and approach to 4G, LTE architecture, evolved packet core, LTE resource management, LTE channel structure and protocols, LTE radio access network, LTE Advanced.

Learning Outcomes:

After completion of this unit the student will be able to

- understand the purpose, motivation, and approach to 4G (L2).
- illustrate the LTE architecture, evolved packet core (L3).
- explain the LTE resource management (L3).
- demonstrate LTE channel structure and protocols (L3).
- distinguish between LTE radio access network, LTE-Advanced (L4).

Unit V: **8L**

Mobile Applications and Mobile IP: Mobile application platforms, mobile app development, mobile application deployment, mobile IP.

Learning Outcomes:

After completion of this unit the student will be able to

- understand the mobile application platforms (L2).
- develop the Mobile App (L3).
- explain the LTE resource management (L2).
- propose a mobile application deployment, mobile IP (L5).

Text Book:

1. Cory Beard, William Stallings, Wireless Communication Networks and Systems, Pearson Education, 2016.

References:

1. William Stallings, Wireless Communication and Networking, 2/e, Pearson Education, 2005.
2. Theodore S. Rappaport, Wireless Communications, Principles and Practice, 2/e, Prentice Hall of India, 2002
3. Kaveh Pahlaven, P. Krishna Murthy, Principles of Wireless Networks, 1/e, Pearson Education, 2002.
4. Kamilo Feher, Wireless Digital Communications, 1/e, Prentice Hall of India, 1999

Course Outcomes:

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

- describe about the different WLAN technologies (L2).
- explain the concepts of Internet of Things and Bluetooth (L2).
- illustrate about IEEE 802.15, ZigBee 402 (L3).
- explain the principles of cellular networks and its evolution(L2).
- demonstrate the motivation towards 4G, LTE architecture resource management and protocols (L3).
- distinguish between LTE radio access network, LTE advanced (L4).
- understand the mobile application platforms and design mobile app (L2).

19EEC344: REAL TIME SIGNAL PROCESSING

L	T	P	C
2	0	2	3

Unit I **(9L)**

Input and output with DSK: Introduction, sampling, reconstruction aliasing, programming examples using C code, basic input and output using polling, basic input and output using interrupts, modifying programme to create delay and echo,
Real time sine wave generation: sine wave generation using sin() function call, sine wave generation with table created by Matlab,signal Reconstruction, Aliasing and properties of the AIC23 codec, AM generation, ramp generation.

Unit II **(8L)**
Architecture and Instruction set of the C6x Processor:introduction,TMS320 6x architecture, Linear and Circular Addressing Mode, types of Instruction, Assembler Directives, timers, interrupts, interrupt control registers, multi channel buffer serial port, memory considerations, fixed and floating point format, constraints, programming examples using C, Assembly and Linear assembly.sum of n+(n-1)+(n-2)+.....+1 using C calling an Assembly function, factorial of a number using C calling an Assembly function.
Unit III
Finite Impulse Response Filters: **(8L)**
Introduction to Z transform, mapping from 'S' plane to 'Z' plane, difference equation, discrete signal, FIR filter, FIR implementation using Fourier series, FIR implementation using window(rectangular, Hanning, Hamming, Blackman),moving average Filter.FIR Filter design using MATLAB.
Unit IV **(8L)**
Infinite Impulse Response Filters: Introduction, IIR filter structure: Direct Form-I, II, parallel and cascade form, Bilinear transformation, impulse invariance method, IIR filter design using MATLAB.
Unit V **(8L)**
Fast Fourier Transform : Introduction, development of FFT algorithm with Radix-2,Decimation in time FFT algorithm with Radix-2.Decimation in frequency FFT algorithm with radix-2 algorithm, Inverse Fast Fourier transform using DIT and DIF algorithm.DFT of a sequence of real number with output in CCS graphics display window(dft

Text Books:
1. Rulph Chassaing, Digital Signal Processing with C6713 and C6416 DSK, 2/e Wiley Publications, 2005
2. DSP processor fundamentals, Archtecture & Features-Lapsley et al. S. Chand & Co.2000

References:
1. Sanjay K. Mitra, Digital Signal Processing- A Computer Based Approach, 4/e, Tata Mc Graw Hill Publications, 2011.

19EEC346: DSP DESIGN WITH FPGAs

L	T	P	C
2	0	2	3

Traditional analog signal processing systems are continuously being replaced by digital signal processing counterparts due to their low area, high accuracy, high flexibility, high speed and low power of operation. High performance DSP systems are implemented in FPGA systems (instead of programmable DSP processors) due to their high speed, low power operation and design specific reconfiguratbility. This course introduces the student to FPGA Architectures and implementation of digital signal processing algorithms on FPGAs.

Course Objectives:

- To introduce data path subsystem design and illustrate their applications in implementing DSP algorithms.
- To explain the computer arithmetic involved in implementation of DSP algorithms.
- To familiarize with FIR and IIR filter designs and implementations.
- To illustrate the importance of FFT for Fourier transform computation.

Unit I: **9L**

Overview of Digital Signal Processing (DSP), FPGA technology, DSP technology requirements, design implementation.

Learning Outcomes:

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

- illustrate the importance of FPGA technology (L1).
- summarize the importance of DSP technology and its requirements (L2).
- describe the implementation of DSP algorithms and design implementation (L2).

Unit II: **8L**

Computer Arithmetic: Number representation, binary adders, binary multipliers, fixed point arithmetic implementation, floating point arithmetic implementation, CORDIC.

Learning Outcomes:

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

- understand fixed point and floating-point number representations and their formats (L1).
- analyze and design data-path subsystems, like adders and multipliers (L4)
- design fixed point and floating point arithmetic implementations of data path subsystems (L5).
- interpret CORDIC algorithms and their operating modes (L3).

Unit III **8L**

FIR Digital Filters: Digital filters, FIR theory, designing FIR Filters, constant coefficient FIR design, direct FIR design, FIR filter with transposed structure, IP core FIR filter design.

Learning Outcomes:

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

- explain the design of FIR filters (L2).

- understand the performance of FPGA implementations of FIR filters (L1).
- implement various digital filter architectures in MATLAB or any ECAD tool (L4).
- explain FIR filter architectures and discriminate their performance characteristics from IIR filters (L5).

Unit IV: **9L**
IIR Digital Filters: IIR theory, IIR coefficient computation, IIR filters implementation.

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

- explain the design of IIR filters (L2).
- illustrate the performance of FPGA implementations of IIR filters (L3).
- implement IIR digital filter architectures in MATLAB or any ECAD tool (L4).
- explain IIR filter architectures and discriminate their performance characteristics from FIR filters (L5).

Unit V: **8L**
Fourier Transforms: DFT algorithms: Fourier Transform Approximations using the DFT, Properties of the DFT, FFT algorithms: Cooley-Tukey FFT algorithm.

Learning Outcomes

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

- understand the importance of DFT and FFT(L1).
- explain about FFT algorithms (L2).
- implement FFT algorithms on FPGA and their characterization (L3).

Text Book:

1. Uwe Meyer-Baese, Digital Signal Processing with Field Programmable Gate Arrays, Fourth Edition, Springer Publications, 2014

References:

1. Roger Woods, John McAllister, Dr. Ying Yi, FPGA-based Implementation of Signal Processing Systems, Wiley Publications, 2011.
2. Shoab Ahmed Khan, Digital Design of Signal Processing Systems, Wiley Publications, 2011.
3. Keshab Parhi, VLSI Digital Signal Processing, Wiley Student Edition, 2010

Course Outcomes:

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

- explain about the computer arithmetic used for DSP implementation on FPGA (L2).
- demonstrate the digital filter designs on FPGA (L1)
- implement FFT algorithms on FPGA (L3).
- develop FPGA prototypes for DSP algorithms, for speech and image processing applications (L5).
- design and develop innovative techniques for realizing DSP algorithms (L5).

19EEC348: MICROWAVE ENGINEERING

L	T	P	C
2	0	2	3

Microwave frequencies are extensively used in domestic, telecommunications, commercial, industrial, defense, aeronautical fields. Generation of microwave energy at various frequency bands and at various power levels is the basic requirement of the usage of these frequencies. Such generation techniques are elaborated in this course. Measurement techniques of all parameters of microwaves which are vital at designing or analyzing a system are essentially enumerated in this course.

Course Objectives:

- To understand the concept of negative resistance devices used for amplification at microwave frequencies.
- To study and analyze the active devices commonly used in microwaves subsystems.
- To explain the operation of various sources i.e, reflex Klystron, two cavity Klystron amplifier, traveling wave tube and Magnetron with apple gate diagram and their comparisons and applications in practical life.
- To study the measurement of different microwave parameters like impedance, frequency, wavelength, guided wavelength, VSWR etc at gigahertz frequencies using the microwave bench setup.

Unit I: **8L**

Transferred Electron Devices: Introduction, GUNN effect diodes (GaAs diode), GUNN diode principle of operation (RWH theory).

Avalanche Transit Time Devices: Introduction, Operation of IMPATT Diode, Operation of TRAPATT diode, parametric amplifiers, applications.

Learning Outcomes:

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

- identify the negative resistance devices used for amplification at microwave frequencies (L4).
- understand the operation of IMPATT, TRAPATT and Gunn diode at microwave frequencies (L2).
- describe the reactance properties and power relations of parametric devices (L2).

Unit II: **8L**

Microwave Linear Beam Tubes: High frequency limitations of conventional tubes, Klystrons, reentrant cavities, velocity modulation process, bunching process, reflex Klystron, velocity modulation, power output and efficiency.

Learning Outcomes:

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

- describe the different types of microwave sources and the limitations of conventional tubes at higher frequencies (L2).
- describe the operation of Klystrons based on Apple gate diagram (L2).
- analyze the performance parameters of Klystron and reflex Klystron (L4).

Unit III: **8L**

Helix Traveling Wave guides: Slow wave structures, amplification process, convection current, axial electric field, wave modes, gain considerations.

Learning Outcomes:

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

- describe the need of slow wave structure in TWT (L1).
- explain the difference in operation between Klystron and TWT (L2).
- analyze parameters like gain of TWT (L4).

Unit IV: **8L**

Microwave Crossed Field Tubes: Magnetron oscillator types, principle of operation of cylindrical magnetron, equations of electron motion, cyclotron angular frequency, pi mode separation.

Learning Outcomes:

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

- classify M-type tubes (L3).
- describe the operation of magnetron and the need of strapping (L2).
- apply the concept of strapping in order to avoid mode jumping (L3).

Unit V: **10L**

Microwave Measurements: Introduction, microwave bench measurement setup, frequency and wavelength measurements, measurement of power, VSWR, impedance, coupling factor, directivity, isolation of a directional coupler.

Learning Outcomes:

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

- describe the operation of microwave bench setup (L2).
- explain the measurement various parameters using the microwave bench setup (L2).
- interpret the power flow in various microwave components of the microwave bench setup (L2).

Text Books:

1. Samuel Y. Liao, Microwave Devices and Circuits, 3/e, Prentice Hall of India, 2003.
2. Sushrut Das, Microwave Engineering, 1/e, Oxford University Press, 2015.

References:

1. R.E. Collins, Foundations for Microwave Engineering, 2 /e, John Wiley & Sons, 2009.
2. Gottapu Sasibhushana Rao, Microwave and Radar Engineering, 1/e, Pearson Education, 2014.
3. M Kulkarni, Microwave and Radar Engineering, 1/e, Pearson Education, 2014.

Course Outcomes

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

- explain the principle of operation of Gunn diode (L2).
- sketch the physical structure and explain the operation of IMPATT, TRAPATT diodes (L3).
- describe the reactance properties and power relations of parametric devices (L1).
- recognize the limitations of existing vacuum tubes and solid state devices at microwave frequencies (L1).
- evaluate the performance of specialized microwave tubes such as Klystron, reflex Klystron, Magnetron and traveling wave tube (L6).
- conduct experiments for measuring frequency, wavelength, power, VSWR, impedance of microwave circuits (L3).

19EEC350: ARM SYSTEM DEVELOPMENT

L	T	P	C
2	0	2	3

The emphasis of this course is to familiarize with the advanced 32-bit ARM microcontroller architecture, programming and develop applications. This course provides the knowledge of LPC2148 microcontroller architecture and pipelining concept used in it. Programming of LPC 2148 with polling and interrupt methods are emphasized. The students are exposed to the interfacing external peripheral devices.

Course Objectives:

- To provide a clear understanding on the RISC and CISC and ARM philosophy.
- To program ARM 32 microcontroller in assembly language.
- To familiarize the pipelining concept used in advanced microcontrollers.
- Todescribe the conceptsof peripheral interfacing with ARM microcontroller.
- To introduce programming with embedded C.

Unit I: 8L

Introduction to ARM 7 Architecture: The RISC design philosophy, ARM design philosophy, embedded system hardware- AMBA bus protocol, embedded system software- applications. ARM core data flow model, Registers, CPSR-Processor modes.

Learning Outcomes:

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

- compare the RISC vs CISC philosophy (L2).
- explain the ARM data flow model(L2).
- demonstrate organization of registers(L3).
- outline AMBA bus protocol(L2).

Unit II: 8L

ARM Instructions Set: Fundamentals of ARM instructions, Barrel shifter, Classification and explanation ofinstructions with examples-Data processing, Branch, Load-store, SWI and Program Status Register instruction,Introduction to THUMB, Differences between ARM and THUMB, Register usage in Thumb.

Learning Outcomes:

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

- demonstrate ARM instructions (L2).
- explain the use of Barrel shifter in instructions (L2).
- select the Instruction set of ARM or Thumb (L4).
- decide the suitable instructions (L4).

Unit III: 9L

Exception Handling: ARM processor exceptions and modes, vector table, exception priorities, link register offsets. Interrupts- assigning interrupts, interrupt latency, IRQ and FIQ exceptions with example- code for enabling and disabling IRQ and FIQ exceptions, Comparison between exception and interrupts. Interrupt handling schemes- nested interrupt handler, non-nested interrupt handler. Basic interrupt stack design

Learning Outcomes:

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

- understand vectored interrupts and non-vectored interrupts (L1.)
- select the exception or interrupt (L4).
- understand the interrupt handling mechanisms (L3).
- demonstrate interrupt latency (L4).

Unit IV: **9 L**

Introduction to ARM7 Microcontroller: LPC2148 ARM 7 microcontroller, Features of LPC2148, Architecture of LPC2148, addressing mode, Memory organization, ARM register model, programmer model, oscillator, PLL, CPSR, SPSR,3stage pipelining.

Learning Outcomes:

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

- understand the architecture of LPC2148 (L2).
- explain the Pin diagram of LPC2148 (L2).
- identify importance of PLL concept (L4).
- demonstrate ARM vs programmer model (L4).

Unit V: **8L**

Interfacing with ARM: LED,GPIO programming with embedded C, LCD interfacing, programming of LCD, ADC, Interfacing of LM35 temperature sensor, DAC, Timers,UART programming, transfer of a character and receive of a character program.

Learning Outcomes:

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

- develop LED interfacing and programming (L4).
- build LCD with LPC2148 (L5).
- build Analog sensor interfacing (L5).
- apply UART interfacing (L4).

Text Books:

1. Andrew N. SLOSS, ARM System Developer's guide, ELSEVIER Publications, 2016.
2. Steve Furber, ARM System-on-chip Architecture, Pearson Education, 2012.

References:

1. In Sider's Guide to Philips Arm7 Based Microcontroller, Shitex.co.uk.
2. ARM Assembly Language – William Hohl, CRC Press.

Course Outcomes:

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

- understand the ARM philosophy and ARM data flow model (L1).
- analyze and understand ARM instruction set and THUMB instruction set (L4).
- understand the exception, interrupts and interrupt handling schemes (L2).
- describe the architectural features of LPC2148 microcontrollers (L2).
- explain the hardware and interfacing peripheral devices to LPC2148 (L2).

19EEC352: RFID ENABLED SENSOR DESIGN AND APPLICATIONS

L	T	P	C
2	0	2	3

Radio-Frequency Identification (RFID) is technology that uses radio waves to transfer data from an electronic tag, called RFID tag or label. This technology is extensively used to automate security systems, payments (ex. Fastag), library management etc. This course introduces the operating principles of RFID technology, different sensors, components (antennas, circuits, and communications) and standards. Further different applications of this technology are also discussed.

Course Objectives:

- To understand the basic concepts of various automatic identification systems and focuses on RFID's potential in the wireless identification world.
- To explain the fundamentals and operating principles of RFID systems.
- To study fundamentals and operating principles of sensors and wireless sensor networks.
- To get acquainted with the design principles for RFID tags and RFID enabled sensors.
- To explore worldwide applications of the RFID enabled sensors.

Unit I: **9L**

Fundamentals and Operating Principles of RFID: Introduction, barcode systems, magnetic strip card, smart cards, RFID systems, history of RFID. RFID tag components, tag antenna, integrated circuits, substrate. RFID tag types, passive tags, active tags, the 1 bit transponder and chip less tags.

Learning Outcomes:

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

- distinguish between different barcode systems (L1).
- describe the magnetic strip card, smart cards (L5).
- understand the basic RFID tag components(L5).
- define passive tags, active tags (L1).
- analyze the 1-bit transponder and chip less tags (L4).

Unit II: **8L**

Communication Fundamentals in RFID Systems: Coupling mechanisms data encoding multipath effect tag reader and sensor communication passive systems active systems, UWB, Zigbee and Wi-Fi tags.

Learning Outcomes:

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

- understand the basics of communication fundamentals in RFID systems (L1).
- define coupling mechanisms-data encoding multipath effect (L2).
- distinguish between different passive systems active systems (L2).
- describe UWB, Zigbee and Wi-Fi tags (L2).

Unit III: **8L**

Fundamentals and Operating Principles of Sensors: Types of sensors, use of sensors, basic considerations of sensor design, requirements for accuracy, requirements for resolution, environment of the sensor, calibration, wireless sensors and wireless sensor networks.

Learning Outcomes:

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

- distinguish different types of sensors(L3).

- describe the use of sensors and basic considerations of sensor design (L3).
- understand requirements for accuracy, requirements for resolution (L4).
- analyze wireless sensors and wireless sensor networks (L5).

Unit IV **9L**

Design of RFID Enabled Sensors: RFID antenna design challenges, antenna basics and the dipole, passive RFID antennas using serial stubs, bowtie T-match RFID antenna, passive RFID antenna using inductively coupled feed structure, voltage multiplier for RFID integrated circuits, microcontroller for active RFID enabled sensor.

Learning Outcomes:

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

- explain RFID antenna design challenges (L2).
- analyze the passive RFID antennas using serial stubs, bowtie T-Match RFID antenna. (L4).
- distinguish between passive RFID antenna using inductively coupled feed structure, voltage multiplier for RFID integrated circuits (L4).
- develop the microcontroller for active RFID enabled sensor (L5).

Unit V: **8L**

RFID Applications: Short range RFID applications, access control transportation, ticketing, personnel identification, vehicle identification, production line monitoring, long range RFID applications, supply chain management, mail and shipping, clothing tags, food production control.

Learning Outcomes:

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

- distinguish various applications of RFIDs (L2).
- analyze short range RFID applications (L5).
- understand long range RFID applications (L5).

Text Books:

1. V. Daniel Hunt, Alber Puglia, Mike Puglia, RFID: A Guide for Radio Frequency Identification, Wiley & Sons, Inc., Publication, 2011
2. Amin Rida**,** Li Yang, Manos Tentzeris, RFID-Enabled Sensor Design and Applications, ARTECH House, 2010.

References:

1. Steven Shepard, "Radio Frequency Identification", McGraw Hill, 2011.

Course Outcomes:

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

- understand basic concepts of various automatic identification systems and RFID tag components (L1).
- analyze communication fundamentals in RFID systems (L2).
- understand the basic fundamentals and operating principles of sensors (L1).
- examine the design of RFID enabled sensors (L4).
- categorize RFID applications (L5).

19EEC362: FIBER OPTIC COMMUNICATIONS

L	T	P	C
2	0	2	3

Recent years have seen an exponential increase in demand for large bandwidth and high data rate applications. This is driven by rapid advances in the field of fiber optic communications. Anexhaustive understanding of optical fibers and fiber optic communications is necessary to communication engineers to address future needs of high data rate communications. This course introduces the student to optical fibers, optical sources and detectors, couplers and connecters,wave length division multiplexing, modulation techniques and applications of Fiber Optics.

Course Objectives

- To understand principle of light transmission in optical fibers.
- To introduce types of optical fiber and its channel impairments.
- To familiarize the optical sources, detectors, couplers and connectors.
- To introduce modulation techniques, types of noise and detection.
- To explain the design considerations of fiber optic communication systems.

Unit I 8L

Optic Fiber Waveguides: Introduction,Raytheory, Step – Index Fiber, Graded – Index Fiber, Attenuation, Pulse Distortion and Information Rate in Optic Fibers, Construction of Optic Fibers, Optic Fibers, Optic Fiber Cables.

Learning Outcomes

After completion of this unit, the student will be able to
- recall basic laws of optical physics (L1).
- distinguish between the various modes of operation of Optical fibers (L2).
- identify the various causes for signal degradation(L4).
- estimate the various types of losses occurring in transmission of energy(L5).

Unit II 8L

Light Sources and Detectors: Light-Emitting Diodes, Light-Emitting – Diodes Operating Characteristics, Laser Principles, Laser Diodes, Laser-Diode Operating Characteristics, Distributed – Feedback Laser Diode, Optical Amplifiers, Fiber Laser, Principles of Photo detection, Photomultiplier, Semiconductor Photodiode, PIN Photodiode, Avalanche Photodiode.

Learning Outcomes

After completion of this unit, the student will be able to
- categorize the types of sources of light on basis of physical construction and principle of operation (L2).
- describe the conversion of light energy to electrical energy (L1).
- classify the optical detectors on basis of ability to efficiently detect and hence convert electrical energy into light energy(L4).
- describe the various phenomenon involved in the conversion of electrical energy into light energy(L5).

Unit III 9L

Couplers and Connectors: Principles, Fiber end Preparation, Splices, Connectors, Source Coupling, Distribution Networks and Fiber Components, Distribution Networks, Directional Couplers, Star Couplers, Switches, Fiber Optical Isolator, Wavelength- Division Multiplexing.

Learning Outcomes

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

- identify the necessity for using couplers and connectors in energy transmission(L1).
- describe different types of couplers and their applications(L2).
- identify various practical problems faced while using couplers and connectors (L4).
- able to know how WDM accomplished (L3).

Unit IV **9L**

Modulation, Noise and Detection: Light-Emitting-Diode Modulation and Circuits, Laser-Diode Modulation and Circuits, Analog-Modulation Formats, Digital-Modulation Formats, Optic Heterodyne Receivers, Thermal and Shot Noise, Signal-to-Noise Ratio, Error Rates, Modal Noise, Amplifier Noise, Laser Noise, and Jitter, Additional Noise Contributors, receiver Circuit Design.

Learning Outcomes

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

- study of modulation circuits and formats(L1).
- explain the operation of optical receiver(L2).
- identify the various effects introducing noise in the system(L4).
- evaluate the performance of digital receiver by calculating the probability of error (L6).

Unit V **8L**

System Design and Fiber Optical Applications: Analog System Design, Digital System Design, Applications of Fiber Optics.

Learning Outcomes

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

- explain the use of analog and digital links(L2).
- design of analog and digital system(L4).
- describe the various criteria viz. power loss wavelength to be considered for point to point link in digital link system(L2).

Text Book(s):

1. Joseph. C. Palais, "Fiber Optic Communications", Pearson Education, Asia, 2002.
2. John Powers," Fiber Optic Systems" Irwin Publications, 1997.
3. Howes M.J., Morgan, D.V," Optical Fiber Communication", John Wiely.1992.
4. John M.Senior, "Optical Fiber Communication: Principles and Practice", Pearson Education, 2nd edition, 2006.

References:

1. Gerd Keiser, Optical Fiber Communications, 4/e, Tata McGrawHill, 2008.
2. S. C. Gupta, Text Book on Optical Fibre Communication and its Applications, Prentice Hall of India, 2005.

3. D. K. Mynbaev, Gupta, Scheiner, Fiber Optic Communications, Pearson Education, India, 2005.

Course Outcomes

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

- describe the advantages and applications of Fiber Optic Communications (L3).
- distinguish between the various modes of operation of Optical fibers (L2).
- identify the various causes for signal degradation due to losses, dispersion, polarization (L2).
- describe the optical detectors, couplers and connecters and theirapplications in Fiber optic communications(L4).
- illustrate the importance of Wavelength Division Multiplexing (L4).
- design analog and digital links(L6).

19EEC364: DIGITAL IMAGE PROCESSING

L	T	P	C
2	0	2	3

This course provides an introduction to the fundamental concepts and general principles of processing of images which are digital in nature. It covers the key stages of digital image processing techniques. This course finds wide range of real time applications like automatic number plate detection, biometric recognition, visual effects, 3D modeling, radar imaging, bio-medical imaging and other applications

Course Objectives

- To provide an understanding of the fundamentals of image processing and steps involved in digital image processing.
- To explain the importance of image transforms in extracting the information in an image.
- To describe image enhancement techniques in spatial and frequency domain.
- To introduce the image compression models for better bandwidth utilization, fast transmission and storage reduction.
- To explore image segmentation and image restoration techniques that helps in extracting object of interest or to procedures better quality image.

Unit I **8L**

Fundamentals of Image Processing: Image acquisition, image sampling and quantization, relationships between pixels

Histogram processing: Histogram equalization. Histogram specification.

Learning Outcomes

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

- list various application of image processing used in the real time. (L1).
- illustrate the basic concepts of digital Image Processing (L3).
- interpret the basic relationship between pixels (L1).
- construct histogram of image and enhance the image by using histogram specification/histogram equalization (L3).

Unit II **8L**

Image Transforms: 2-D DFT, properties, Walsh transform, Hadamard transform, discrete cosine transform, Haar transform, comparison of different transforms.

Learning Outcomes

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

- describe 2-D DFT and its properties(L2)
- explain the different types of image transforms (L2).
- apply appropriate transform to images as per application (L3).

Unit III **8L**

Image Enhancement: (by spatial domain methods) point processing, image smoothing and sharpening filters in spatial domain.

Image Enhancement: (by frequency domain methods) Image smoothing and image sharpening filters in frequency domain, Homomorphic filter, comparison of filters in frequency domain and spatial domain.

Learning Outcomes

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

- illustrate basic Image Enhancement techniques in both SPATIAL Domain Methods FREQUENCY Domain Methods (L4).
- choose image enhancement techniques suitable for an application (L4).
- estimate enhancement techniques and develop initial pre-processing task for any image processing application(L6).

Unit IV **8L**

Image Compression Fundamentals: Types of redundancy, Image compression model: lossy and lossless, Variable length coding, LZW coding, basics of image compression standards: JPEG, JPEG 2000.

Learning Outcomes

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

- explain fundamentals concepts of Image Compression (L2).
- describe various Image Compression techniques (L2).
- outline various Image Compression standards (L2).
- solve problems on image compression (L3).

Unit V **8L**

Image Segmentation: Thresholding, Region based segmentation, Edge linking.
Image Restoration: Estimation of degradation function, Restoration filters: Inverse filter, Wiener filter, Constraint least square filtering.

Learning Outcomes

After completion of this unit the student will be able to

- illustrate various Image Segmentation techniques and derive their mathematical formulations (L4).
- use appropriate method of image segmentation for an application (L3).
- illustrate various filtering techniques used in image restoration (L4).

Text Book(s):
2. R.C. Gonzalez, R.E. Woods, Digital Image processing, 3/e, Pearson Education, 2009.
References:
6. Anil K. Jain, Fundamentals of Digital Image processing, Prentice Hall of India, 1989.
7. Rafael C. Gonzalez, Richard E. Woods, Steven L., Digital Image Processing using MATLAB, Pearson Education, 2004.
8. William K. Pratt, Digital Image Processing, 3/e, John Wiley and Sons, 2004.
9. S. Jayaraman, S. Esakkirajan, T.Veerakumar, Digital Image Processing, Tata McGraw Hill, 2011.

Course Outcomes

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

- understand basics of digital image processing (L1).
- explain different algorithms involved in image enhancement, compression, segmentation and restoration (L2).
- apply various transforms on digital images (L3).
- apply image enhancement and compression methods to tackle any industry oriented problem domain with image processing techniques (L3).
- use segmentation and restoration techniques on various digital image processing problem domains (L3).

19EEC366: ASIC DESIGN

L	T	P	C
2	0	2	3

This course familiarizes the students with automation of different steps and algorithmsin digital IC design process including Verilog design entry, logic synthesis, simulation, test insertion, floor planning, placement and routing.

Course Objectives

- To introduce the different types of ASICs in terms of power dissipation, delay, area, cost and programmability.
- To designthe art of modeling digital systems in Verilog and synthesize them.
- To understandneed for simulation and learn the different types of simulations and their relative advantages.
- To explain the need for testing and understand different test architectures.
- To understand the floorplanning, partitioning, placement and routing issues in automatic layout generation.

Unit I **8L**

Types of ASICs: Full-Custom ASICs, Standard-cell-based ASICs, Gatearray-based ASICs, channeled gate array, channel less gate array, structuredgate array, programmable logic devices, field-programmable gate arrays,design flow, case study. ASIC Cell Libraries. ASIC library design: transistorsas resistors, transistor parasitic capacitance, library-cell design, libraryarchitecture, gate-array design, standard-cell design, datapath-cell design.

Learning Outcomes

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

- classify different ASICs based on power dissipation, delay, area, programmability and cost(L3).
- identify or choose a ASIC technology for given specifications (L4).
- appreciate the need for cell libraries and issues involved with cell library based design (L2).
- explain the use of transistors in building standard cells and their delay modeling (L1).
- describe the guidelines in choosing a library architecture and standard cells (L1).

Unit II **8L**

Verilog: Basics of the Verilog language, operators, hierarchy, proceduresand assignments, timing controls and delay, logic-gate modeling, modelingdelay, altering parameters. **Logic Synthesis**: A logic-synthesis example,a comparator/MUX, inside a logic synthesizer, synthesis of the Viterbi decoder, verilog and logic synthesis.

Learning Outcomes

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

- list the different operators, modeling styles in Verilog hardware modeling (L1).
- model combination circuits, sequential circuits, FSMs and test benches in Verilog (L5).
- describe the synthesis semantics of various Verilog operators and constructs (L2).
- design the different steps of the logic synthesis process (L3).
- explain the inputs and different outputs of the logic synthesis process (L2).

Unit III **8L**

Simulation: Types of simulation, the comparator/MUX example, logic systems, how logic simulation works, cell models, delay models, static timing analysis, switch-level simulation, transistor-level simulation.

Learning Outcomes

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

- explain the need for simulation and enumerate the different types of simulation (L1).
- distinguish between simulation and static timing analysis for verification (L3).
- explain the modeling of cells and their delays for supporting different types of simulation (L2).
- compare switch level and transistor level simulation (L2).
- design the operation of logic simulator (L5).

Unit IV **8L**

Test: The importance of test, boundary-scan test, faults, fault simulation,automatic test-pattern generation, scan test, built-in self-test, a simple testexample.

Learning Outcomes

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

- appreciate the importance of testing and design for test in VLSI design process (L1).
- explain the architecture of boundary-scan test (L2).
- discuss the different fault models (L1).
- describe the need for fault simulation and EDA approaches (L2).
- discuss the automatic-test pattern generation process with the help of an EDA tool (L5).
- motivate the need for BIST and describe its architecture (L2).

Unit V **8L**

ASIC Construction: Physical design, system partitioning, partitioning methods. **Floor planning and Placement**: Floor planning, placement, physical design flow, information formats. **Routing:** Global routing, detailed routing, special routing, circuit extraction and DRC.

Learning Outcomes

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

- list the guidelines for system partitioning and popular methods(L1).
- distinguish between floorplanning and placement with neat diagrams (L1).
- explain typical guidelines and algorithms for placement under different constraints (L4).
- demonstrate the floorplanning, placement and routing flow with an EDA tool (L2).
- explain the different routing algorithms used under different cell placement strategies(L1).

Text Book(s):

4. Michael John Sebastian Smith, Application-Specific Integrated Circuits,Pearson Education, 2001.

References:

1. Jan. M. Rabaey, Digital Integrated Circuits, 2/e, Prentice Hall, 2001
2. SabihGerez, Algorithms for VLSI Design Automation, Wiley, 1999.
3. Wayne Wolf, Modern VLSI Design, 4/e, Pearson Education, 2002.
4. Samir Palnitkar, Verilog HDL, 2/e, Pearson Education, 2003

Course Outcomes

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

- list different ASIC technologies and compare them based on power dissipation, speed, programmability, area, design time and cost (L4).
- model, simulate and synthesize digital systems using Verilog HDL language and EDA tools (L4).
- compare, describe and contrast the different types of simulations carried out during the VLSI design process (L3).
- appreciate the need for testing and describe different test architectures (L3).
- describe the guidelines and techniques used during floorplanning, placement and routing phases of VLSI design flow (L2).

19EEC368: RF CIRCUIT DESIGN

L	T	P	C
2	0	2	3

The objective of this course is to present the fundamental concepts of design and analysis of modern RF and wireless communication integrated circuits. This course mainly concentrates on the RF and microwave concepts, Smith chartanalysis ,amplifier and oscillator circuit design at RF frequency and applications of RF circuits

Course Objectives:

- To understand Basic RF frequency advantages and circuit design process.
- To impart the knowledge of basic resonant and impedance matching circuits
- To explain the use of smith chart for calculating certain parameters.
- To explore the design of RF amplifiers.
- To understand RF oscillators and their design process.

Unit I **9L**

Introduction to RF and Microwave concepts and applications: Introduction, Reasons for using RF/Microwaves, RF/Microwave applications, Radio frequency waves, RF and Microwave circuit design, General active circuit block diagrams.

Learning Outcomes

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

- understand the concept of basic RF/ Microwaves (L1).
- apply RF concepts to basic applications (L3).
- explain the RF and Microwave circuit design (L2).
- describe general active circuit block diagrams (L2).

Unit II **9L**

RF Electronics Concepts : Introduction, RF/Microwaves versus DC or low AC signals, EM spectrum, Wave length and frequency, Resonant circuitsImpedance transformers, RF impedance matching, Three element matching.

Learning Outcomes

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

- apply basic RF electronic concepts to circuit design (L3).
- distinguishDC or low AC signals (L1).
- determine wave length and frequency (L4).
- understand ResonantCircuits Impedance transformers (L1).
- explainRF impedance matching (L2).

Unit III **8L**

Smith Chart and its Applications: Introduction, A valuable graphical aid the smith chart, Derivation of smith chart, stability circles, Description of two types of smith charts, Smith charts circular scales, Smith charts radial scales, the normalized impedance-admittance (ZY) smith chart introduction.

Learning Outcomes

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

- describe valuable graphical aid ,the Smith chart (L2).
- categorize different types of smith charts (L4).
- state Smith charts circular scales (L1).
- evaluatethe normalized impedance-admittance (ZY) using Smith chart (L6).

Unit IV **8L**

RF and Microwave Amplifiers: Introduction, Types of amplifiers, Small signal amplifiers, Multistage small signal amplifier design, High-power amplifiers, Microwave power combining/dividing techniques, Signal distortion due to inter modulation products, Multistage amplifiers.

Learning Outcomes

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

- state types of amplifiers(L1).
- categorizesmall signal amplifiers(L4).
- buildmultistage small signal amplifier design(L5).
- explainmicrowave power combining/dividing techniques(L2).
- analyzesignal distortion due to inter modulation products(L4).

Unit V **8L**

RF and Microwave Oscillator Design: Introduction, Oscillator versus amplifier design, Oscillation conditions, Design of transistor oscillators, Generator-tuning networks.

Learning Outcomes

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

- distinguish between oscillator and amplifier design(L1).
- explain conditionsof oscillation(L2).
- design transistor oscillators(L5).
- constructGenerator-tuning networks (L3).

Text Book(s):

1. Mathew M. Radmanesh, "Radio Frequency and Microwave Electronics", Prentice hall,2001.
2. Joseph Helszain,"Microwave Engineering, Active and Non-reciprocal Circuits", McGraw HillInternational Edition, 1992.

Course Outcomes

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

- explain different types of Smith charts used for RF and Microwave circuit design (L2).
- determine wave length and frequency (L4).
- evaluate the normalized impedance-admittance using Smith chart (L6).
- design Multi stage small signal amplifier (L5).
- explain Signal distortion due to inter modulation products (L2).
- describe construction of Generator-tuning networks (L2).

19EEC370: SOFTWARE DEFINED RADIO

L	T	P	C
2	0	2	3

Software-defined radio (SDR) is an inherent part of modern communication system, where many processes, which used to be implemented in hardware, are defined in software domain for flexibility and configurability. This course describes software-defined-radio architectures and focuses on the design aspects of SDR, namely, systems design and RF, IF, and base-band analog hardware design. The concept of unified platform and the ability to correct errors in real time are the classic applications of SDR. SDR can also be used in areas as diverse as proto type development, evaluation of multi-path communications, broadcast transmissions in multi-media mobile environments and wireless networks.

Course Objectives

- To familiarizefundamentals and state of the art concepts in software defined radio.
- To study requirements, benefits and limitations of software defined radio.
- To study in detail about software defined radio architectures for performance optimization.
- To acquaint good knowledge regarding functionality of different blocks and techniques associated with software defined radio.
- To introduce the concept offlexible transmitters.

Unit I **8L**

Introduction:The requirement for software defined radio, Thebenefits of multi-standard terminals, Operational requirements, Business models for software defined radio, New base station and network architectures, Smart antenna systems.

Learning Outcomes

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

- understand the basic concepts of Software Defined Radio (L1).
- describe the benefitsand limitations of software defined radio (L2).
- analyze requirements of different models of Software Defined Radio (L4).

Unit II **8L**

Basic Architecture of a Software Defined Radio: Software defined radio architectures, Ideal Software defined radio architectures, required hardware specifications, Digital aspects of a Softwaredefined radio, Current technology limitations.

Learning Outcomes

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

- understand in detail aboutthe architecturesof Software Defined Radio (L1).
- analyze the hardware specifications of Software Defined Radio (L4).
- explain the digital processing techniques of Software Defined Radio (L2)

Unit III **8L**

Flexible RF receiver architectures: Receiver architecture options, implementation of a digital receiver: frequency upconversion using under sampling, achieving processing gain using oversampling, Noise figure, Receiver sensitivity, ADC spurious signals.

Learning Outcomes

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

- understand the concept of flexibility in a RF receiver (L1).
- describe in detail aboutthe architecturesof flexible RF receiver (L2).
- demonstrate the techniques to improve the performance of the receiver (L4).

Unit IV **8L**

Multi-Band and General Coverage Systems: Multiband Flexible receiver design,The problem of the Diplexer,Achieving Image rejection, Dynamic range enhancement, feedback and feedforward techniques.

Learning Outcomes

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

- understand the concept of multiband flexible RF receivers and transmitters (L1).
- demonstrate the various image rejection techniques in RF receivers (L4).
- understand the concept involved in improving the dynamic range of SDR (L1).

Unit V **8L**

Flexible transmitters and Power amplifiers: Analog quadrature upconversion, quadrature upconversion with interpolation, Interpolated bandpass upconversion, PLL based transmitters, Active All-pass filter, Use of highpass and lowpass filters, Polyphase filtering.

Learning Outcomes

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

- understand the concept of linearization in RF transmitters (L1).
- differentiate the PA requirements for SDR base station unit and handset (L2).
- describe in detail about various linear upconversion architectures (L2).

Textbook(s):

1. P Kenington, “RF and Baseband Techniques for Software Defined Radio”, Artec House,2005

References:

1. JoukoVanakka, “Digital Synthesizers and Transmitter for Software Radio”, Springer,2005
2. Wally H. W. Tuttlebee, “Software Defined Radio: Baseband Technologies for 3G Handsets and Base stations”,John Wiley & sons, 2003

Course Outcomes

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

- understand the design principles of software defined radio (L1).

- analyze requirements, benefits and different models of Software Defined Radio (L4).
- explain in detail about Software Defined Radio Architectures for performance optimization (L2).
- understand the concept of flexibility in a RF receiver and techniques to improve the performance of the receiver (L1).
- understand the concept of linearization in RF transmitters and PA (L1).

19EEC372: FIBER OPTIC SENSORS AND APPLICATIONS

L	T	P	C
2	0	2	3

The emphasis of this course is to introduce the basic components of fiber optic communication systems, principles of light propagation through fibers and their loss mechanisms. The design aspects of optical sources like LED, LASER and photo detectors like P-i-N, Phototransistors are discussed. Industrial applications of optical fibers and lasers are introduced in this course. This course also deals with various optical network topologies, physical and logical design of IoT.

Course Objectives

- To study the propagation of electromagnetic wave through fiber, types of fibers and loss mechanisms
- To understand the working principles of LED, LASER and their types
- To explore the compatibility requirements for detectors and the principles of various photo detectors
- To know the Industrial applications of Optical Fibers and LASER's
- To describe the functioning of Fiber optic networks and IoT

Unit I **8L**

Propagation of EM waves in Optical fibers: Fiber optic communication system, Light propagation through fibers, Acceptance angle, Numerical Aperture, Types of fibers and their properties - step index, graded index, single mode & multimode, Losses in optical fibers- Absorption, Attenuation, Scattering and Dispersion losses.

Learning Outcomes

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

- explain the components of Fiber optic communication system(L2).
- illustrate the Light propagation through fibers (L2).
- compare step index and graded index fibers(L2).
- list out propagation modes in fiber (L1).
- summarize various losses in optical fibers (L2).

Unit II **9L**

Optical Sources: LED- Principle of operation, LED materials, power and efficiency calculation, LED structures- Homostructure, Heterostructure, LED types-surface emitting and edge emitting LEDs - and their characteristics.

LASER-Fundamental characteristics, three level and four level lasers-Properties of lasers-Laser modes-Resonator configuration, Types of lasers-Gas laser, solid laser, liquid laser, semi conductor laser.

Learning Outcomes

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

- outline the operating principle of LED (L2).
- summarize LED materials and LED characteristics (L2).
- compare surface emitting and edge emitting LED's (L2).
- classify three level and four level lasers (L4).
- interpret the working principles of various lasers (L5).

Unit III **8L**

Photo detectors: Performance and compatibility requirements for detectors, Optical detection principles, Quantum efficiency, responsively, noise and gain calculation of detectors, PN, P-i-N photodiodes, Avalanche photodiodes, Quantum-dot photo detectors, Phototransistors.

Learning Outcomes

After completion of this unit the student will be able to

- discuss the principles used in optical detection (L6).
- explain the significance of Quantum efficiency (L2).
- interpret the concepts of noise and gain calculation in detectors (L5).
- summarize the working principles of PN and P-i-N photodiodes (L2).
- distinguish the working of various photo detectors (L4).

Unit IV **9L**

Industrial applications of Optical Fibers and LASER's: Mach-Zehnder Interferometric sensor, fiber optic gyroscope, distributed fiber optic sensor-OTDR, LIDAR, measurement of pressure, temperature, current and liquid level, Material processing-Laser heating, removal and vaporization. Holography-Basic principle, Holographic interferometer, applications –Holography for non destructive testing-Medical applications of lasers.

Learning Outcomes

After completion of this unit the student will be able to

- outline various principles used in various fiber optic sensors (L2).
- illustrate the working of fiber optic sensors for the measurement of different physical parameters (L2).
- summarize the role of lasers for material processing (L2).
- illustrate the working of Holographic interferometer (L2).
- interpret the medical applications of lasers (L5).

Unit V **9L**

Fiber Optic networks and IOT: Optical Networking: Network terminology, Network categories, network layers, Network topologies, SONET/SDH-Networks, High-speed light wave links, Building blocks of IOT enabling technologies, characteristics of IOT systems, physical and logical design of IOT, Data acquisition using sensors, camera, GPS, Smart phone.

Learning Outcomes

After completion of this unit the student will be able to

- outline the optical network terminology (L2).
- list out various network topologies (L1).
- discuss the building blocks of IOT (L6).
- analyze the physical and logical design of IOT (L4).
- explain the concept of Data acquisition using sensors (L2).

Text Book(s):

1. Optical Fiber Communications Principles and Practice, Third edition John M. Senior, Pearson Education Limited 2009.
2. Optical Fiber Communications, fourth edition, Gerd Keiser, Tata McGraw Hill Education Private Limited,2012.
3. Industrial lasers and their applications, John and Harry, McGraw Hill, 1974.
4. Internet of Things: A Hands-On Approach By Arshdeep Bahga, Vijay Madisetti, 2014.

References:

1. Optical electronics foundation book, Ghatak A.K. and Thiagarajan K, TMH, New Delhi, 1991.
2. Fibre Optic Communications, Joseph C. Palais, 5th Edition, Pearson Education,2008.
3. Introduction to lasers and their applications, D.C.O'shea, Russel Callen, Mc Millan,1977.
4. Industrial applications of lasers, John F Ready, Academic press, 1978.

Course Outcomes

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

- illustrate the basic principles involved in Light propagation through fibers, types of fibers and losses (L2).
- analyze the principle involved in LED and LASER design (L4).
- distinguish the characteristics and types of LASER's, LED's (L4).
- explain the working of various photo detectors (L2).
- identify optical fibers and lasers for measuring various physical quantities in industries (L3).
- categorize various topologies involved in Fiber optic networks (L4).
- adapt various fiber optic topologies in IOT (L6).

19EOE302: GERMAN FOR BEGINNERS
(Elective)

L	T	P	C
3	0	0	3

Unit I **9 hours**

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 hours**

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 hours**

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 hours**

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 hours**

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 (Elective)

L	T	P	C
3	0	0	3

Unit I **9 hours**

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 hours**

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 hours**

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 hours**

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 hours**

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 (Elective)

L	T	P	C
3	0	0	3

Unit I **9 hours**

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 hours**

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 hours**

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 hours**

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 hours**

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 (Elective)

L	T	P	C
3	0	0	3

Unit I **9 hours**

Structure of Indian Economy: Meaning of economic growth and devel-opment, features of Indian economy, changing structure of Indian economy, trends in national income, sources of growth, agriculture, industry and service sectors.

Unit II **8 hours**

Demography, Poverty and Unemployment in India: Demography: Popu-lation 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 hours**

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 commission.

Unit IV **8 hours**

Foreign Trade: Importance, composition and direction of foreign trade,foreign direct investment, BoPs equilibrium, Foreign Exchange Manage-ment Act (FEMA).

Unit V **8 hours**

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 (Elective)

L	T	P	C
3	0	0	3

Unit I **10 hours**

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 hours**

Administrative Thought: Scientific management theory, classical theory,bureaucratic theory, human relations theory, system theory.

Unit III **8 hours**

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 hours**

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 hours**

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 Books, 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

Course Objectives:

1. To familiarize with basic with basic concepts of green buildings
2. To acquire an insight on characteristics, collection transportation and disposal of different types ofbiomedical wastes
3. To acquaint the basic principles of EIA.
4. To impart about e-waste management.
5. To understand the activities in environmental auditing.

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.

Course outcome:

1. To explain the concepts of green buildings –L2.
2. To outline the disposal techniques in biomedical waste –L2.
3. To explain the preparation of EIA statements-L4
4. To Summarize e-waste management rules-L2
5. To identify various acytiviites involved in environmental audit –L3

Text Books

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.
3. Rittmann, B.E., and McCarty, P.L., Environmental Biotechnology : Principles and Applications, McGraw Hill, 2001.

Reference Books

4. Reddy, L.N. and Inyang. H. I., Geoenvironmental Engineering –Principles and Applications, Marcel Dekker, Inc., New York., 2000

5. Industrial Wastewater Management, Treatment and Disposal, WEF Manual of practice No. FD-3, 3rd Ed., WEF Press and McGrawHill, 2008

19EOE327: PROFESSIONAL COMMUNICATION
(Elective)

L T P C
3 0 0 3

Unit I **8 hours**
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 hours**
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 hours**
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 hours**
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 hours**
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

19MOE301: BASICS OF FINANCE

L T P C
3 0 0 3

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.

Recommended Textbook:

1. Shashi K. Gupta & R.K. Sharma, "Financial Management –theory and practices" 8th revised edition, 2014, Kalyani Publishers.

REFERENCES (All Latest Editions)

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

GITAM Journal of Management, GITAM Institute of Management, GITAM University, Visakhapatnam

19LOE301: FUNDAMENTALS OF CYBER LAW
(Elective)

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 Module) cloning–Mobile frauds - Usage of mobile software - Special reference to the relevant provisions of IT ACT 2008, India Penal Code and Evidence Act.

Textbooks:

a. Yatindra Singh : Cyber Laws
b. Vakul Sharma, Handbook of Cyber Laws

References:

4. Linda Brennan and Victoria Johnson: Social, ethical and policy implication of Information Technology.
5. Kamath Nandan : Law relating to Computer, Internet and E-Commerce.
6. 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 hours**

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 hours**

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 hours**

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 hours**

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 hours**

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 Books, 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

1. Philip Kotler (2014), *A Framework for Marketing Management*, New Delhi: Pearson Education.

REFERENCE BOOKS

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.

GEL345: Workplace Communication – Basic

L	T	P	C
3	0	0	3

Introduction

The course is used to teach contemporary international business communication. An integrated skills approach is followed to enable students to communicate effectively in business contexts. It is a topic-based course with ample opportunity for practise to develop LSRW skills. It motivates and engages the students who wish to pursue various careers.

Course Objectives

- To enable students to hone their language skills with special focus on effective communication in business contexts
- To reinforce learning and enhance the ability to understand business communication
- To conduct business correspondence, write reports and suggestions, make presentations and participate in discussions
- To prepare students for BEC certification (B2 Level)

Unit 1: Listening

Understanding general idea; listening for specific information to complete notes, forms, and messages based on telephone conversations; recognising functions such as complaining, greeting, apologising; recognising topics and contexts; ability to follow extended speech during interviews, discussions, and presentations; ask relevant questions to indicate one's understanding of the main points of the speech

Learning Outcomes

At the end of the Unit the learners will be able to

- understand and follow a range of spoken business communication
- collect specific information from telephone conversations, interviews, discussions and presentations
- recognise different language functions such as greeting, apologising, and complaining
- make inferences and draw conclusions

Unit 2: Speaking

Interactive communication: sharing and participating in a conversation; giving a presentation or speaking at a business meeting: structuring a speech and connecting ideas; discussing on a given topic and expressing opinions, agreeing, disagreeing, comparing and contrasting ideas to reach a decision; speaking at length about the topic in a logical way

Learning Outcomes

At the end of the Unit the learners will be able to

- communicate with clarity and precision in business contexts
- understand and apply effective discourse management strategies
- make structured mini presentations/ elevator pitches
- participate in targeted discussions

Unit 3: Reading

Understanding the meaning, structure and cohesion of the text; reading in detail; scanning for specific details/information; identifying the writer's purpose and main idea of a paragraph; understanding opinions and ideas expressed in the text; understanding sentence structure; identifying and correcting errors in text.

Learning Outcomes

At the end of the Unit the learners will be able to

- comprehend business texts with focus on meaning, structure and cohesion
- get the gist, identify specific details and understand the writer's purpose
- make inferences and draw conclusions
- read short texts for error identification and correction

Unit 4: Writing

Writing for internal communication: a note/memo/email/message (formal); writing requests, instructions, explanations, ask for information, etc.; writing concisely and cohesively: linking your ideas; writing reports and proposals based on notes, charts, and tables.

Learning Outcomes

At the end of the Unit the learners will be able to

- identify formal internal communication contexts and write a note/ memo/ email/ message accordingly
- write instructions and explanations for process oriented activities
- produce different pieces of writing concisely and cohesively with appropriate discourse markers based on charts and tables.
- write effective letters, emails, reports, and proposals

Unit 5: Grammar and Vocabulary in Context

Countable and uncountable nouns; present perfect and past simple; phrasal verbs; collocations; linking words; infinitives and verb + -ing; formal requests; first and second conditionals; prepositions in time clauses; modal verbs: perfect forms; referencing; passives; the definite article; tense changes in reported speech; relative clauses

Learning Outcomes

At the end of the Unit the learners will be able to

- demonstrate appropriate use of a range of grammatical structures and vocabulary
- understand various forms of nouns, verb tense, voice, and reported speech
- use phrasal verbs, collocations and discourse markers as required
- be consistent in the correct use of grammar and effective word choice in written and oral communication

References:

Whitby, N. (2014). *BusinessBenchmark: Upper Intermediate.* Cambridge English: CUP.

Seely, John.*Oxford Guide to Effective Writing and Speaking*.Oxford University Press, (India), 2013

Rizvi, M Ashraf. *Effective Technical Communication*.Tata McGraw Hill. 2005.

Olsen, Leslie & Huckin, Thomas.*Technical Writing and Professional Communication for Non- native Speakers*.McGraw-Hill. 1991

GEL347: Workplace Communication –Advanced

L	T	P	C
3	0	0	3

Introduction

The aim of the course is to equip students with advanced language skills for successful communication in business contexts. This course will enhance students' employability and add value to their career prospects. This course will be taught through integration of the four language skills, using a blended approach.

Course Objectives

- To enhance critical thinking skills through challenging tasks and activities
- To train students for effectively using advanced language functions such as persuading, negotiating, interpreting data, hypothesizing and speculating
- To enable students to become independent and proficient users of English

Unit 1: Listening

Comprehending extended speech about complex topics in situations such as interviews, lectures, talks and meetings; identifying the purpose of speech and understanding advanced functions such as persuasion and negotiation; practising active listening strategies such as reflecting on what has been said during an extended conversation by paraphrasing, asking specific questions, and responding appropriately; dropping assumptions while listening; inferential listening: picking up on cues from what is said and not said

Learning Outcomes

At the end of the unit, the learners will be able to

- follow complex discussions, talks and presentations on business related topics
- understand the use of language in different situations for different purposes
- demonstrate an understanding of implicit language use

Unit 2: Speaking

Talking about one's work and experience; speaking at length on specific business related topics and demonstrating knowledge of relevant topics based on the conversation/discussion; developing, presenting, and defending an argument; use of persuasive language; use of appropriate register and tone

Learning Outcomes

At the end of the unit, the learners will be able to:

- express views/opinions and take part in discussions on business/work related topics using appropriate vocabulary and register
- contribute effectively to meetings and seminars
- engage in extended conversation on different topics in workplace contexts

Unit 3: Reading

Comprehending complex texts including articles on business related topics; reading with specific goals; using suitable strategies such as making connections, predicting, questioning, visualising, and summarising to become independent readers; using knowledge of text structure to enhance comprehension; interpreting opinions and ideas expressed in the texts; developing critical reading skills to identify generalizations, spot errors in reasoning, and draw inferences/conclusions

Learning Outcomes

At the end of the unit, the learners will be able to:

- comprehend complex texts on business/workplace related topics
- understand implicit meaning and purpose of texts read
- develop critical reading skills to enhance comprehension at the inferential level

Unit 4: Writing

Writing brief reports: describing and interpreting graphical representation of data; writing proposals: describing, summarising, recommending a course of action, and persuading the reader; writing letters for specific purposes; planning and organising content in a coherent manner; using appropriate register for specific task types (correspondence, report or proposal)

Learning Outcomes

At the end of the unit, the learners will be able to

- produce different pieces of writing such as letters, reports, and proposals using language with clarity, precision, and accuracy
- consistently produce desired written message using a wide range of grammatical structures and vocabulary
- understand the use of appropriate register for different contexts

Unit 5: Grammar and vocabulary in context

Verb forms; modal verbs; defining and non-defining relative clauses; compound nouns; embedded questions; position of adverbs; cleft sentences; conditional sentences; future time clauses; complex sentences; infinitive and verb + ing; reference devices; articles; devices of concession; business vocabulary/ vocabulary related to workplace

Learning Outcomes

At the end of the unit, the learners will be able to:

- demonstrate understanding of a range of business vocabulary
- refine the ability to use English grammar as a tool for comprehension
- identify and correct select grammatical and word choice errors in texts
- speak fluently and write effectively

References

Whitby, N. (2014). *Business Benchmark: Advanced.* Cambridge English: CUP.

Seely, John. *Oxford Guide to Effective Writing and Speaking.* Oxford University Press, (India), 2013

Rizvi, M Ashraf. *Effective Technical Communication*. Tata McGraw Hill. 2005.

Olsen, Leslie & Huckin, Thomas. *Technical Writing and Professional Communication for Non- native Speakers.* McGraw-Hill. 1991

19EHS302: ENGINEERING ECONOMICS AND MANAGEMENT

L T P C
3 0 0 3

Course objectives

- Define the basic terms of economics and analyze law of demand and elasticity of demand
- Explain cost concepts and interpret Financial statements
- Apply break even analysis concept in business organization
- Discuss the advantages of different forms of organization
- Elaborate the principles of Management

Unit I **8 hours**

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, simple problems.
Learning outcomes :
Student will be able to
1. Define utility and value of goods.
2. Distinguish between necessities, comforts and luxuries.
3. Classify demand
4. Analyze the elasiticity of demand for various economic goods.

Unit II **8 hours**

Costing: Cost concepts, elements of cost, 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:
Student will be able to
1. List types of costs
2. Apply cost analysis in finding profit
3. Classify accounts
4. Compose & Interpret balance sheet for a given enterprise

Unit III **6 hours**

Break-Even Analysis: Assumptions, break-even charts, simple problems.
Depreciation: Depreciation methods - Simple problems.

Learning outcomes:
Student will be able to
1. Apply break even analysis in business organization
2. Examine the impact of fixed and variable costs on profits
3. List depreciation methods
4. Compute the depreciation of assets.

Unit IV **10 hours**

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 :
Student will be able to
1. Categorize forms of business organization
2. Distinguish types of organization
3. Illustrate advantages and disadvantages of each form of organization
4. Evaluate the effect of span of management on decision making

Unit V **10 hours**
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:

Student will be able to
1. Summarize the function of management
2. Assess the role of manager
3. Compare and contrast between Leader and Manager
4. List the characteristics of Leader

Course Outcomes
- Interpret and summarize the country's economy and market economics, as an entrepreneur.
- Develop the background behind making cost implications and related concepts.
- Analyze various accounting concepts and financial management techniques for preparing effective profit and loss statements
- Discover the optimal production strategies.
- Examine and analyze break even evaluation concepts for identification of minimum production volume for survival and to gain profits.
- Adapt and build good manager skills by employing the concepts of various skills like good leadership qualities, utilizing motivation capabilities and incorporating communications skills.

19EMC382: ENGINEERING ETHICS (Mandatory Course)

L	T	P	C
3	0	0	0

Unit I **8 hours**

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 hours**

Rights and Responsibilities: As citizens, as professionals, concepts ofjustice and fairness, preservation, production, exchange for mutual fulfilment vs. storage for future use, social responsibility and individual rights.

UnitIII **9 hours**

Global Issues in Ethics: Technology and globalization, business ethics,corporate social responsibility, environmental ethics, media ethics, pro-tecting the common good while respecting the values and beliefs of nations/ ethnic groups, issues of compliance and governance, equal opportunities.

Unit IV **8 hours**

Ethical Integrity and Attitudes: Integrity as wholeness and consistencyof 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 hours**

Ethical Living: Needs of life, materialistic and non-materialistic, quali-tative 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 condi-tions, 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

19EEC392: COMPREHENSIVE SKILL DEVELOPMENT V

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 **- 3 Hours per week**

A. Verbal and Soft 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**

B. Quantitative Aptitude and Reasoning

Unit	Module/ Topics	Hrs
1.	Combinatorics	4
2.	Crypt arithmetic & Modular Arithmetic	5
3.	Analogy & Classification of Numbers	3
4.	Puzzles	3
	Total	15

Unit	Module/ Topics	Hrs
1.	GRE-Oriented Advanced Concepts Discussion	4
2.	CAT-Oriented Advanced Concepts	4
3.	TCS, Infosys-Oriented Advanced Concepts	4
4.	Successful Test Cracking Techniques	3
	Total	15

Part-2 Domain Skills - 3 Hours per week

IoT: Line follower robot using Arduino, Solar tracking system using Arduino, **develop smart home automation using Arduino.**

Communications: Creation of Zigbee network with 3 nodes, 5G New Radio (NR) communications system, FM radio using Software define Radio, Digital Speech Decoder using SDR.

Microcontroller: GPS Based Train/Bus Station Indication System with display on LCD, Bidirectional Visitor Counter using 8051 Microcontroller.

VLSI: FPGA Design methodology, Verification Of UART, Verification Of FIFO, FPGA design for Embedded Systems. Verification of Memory, Parity And CRC, Single Port RAM Asynchronous Read/Write, Dual Port RAM Asynchronous Read/Write, Gray Counter

References:

1. Wireless Communication Signals: A Laboratory-based Approach by Huseyin Arslan
2. https://in.mathworks.com/help/5g/gs/polar-coding.html
3. https://www.allaboutcircuits.com/projects/an-introductory-project-for-software-defined-radio/
4. www.engineersgarage.com
5. www.electronicshub.org
6. https://www.tinkercad.com
7. https://www.arduino.cc
8. https://www.asic-world.com/
9. https://www.coursera.org/lecture/fpga-softcore-proccessors-ip/testbenches-for-verification-LFBJF

19EEC431: COMMUNICATION NETWORKS

L	T	P	C
3	0	2	4

This course introduces the student to the fundamental principles and tools used in building data communication networks. This course shall lay the foundation for other courses including Internet of things, Wireless Networks and Wireless Sensor networks.

Course Objectives

- To introduce the basics of computer network technology, typical network scenarios, layering models and service descriptions
- To familiarize the principles and usage of networking applications including web, HTTP, DNS and socket programming
- To acquaint the principles and design issues of transport layer services and the protocols supporting these services for different network applications
- To acquaintthe data plane and control plane aspects of network layer
- To demonstrate the data link layer aspects and physical layer technologies enabling the internet.

Unit I: **8L + 3P**

Computer Networks and the Internet: Services description and definition of protocol, Network Edge and Network Core. Delay, Loss and Throughputin Packet-Switched Networks, Protocols layers and their service models.

Learning Outcomes:

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

- define the concept of protocol and notion of services(L1).
- explain the structure of socket programs for client server applications(L1).
- describe the need for and advantages of protocol layering(L4).
- describe the different layers in OSI and TCP/IP protocol suites and their services(L1).
- list the basic implicit limitations of computer networks including delay, loss, shared throughput etc. (L2).

Unit II: **8T + 6P**

Application Layer: Principles of Network Applications, The Web and the HTTP, Electronic Mail, Domain Naming Systems, Socket Programming.

Learning Outcomes:

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

- describe the principles of network applications (L2).
- list the different fields of HTTP protocol(L1).
- explain the design principles of electronic mail(L2).
- enumerate the different transactions during domain name systems lookup(L2).
- develop socket programming based basic client-server applications(L5).

Unit III: **8T + 6P**

Transport Layer: Introduction to transport layer services, multiplexing and demultiplexing, connectionless transport: UDP, principles of reliable data transfer, connection oriented transport: TCP.

Learning Outcomes:

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

- enumerate the different transport layer services and the protocols supporting these services(L1).
- describe the multiplexing and demultiplexing service provided by transport layer (L1).
- tabulate the different fields of UDP and explain their significance(L2).
- tabulate the different fields of TCP and explain their significance(L2).
- explain the handshaking involved in TCP connect establishment and termination (L2).

Unit IV: **8T + 9P**

Network Layer (Data Plane): Overview of network layer, Internals of a Router, Internet Protocol: IPv4, Addressing, IPv6. **Network Layer (Control Plane):** Routing algorithms, Intra-AS routing (OSPF), Routing among ISPs (BGP), Internet control message protocol (ICMP).

Learning Outcomes:

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

- list the function of network layer at the data plane and control plane(L1).
- demonstrate the internal structure of a router and explain the data path(L2).
- list the different classes of IP addresses and their ranges(L1).
- identify the appropriate class from the IP address fields(L4).
- construct an IP addressing mechanism for a network of diverse physical networks(L5).
- distinguish between intra-AS and inter-AS routing principles and describe their protocols(L4).
- tabulate the different fields of ICMP protocol and identify its applications(L3).

Unit V: **8T + 9P**

Link Layer and LANs: Introduction to the link layer, error detection and correction techniques, multiple access links and protocols, switched local area networks. Wireless links and network characteristics, 802.11 Wireless LANs, Cellular Internet Access.

Learning Outcomes

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

- list the different functions of data link layer and corresponding protocols(L1).
- classify and compare the different error correction and detection techniques used in link layer(L1).
- justify the use of different error correction/detection mechanism in different protocols(L4).
- tabulate the different physical layer technologies and compare their data rate, operation range and cost of operation(L2).
- explain the operation of MAC protocols used in wireline and wireless links(L1).

Communication Networks Laboratory

List of Experiments:

8. **Basic Networking:** Network interface exercises, ARP exercises, Exercises with ICMP and ping, Exercises with IP address and subnets mask
9. **Bridges, LANs and the Cisco IOS:** Exercises on Cisco IOS, A simple bridge experiment, Spanning tree exercises, Exercise on the Cisco IOS web browser UI
10. **Static and dynamic routing:**A simple router experiment, RIP exercises, Routing experiments with ICMP, OSPF exercise, Static routing experiment, Traceroute experiment
11. **UDP and its applications:**Using the sock program, UDP exercises, Path MTU discovery exercise, Exercises with FTP and TFTP
12. **TCP IP and its applications:**Exercises on TCP connection control, Exercise on TCP interactive data flow, Exercise on TCP bulk data flow, Exercises on TCP timers and retransmission

13. **The Web, DHCP:** Socket programming, HTTP exercises, DHCP exercises

Text Book(s):

5. J.F. Kurose and K. W. Ross, "Computer Networking – A top down approach featuringthe Internet", 5/e, Pearson Education, 2017.

Reference books:

8. L. Peterson and B. Davie, "Computer Networks – A Systems Approach", 5/e, Elsevier India, 2011.
9. B. A. Forouzan, "Data Communications and Networking", 4/e, Tata McGraw Hill, 2013.
10. Andrew Tanenbaum, "Computer networks", 7/e, Prentice Hall, 2015.
11. D. Comer, "Computer Networks and Internet/TCP-IP", Prentice Hall of India, 2007.
12. William Stallings, "Data and computer communications", 4/e, Prentice Hall of India, 2010.

Course Outcomes:

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

- describe the notion of services, protocols, layering and fundamentals metrics of data networks(L1).
- appreciate the need and operation of different application layer protocols and their services(L1).
- explain the different transport layer services, protocols and their operation(L4).
- demonstrate the architecture of internet and identify the use of different routing algorithms (L4).
- compare the capabilities and use of different MAC layer protocols, devices employed in different physical layer technologies(L4).

19EEI371: SENSORS AND SIGNAL CONDITIONING

L	T	P	C
2	1	0	3

Preamble:

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 in order 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 1: **8 hours**

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: **8 hours**

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: **8hours**

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

- 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: **8hours**

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

- Understand the basic principles related to temperature sensors.
- 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: **8hours**

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

- Understand the Interfacing circuits
- 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, Puneet Sawhney, 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)

19EME361: 3D PRINTING

L	T	P	C
2	1	0	3

3D printing, is transforming how products are designed, produced, and serviced. AM enables on-demand production, without dedicated equipment or tooling, and unlocks digital design tools, giving breakthrough performance and unparalleled flexibility. Across industries, knowledge remains one of the greatest barriers to AM's wider adoption.

Course Objectives

- To demonstrate the broad range of AM processes, devices, capabilities
- To expose the basics of additive manufacturing/rapid prototyping and its applications in various fields, reverse engineering techniques.
- To analyze the different processes in rapid prototyping systems.
- To explain about mechanical properties and geometric issues relating to specific rapid prototyping applications.

Unit I: **10L**

Introduction: Overview – History - Need-Classification -Additive Manufacturing Technology in product development- Materials for Additive Manufacturing Technology – Distinction between AM & CNC machining, Advantages of AM, Tooling - Applications.

Classification of AM processes: Liquid polymer system, discrete particle system - molten material systems - solid sheet system.

Learning Outcomes:

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

- demonstrate the knowledge of Additive Manufacturing and Rapid Prototyping technologies(L2)
- describe different RP techniques (L3).
- discuss fundamentals of Reverse Engineering (L3).

Unit II: **8L**

CAD for Additive Manufacturing: Conceptualization, CAD model preparation – conversion to STL - STL file manipulation - Part Orientation and support generation – Model Slicing –Tool path Generation – Transfer to AM - Machine setup, build , removal and clean up, post processing. Data Processing for Additive Manufacturing Technology - Softwares for Additive Manufacturing Technology: MIMICS, MAGICS.

Learning Outcomes:

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

- recognize the significance of softwares for additive Manufacturing Technology (L1).
- utilize the concept of 3D printing (L3).
- calculate the time required to perform a job (L2).
- Processes related to AM, such as 3D scanning, mold-making, casting and sintering (L2).

Unit III: **8L**

Liquid Based and Solid Based Additive Manufacturing Systems: Classification – Liquid based system – Stereolithography Apparatus (SLA)- Principle, process, advantages and applications - Solid based system – Fused Deposition Modeling - Principle, process, advantages and applications, Laminated Object Manufacturing.

Learning Outcomes:

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

- identify the significance of Liquid based systems in 3D design (L1).
- calculate the material required for making of an actual part (L3).
- differentiate the object manufacturing to utilize the concepts (L3).

Unit IV: **8L**

Powder Based Additive Manufacturing Systems: Selective Laser Sintering – Principles of SLS process - Process, advantages and applications, Three Dimensional Printing - Principle, process, advantages and applications - Laser Engineered Net Shaping (LENS), Electron Beam Melting.

Learning Outcomes:

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

- differentiate the SLS process
- select between a subtractive and an AM process for a particular application (L1).
- select a particular AM process (L3).
- take a career in research or in advanced manufacturing, the AM being a rapidly evolving area and with wide applications (L4).

Unit V: **8L**

Medical And Bio-Additive Manufacturing: Customized implants and prosthesis: Design and production. Bio-Additive Manufacturing- Computer Aided Tissue Engineering (CATE) – Case studies.

Learning Outcomes:

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

- select between a subtractive and an cage process for a particular application (L1).
- select the ability of to make GATE a activity (L3).
- take a career in research or in advanced manufacturing, the AM being a rapidly evolving area and with wide applications (L4).

Text Book(s):

1. Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", Third Edition, World Scientific Publishers, 2010.
2. Gebhardt A., "Rapid prototyping", Hanser Gardener Publications, 2003.

References:

1. Liou L.W. and Liou F.W., "Rapid Prototyping and Engineering applications : A tool box for prototype development", CRC Press, 2007.
2. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer, 2006. Hilton P.D. and Jacobs P.F., "Rapid Tooling: Technologies and Industrial Applications", CRC press, 2000.

Course Outcomes:

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

- select between a subtractive and an AM process for a particular application (L1).
- select a particular AM process (L5).
- take a career in research or in advanced manufacturing, the AM being a rapidly evolving area and with wide applications (L3).
- ready for product development of engineering components and for entrepreneurship (L5).
- employ RE for value addition and reproduction of parts (L4).

19ECS375: INTRODUCTION TO PROGRAMMING WITH JAVA

L	T	P	C
2	1	0	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 packages applicability and usage of multithreading concepts.
- Applet creation and its graphical effects.
- Learn different components required for forms designing in AWT.

Unit I: 10L

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 the unit, student will be able to

- identify the difference between c++ and Java (L2)
- identify the Environment that allows to write platform independent programs(L2)
- apply the methods of Strings to solve the string oriented problems.(L3)
- analyze the uses of wrapper classes in the design of solutions.(L4)
- contrast the difference between the usage of I/O Streams(L4)

Unit II: 11L

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 the unit, student will be able to

- define the user defined classes of the given problem to be solved.(L1)
- explain the behavior of each object in its scope.(L2)
- apply the concepts finalize, abstract and final over the methods and classes.(L3)
- analyze the exception handling mechanisms.(L4)
- develop a code with try and catch blocks.(L3)

Unit III: 9L

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 the unit, student will be able to

- review the concepts of Inheritance for implementing new classes.(L2)
- extends the new classes from one or more classes.(L2)
- define the interfaces and packages.(L1)
- develop new packages for solving complex problems.(L3)
- analyze the flow of execution by decomposing into two or more.(L4)

Unit IV: **9L**

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 the unit, the student will be able to

- definine the new concept applet on internet programming.(L1)
- compare applet with application programs(L2)
- apply applet life cycle to the real problem to solve.(L3)
- test the parameterized applet.(L3)
- examine the behavior of applet using HTML code (L4)

Unit V: **8L**

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 the unit, the student will be able to

- choose awt to create GUI(L3)
- classify the various layouts (L3)
- develop the very user friendly GUIs(L3)
- contrast the between applet and Swings(L2)
- construct an Internet based application using networking concepts in java(L3)

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..

Course Outcomes:

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

- differentiate Java and C,C++ and basic environment required for implementing Java program.(L4)
- explain the concept of class and object and Ability to apply inheritance concepts(L2)
- illustrate concept of user defined exceptions(L4)
- demonstrate usage of a package and thread implementation in application development(L3)
- develop applets with various graphical aspects and Develop GUI forms using different AWT components(L3)

19ECS344: INTRODUCTION TO MACHINE LEARNING

L	T	P	C
2	1	0	3

Machine Learning addresses the question how to enable computers to learn from past experiences. It introduces the field of machine learning describing a variety of learning paradigms, algorithms, theoretical results and applications. Upon successful completion of the course, students will have an understanding the working of various machine learning algorithms which can be implemented through projects they undertake.

Course Objectives

This Course imparts knowledge on how

- To design a learning system and what are concept learning tasks
- To apply decision tree learning in classification tasks
- To develop neural networks algorithms in machine learning
- To illustrate bayesian learning and instance based learning
- To examine the concepts of genetic algorithms and reinforcement learning

Unit I: **10 L**

Introduction: Well-Posed Learning Problems, Designing a Learning System, Perspectives and Issues in Machine Learning.

Concept Learning and the General-to-Specific Ordering: Introduction, A Concept Learning Task, Concept Learning as Search, FIND-S: Finding a Maximally Specific Hypothesis.

Learning outcomes:

After completion of this unit, student will be able to

- define a well-posed learning problem (L1).
- illustrate the designing of a learning system (L1).
- explain a concept learning task (L2).

Unit II: **10 L**

Concept Learning and the General-to-Specific Ordering: Version Spaces and the Candidate-Elimination Algorithm, Remarks on Version Spaces and Candidate-Elimination.

Decision Tree Learning: Introduction, Decision Tree Representation, Appropriate Problems for Decision Tree Learning, The Basic Decision Tree Learning.

Learning outcomes:

After completion of this unit, student will be able to

- name what are version spaces (L1).
- define a decision tree (L1).
- illustrate the decision tree learning algorithm (L2).

Unit III: **10 L**

Decision Tree Learning: Inductive Bias in Decision Tree Learning, Issues in Decision Tree Learning; **Artificial Neural Networks:** Introduction, Neural Network Representations, Appropriate Problems for Neural Network Learning,

Learning outcomes:

After completion of this unit, student will be able to

- list various issues in decision tree learning (L1).
- define what is a neural network and associated fundamentals (L1).

Unit IV: **8 L**

Bayesian Learning: Introduction, Bayes Theorem, Bayes Theorem and Concept Learning.

Instance-Based Learning: Introduction, k-Nearest Neighbour Learning, Locally Weighted Regression.

Learning outcomes:

After completion of this unit, student will be able to

- define bayestheorem (L1).
- summarize the importance of Bayesian methods in machine learning (L2).
- show how bayes theorem and concept learning are related (L2).
- contrast instance-based learning with other methods of learning (L4).

Unit V: 8 L

Genetic Algorithms: Motivation, Genetic Algorithms, An Illustrative Example, Hypothesis Space Search, Genetic Programming;

Learning outcomes:

After completion of this unit, student will be able to

- model genetic learning method by an analogy to biological evolution (L3).
- experiment with hypothesis space search in genetic learning (L3).
- apply the concepts of genetic programming (L3).

Textbook(s):

1. Tom M. Mitchell, *Machine Learning*, McGraw Hill Education (India) Private Limited, 2013.

References:

1. Vinod Chandra S.S. and Anand Hareendran S., *Artificial Intelligence and Machine Learning*, PHI.
2. Shai Shalev-Shwartz and Shai Ben-David, *Understanding Machine Learning: From Theory to Algorithms*, Cambridge University Press, 2014.

Course Outcomes:

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

- illustrate the designing of a learning system and concept learning task(L3)
- describe version spaces and explain the concepts of decision tree learning(L2)
- determine the working of single-layer and multilayer neural networks(L5)
- interpret the importance of Bayesian methods in machine learning and how instance-based learning methods are different(L5)
- illustrate genetic algorithms and reinforcement learning(L3)

19ECS471: INTRODUCTION TO OPERATING SYSTEMS

L	T	P	C
2	1	0	3

Operating systems are essential part of any computer system and equally important for computer science education. This course provides a clear description of the concepts that underlie operating systems.

Course Objectives

This course imparts knowledge on

- To introduce students with basic concepts of operating system, its functions and services.
- To provide the basic concepts of process management and synchronization
- To familiarize the dead lock issues
- To understand the various memory management schemes.
- To give exposure over I/O systems and mass storage structures and Linux system.

Unit I: 8 L

Introduction: What Operating Systems Do, Computer System Organization, Computer-System Architecture, Operating System Structure, Operating system operations, Process Management, Memory Management, Storage management, Protection and security, Kernel data structures

Learning Outcomes:

After completion of this unit, student will be able to

- describe the basic organization of the computer systems.(L1)
- interpret the major components of operating systems.(L2)
- give an overview of the many types of computing environments.(L2)

Unit II: **8 L**

Operating system Structures: operating system services, User and operating system Interface, system calls, Types of System calls, system programs, operating system structure, system boot.

Process Management: Process concepts, process scheduling, Operations on processes, inter-process communication.

Learning Outcomes:

After completion of this unit, student will be able to

- describe the services an operating system provides to user's, processes, and other systems.(L1)
- explain the various ways of structuring an operating system.(L2)
- interpret the notion of a process- a program in execution and describe the various features of processes, including scheduling, creation and termination.(L3)
- analyze inter process communication using shared memory and message passing.(L4)

Unit III: **10 L**

CPU Scheduling: Scheduling-criteria, scheduling algorithms, Thread scheduling, Multiple processor scheduling, algorithm evaluation.

Process Synchronization: Critical section problem, Peterson's solution, synchronization hardware, Mutex locks, semaphores, classic problems of synchronization, monitors.

Learning Outcomes:

After completion of this unit, student will be able to

- identify CPU-scheduling and describe various CPU-scheduling algorithms.(L2)
- estimate evaluation criteria for selecting a CPU-scheduling algorithm for a particular system.(L2)
- identify critical section problem. (L2)
- find both hardware and software solutions to the critical section problem.(L1)
- classify several classical process synchronization problems.(L3)

Unit IV: **10 L**

Deadlock: System model, deadlock characterization, deadlock prevention, detection and avoidance, recovery from deadlock.

Memory Management: Swapping, contiguous memory allocation, paging, segmentation, structure of page the table.

Learning Outcomes:

After completion of this unit, student will be able to

- develop description of deadlocks.(L3)
- show a number of different methods for preventing or avoiding deadlocks.(L3)
- reproduce detailed description of various ways of organizing memory hardware.(L2)
- review various techniques of allocating memory to processes.(L2)

Unit V: **8 L**

Virtual memory: Demand paging, Copy-on-Write, page-replacement, allocation of frames, thrashing.

File Concepts: File concept, access Methods, directory and disk structure, protection.

Learning Outcomes:

After completion of this unit, student will be able to

- illustrate how paging works in contemporary computer systems.(L3)
- explain the concept of demand paging, page replacement algorithms, allocation of page frames.(L2)
- summarize briefly about file concepts.(L2)

Textbook(s):

1. Abraham Silberchatz, Peter B. Galvin, Greg Gagne, Operating System Concepts with Java, 9/e, John Wiley, 2016.

References:

1. Andrew S Tanenbaum, Modern Operating Systems, 2/e, Pearson/PHI, 2014.
2. Crowley, Operating System, A Design Approach, McGraw-Hill, 2012.
3. Stallings, Operating Systems - Internal and Design Principles, 5/e, 2013.
4. Pal Chaudhary, Operating system principles & Design, PHI Learning,1/e, 2013.
5. Deitel and Deitel, Operating System, Pearson Education, 2003.
6. D.M. Dhamdhere, Operating systems- A Concept based Approach-2/e, McGraw Hill, 2010.

Course Outcomes:

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

- illustrate the basic and overall view of operating system(L3)
- describe the structure of operating systems, applications, and services provided by operating systems(L2)
- analyze the concept of a process, process life cycle, process states and state transitions.(L4)
- implement various CPU scheduling strategies and process synchronization techniques.(L3)
- verify & resolve deadlock handling situation(L4)
- explain the importance of file structures in the data storage and manipulation.(L2)
- implement and practice various memory-management schemes.(L3)

19ECS476: INTRODUCTION TO BIG DATA

L	T	P	C
2	1	0	3

Thecourseisdesignedwhich largely involves collecting data from different sources, manage it in a way that it becomes available to be consumed by analysts and finally deliver data products useful to the organization business. The process of converting large amounts of unstructured raw data, retrieved from different sources to a data product useful for organizations by creating different applications using suitable Data Analytics for solving for different problems.

Course Objectives:

- Optimize business decisions and create competitive advantage with Big Data analytics.
- Introducing Java concepts required for developing map reduce programs.
- Derive business benefit from unstructured data.
- Analysing Business Solution to take decisions.
- Identifying social networks issues and relations.

Unit I: **8 L**

Objective: Learn how to collect data, data sampling and preprocessing.

Data Collection, Sampling, and Preprocessing: Types of Data Sources, Sampling, Type of Data Elements, Visual Data Exploration and Exploratory Statistical Analysis, Missing Values, Outlier Detection and Treatment, Standardizing Data, Categorization.

Learning outcomes:

After completion of this unit, student will be able to

- demonstrate Big Data Concepts (L1).
- identifying Statistical Exploration (L3).
- understanding Various Statistical Methods for Preprocessing (L5).

Unit II: **8 L**

Objective: Understanding different types of data analytics like descriptive & predictive analytics.

Predictive Analytics: Target Definition, Liner Regression, Logistic Regression, Decision Trees, Neural Networks, Support Vector Machines, Ensemble Methods, Multiclass Classification Techniques, Evaluating predictive Models.

Learning outcomes:

After completion of this unit, student will be able to

- applying descriptive Analytics to analyze the data for getting useful information (L1).
- applying Predictive Analytics for Data Analysis (L2).
- understanding Business Decisions (L3).

Unit III: **10 L**

Objective: Understanding how survival analysis supports to take decisions.

Survival Analysis: Survival Analysis Measurements, Kaplan Meier Analysis, Parametric Survival Analysis, Proportional Hazards Regression, Extensions of Survival Analysis Models, Evaluating Survival Analysis Models.

Learning outcomes:

After completion of this unit, student will be able to

- demonstrating survival analysis (L2).

- analyzing survival analysis to take decisions (L1).
- building Survival Analysis Models (L3).

Unit IV: **8 L**

Objective: Analyzing Social Network and Relations.
Social Network Analytics: Social Network Definitions, Social Network Metrics, Social Network Learning, Relational Neighbor Classifiers, Probabilistic Relational Neighbor Classifier.
Learning outcomes:
After completion of this unit, student will be able to
- evaluating social network and its relations: (L4)
- understanding Graph Structures of Social Networks: (L2)
- analyzing and Configuring Social Network Models: (L2)

Unit V: **10 L**

Objective: Understand how data analytics applied in different applications.
Analytics: Putting it all to Work- Back testing Analytical Models, Benchmarking, Data Quality, Software, Privacy, Model Design and Documentation, Corporate Governance.
Example Applications: Credit Risk Modeling, Fraud Detection, Recommender Systems, Web Analytics, Social Media Analytics, Business Process Analytics.
Learning outcomes:
After completion of this unit, student will be able to

- creating different applications by using suitable data analytics for solving different Problems (L1).
- illustrating Big Data Models for Business Processing (L3).
- understanding corporate governance (L5).

Text Book(s):
1. Analytics in a Big Data World: The Essential Guide to Data Science and its Applications by Bart Baesens. 2014, SAS Institute Inc.

References:

1. Data Analytics Models and Algorithms for Intelligent Data Analysis By Thomas A. Runkler Springer Vieweg 2012
2. Data Analytics Made Accessible -2018 by Anil K. Maheshwari.

Course Outcomes:
After completing this Course, the student should be able to
- demonstrate the big data concepts for real world data analysis (L1).
- understanding Survival Analysis and its models (L2).
- analyze and understanding Business models (L3).
- illustrate Social Network Models and its Properties (L4).
- building a complete business data analytic solution (L5).

19EHS475: ENTREPRENEURSHIP DEVELOPMENT

L	T	P	C
2	1	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 Entrepreneurshipanditsroleinthesociety.
- 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, Startup 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 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 Centers 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 centers(L2).

Unit IV: **8L**

Registration of Business Enterprises: Business Name registration; Trade Mark 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).
- estimatefunds 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. AryaKumar, "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

19ECE371: DISASTER MANAGEMENT

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

Most of the hazards turn into disasters due to unsustainable activities of human beingsand cannot be completely avoided. However, the impact can be mitigated by proper planning, preparedness and organizing at various levels. Civil Engineers may have to work in varied locations where in they have to encounter a variety of disaster scenarios. Hence, they need to have adequate knowledge to deal with these disasters. This subject is aimed at providing a detailed understanding of various phases of disaster management, vulnerability profileand organizational structure of disaster management in India, and applications of science & technology for better disaster management.

Course objectives;

- To explain Disaster management
- To illustrateVulnerability profile of India towards various disasters
- To interpretComponents of disaster relief, disaster management policies
- To identify latest trends in disaster management
- To inferoutcomes from various disasters in India

Unit I: 9L

Introduction to disaster management: Basic terminology (hazard, vulnerability, disaster, risk, exposure, resilience, capacity), classification of disasters, disaster mitigating agencies and their organizational structure at different levels (NDMA, NDRF, SDMA, DDMA), disaster management cycle.

Learning outcomes:

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

- define various terms related to disaster management (L1).
- classify various types of disasters (L2).
- illustrate the organizational structures of disaster mitigating agencies (L2).
- outline the significance of Disaster Management Cycle (L2).
- draw the disaster management cycle (L3).

Unit II: 8L

Vulnerability of profile of India: Vulnerability towards wind and cyclone, floods, earthquakes, heat waves, cold waves, dust storms, droughts, tsunamis, landslides, forest fires.

Learning outcomes:

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

- explain the vulnerability scenario of India with respect to various disasters (L2).
- mark the vulnerable zones with respect to various disasters in India (L3).

Unit III: 8L

Components of disaster relief: Water, food, shelter, protection and security, sanitation, health, waste management, financial assistance.

Institutional arrangements: Disaster management act 2005 and national policy on disaster management 2009.

Learning outcomes:

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

- state the components of disaster relief (L1).
- describe the significance of disaster relief components (L2).
- explain the significance of institutional arrangements (L2).

Unit IV: **9L**

Applications of science and technology for disaster management: Geo-informatics in disaster management (RS, GIS, GPS), disaster communication system (early warning and its dissemination), land use planning and development regulations, disaster safe designs and constructions, structural and non-structural mitigation of disasters.

Learning outcomes:

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

- explain the significance ofGeo-informatics in disastermanagement**,** disaster safe designs and constructions (L2).
- describe the functioning ofdisaster communicationsystem (L2).
- outline theland use planning and development regulations (L2).

Unit V: **8L**

Case studies: Related to various recent disasters of earthquake, tsunami, cyclone, flood, drought, landslides, volcanic eruption, forest fire, heat wave, cold wave.

Learning outcomes

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

- name various disasters occurred in India and worldwide (L1).
- identify major disasters in each category (L3).
- analyze various disaster management case studies (L4).

Text Book(s):

1. R.B.Singh, Disaster Management, Rawat Publications, 2000.

Reference Books:

1. Iyengar, Natural Hazards in the Urban Habitat, C.B.R.I., Tata McGraw Hill, 1997.
2. Jon Ingleton, Natural Disaster Management, Tulor Rose Holdings Pvt. Ltd., 1999.

Course outcomes:

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

- classify various types of disasters, explain disaster management cycle (L2).
- explain the vulnerability scenario of India with respect to various disasters (L2).
- describe the significance of disaster relief components, institutional arrangements (L2).
- explain the significance of geo-informatics, communication system in disaster management (L2).
- analyse various disaster management case studies (L4).

19EEC441: SATELLITE COMMUNICATIONS

L	T	P	C
3	0	0	3

The satellites are an essential part of telecommunication systems worldwide, which carry large number of data, telephone traffic in addition to television signals. This course deals with the satellite inventions, frequency allocation to different regions worldwide, and gives information about satellite orbits, satellite launching methods, design of satellite and satellite subsystems, satellite link over the earth, satellite application in communication, internet and remote sensing.

Course Objectives:

- To introduce invention of satellite and developments in worldwide.
- To explain the basics of orbital mechanics, the types of satellite orbits, the location of ground stations, and the look angles from ground stations to the satellite.
- To provide the knowledge of various modulation and multiplexing techniques in satellite communication.
- To familiarize the link budget for satellite performance
- To examine concepts of propagation losses in satellite networkingfor voice and internet communication, data networks, and scientific data.

Unit I: **8L**

Over view of satellite system: Introduction, Frequency allocation to satellite services, INTELSAT, INSAT.

Learning Outcomes:

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

- understand the basic information about satellite Communications System (L2).
- identify the frequency allocations to satellite services(L3).
- know the World wide and Indian satellite development(L6).

Unit II: **8L**

Orbits & Launching: Introduction, Kepler's laws, Orbital Elements, Tracking and orbit determination, orbital correction/control, satellite launch systems, multistage rocket launchers and their performance.

Learning Outcomes:

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

- understand the basics of orbital mechanics (L2).
- identify the satellite orbits(L3).
- design the satellite foot print area (L4).
- describe the satellite look angles(L4).

Unit III: **9L**

Elements of Communication Satellite Design: Spacecraft subsystems, reliability considerations, spacecraft integration, Satellite Access, Satellite onboard processing.

Learning outcomes:

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

- understand the satellite subsystems (L2).
- describe various modulation and multiplexing techniques used in satellite communication. (L2).
- describe practical look at the engineering impact of the various satellite components on performance(L4).

Unit IV: **8L**

Satellite Link Design: Performance requirements and standards, design of satellite links, Satellite Access, Satellite based personal communication.

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

- understand the link budget for satellite performance (L2).
- design the satellite communication link (L4).
- distinguish satellite based personal communication (L4).

Unit V: **8L**

Earth Station Design: Configurations, antenna and tracking systems, satellite broadcasting. Satellite applications in remote sensing (**Radarsat**).
Learning Outcomes:

After completion of this unit, the student will be able to
- understand earth station receivers (L2).
- design the communication antenna (L4).
- identify the remote sensing applications (L3).

Text Book(s):

1. Dennis Roddy, Satellite Communications, 4/e, Tata McGraw Hill, 2006.
2. T. Pratt, S. W. Bostian, Satellite Communication, 2/e, John Wiley and Sons,2006.

References:

1. Dharma Raj Cheruku, Satellite Communication, 1/e, IK InternationalPublishing, 2010.
2. D. C. Agarwal, Satellite Communication, 1/e, Khanna Publishers, 1991.

Course Outcomes:
After successful completion of this course, the student will be able to
- understand the basic information about satellite communications system (L2).
- identify the frequency allocations to satellite services, orbital mechanism substations(L4).
- design the communication link and its budget for satellite (L4).
- explain about earth station receivers and its main subsystems (L5).
- identify the remote sensing applications (L3).

19EEC443: DIGITAL SIGNAL COMPRESSION

L	T	P	C
3	0	0	3

Compression of digital signals is an important aspect in computer and communications technology. This course makes the students familiar with different types of compressiontechniques as well as the mathematical foundation for textual, audio, image and video compression and solve the problems associated with different source coding techniques.

Course Objectives:

- To understand the concepts of data compression, and algorithms for lossy and lossless data compression.
- To impart the knowledge of scalar and vector quantization.
- To understand the principles of Differential Encoding techniques.
- To develop the skill to analyze transform coding, signal modeling and its extension to compression with applications to speech, image and video processing.

Unit I: **9L**

Mathematical Preliminaries for Lossless Compression: Overview, a brief introduction to information theory, derivation of average information, models, coding.

Huffman Coding: Overview, the Huffman coding algorithm.

Arithmetic Coding: overview, introduction, coding a sequence, generating a binary code, comparison of Huffman and arithmetic coding, adaptive arithmetic coding.

Learning Outcomes:

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

- understand the concept of information theory (L1).
- derive the equation for average information (L4).
- distinguish between Huffman and arithmetic coding (L2).
- explain adaptive arithmetic coding (L2).

Unit II: **8L**

Mathematical Preliminaries for Lossy Coding: Overview, introduction, distortion criteria, information theory revisited, models. **Scalar Quantization:** Overview, introduction, the quantization problem, uniform quantizer, adaptive quantization, nonuniform quantization.

Learning Outcomes:

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

- understand the concept of lossy coding (L1).
- describe the concepts of information theory (L2).
- formulate quantization problem (L5).
- discriminate between uniform and nonuniform quantization (L4)

Unit III: **9L**

Vector Quantization: Overview, introduction, advantages of vector quantization over scalar quantization, the Linde-Buzo-Gray algorithm

Differential Encoding: Overview, introduction, the basic algorithm, prediction in DPCM, adaptive DPCM, delta modulation, speech coding.

Learning Outcomes:

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

- understand the concept of vector quantization (L1).
- discriminate vector quantization and scalar quantization (L4)
- formulate Linde-Buzo-Gray algorithm (L5).
- analyse coding algorithms (L4).

Unit IV: **8L**

Transform Coding: The Transform, Transforms of interest, quantization and coding of transform coefficients, application to image compression—JPEG, application to audio compression-the MDCT.

Subband Coding: Overview, introduction, filters, some filters used in subband coding, the basic subband coding algorithm.

Learning Outcomes:

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

- formulate the transforms of interest (L5).
- understand the concept of vector quantization (L1).
- apply transform principles to image compression, audio compression (L3).
- study the filters used in subband coding (L1).
- formulate subband coding algorithm (L5).

Unit V: **8L**

Audio Coding: Overview, introduction, MPEG audio coding **Video compression:** Overview, introduction, motion compensation, video signal representation, ITU-T recommendation H.261.

Learning Outcomes:

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

- state the difference between audio and video coding (L1).
- generate MPEG audio coding (L5).
- demonstrate video compression(L2).
- develop video standards (L3).

Text Book(S):

1. Khalid Sayood, Introduction to Data Compression, 4/e, Elsevier, India, 2012.

References:

1. 1.Jayant, Noll, Digital Coding of Waveforms-Principles and Applications to Speech and Video Prentice Hall, New York, 1984.
2. David Salomon, Data Compression: The Complete Reference, Springer, 2000.
3. ZiNian Li, Fundamentals of Multimedia, Pearson Education, 2003.

Course Outcomes:

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

- calculate the information content in a message given its probabilistic description(L2).
- compute Huffman and arithmetic coding for data compression (L4).
- compare different distortion criteria used in lossy coding (L2).
- design uniform, non-uniform and adaptive quantizers for a given input data with low quantization error (L5).

19EEC445: DIGITAL INTEGRATED CIRCUIT DESIGN

L	T	P	C
2	0	2	3

This course introduces the design and fabrication of digital integrated circuits usingvarious MOS technologies. Thefocus of this course is on the design and analysis of different combinational and sequential systems.This course is used to design and to implement the product level design blocks for VLSI applications.

Course Objectives:

- To impart basic knowledge of MOSFET, its circuit design and fabrication ofdigital circuits using NMOS, PMOS and CMOS technologies.
- To introducestick diagram, design rules and layouts.
- To expose combinational and sequential logic circuits using CMOS.
- To understand the concepts of adders, shifters, memory devices and system on chip design.

Unit I: **8L**

Fabrication and Devices: Fabrication process, structure of transistor, a simple transistor model, transistor parasitics, Tub ties and latchup, Fabrication errors, Scaling Theory and Practice,SCMOS design rules,Layout for circuits,Stick diagramsHierarchical stick diagrams.

Learning Outcomes:

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

- identify the different fabrication techniques (L1).
- explainscaling theory (L2).
- illustrate MOS design rules (L3).
- distinguish layouts and stick diagram for different MOS circuits (L4).

Unit II: **8L**

Logic Gates: Combinational logic functions, Gate structures, Basic gate layouts, Logic levels,Delay and transition time, Switch logics, Alternative gate circuits.

Learning Outcomes:

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

- illustrate different combinational logic functions using CMOS (L1).
- describe gate structures and its layouts (L2).
- classifydifferent delay types used in Gate circuits (L3).
- analyzeswitch logic and alternative gate circuits (L4).

Unit III: **8L**

Combinational Logic Networks: Standard cell based layouts, Combinational network delay, Logic and interconnect design, power optimization.

Learning Outcomes:

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

- state about single row and standard cell layout design (L1).
- predict path delay, fan-out, transistor sizing of combinational networks (L2).
- determine crosstalk minimization and wire sizingof interconnect design (L4).
- explain different power optimization techniques (L5).

Unit IV: **8L**

Sequential Machines: Latches and flip flops, Sequential systems and clocking disciplines, Performance of a flip flop based system,Performance of a latched based system, Clock skews, Clock generation, Structure specifications of a sequential machines.

Learning Outcomes:

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

- define latches and flip flops based on sequential circuits (L1).
- describe performance based latches and flip flops (L2).
- determine clock skews and clock generation (L4).
- analyze specifications of sequential machine (L4).

Unit V: **8L**

Subsystem Design: Combinational shifters, Adders, ALUs, Multipliers, ROM,STATIC RAM, The three and one transistor dynamic RAM, flash memory, multiprocessor system-on-chip design.

Learning Outcomes:

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

- design shifters and adders (L5).
- construct different ALUs and Multipliers(L3).
- differentiate between ROM and RAM (L4).
- understand flash memory and SOC design (L5).

Text book(s):

1. Wayne Wolf, Modern VLSI design,4/e, PHI learning.

References:

1. Weste, N. H. E., Harris, D. M, CMOS VLSI design: a circuits and systems perspective, Pearson/Addison-Wesley,2005.
2. Rabey, Digital integrated circuits, 2/e, PHI Learning.

Course Outcomes:

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

- understand MOS FET and its fabrication(L1).
- draw stick and layout diagram for CMOS circuits(L4).
- predict path delay, fan-out, transistor sizing of combinational networks (L2).
- construct shifter, adder, ALU and multipliers (L3).
- differentiate between ROM and RAM (L4).
- design flash memory and understand SOC design (L5).

19EEC447:MICROWAVE ANTENNAS

L	T	P	C
2	0	2	3

This course is an advanced course of Antennas. The prerequisite for this course is antenna analysis and design. This course starts with various broad band dipoles such as biconical, cylindrical, folded dipoles etc. and moves towards broad band antennas, frequency independent antennas and reflectors. This course introduces various antenna parameters and their measurements.

Couse Objectives:

- To understand the concepts of travelling wave and broad band antennas.
- To impart knowledge on antenna miniaturization and frequency independent antennas.
- To understand the concept of reflector antennas.
- To develop the skill to analyze various antenna parameter measurements.

Unit I: **10L**

Broadband dipoles: Biconical antenna, triangular sheet, bow-tie and wire simulation, cylindrical dipole and folded dipole.

Learning Outcomes:

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

- understand the concept of biconical antenna (L1).
- simulate wire antennas (L3).
- develop skill to analyze conical and folded dipoles(L4).

Unit II: **8L**

Traveling wave and broadband antennas: Introduction, long wire, V antenna, rhombic antenna and helical antenna.

Learning Outcomes:

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

- understand the concept of wire antennas (L2).
- analyze V antenna and rhombic antenna (L4).
- illustrate the operating modes of a helical antenna (L3).

Unit III: **10L**

Frequency independent antennas, antenna miniaturization: Introduction, theory, equiangular spiral antennas, log-periodic antennas, antenna miniaturization.

Learning Outcomes:

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

- understand the concept of frequency independent antennas (L2).
- understand the concept of antenna miniaturization (L4).

Unit IV: **8L**

Reflector antennas: Introduction, plane reflector, corner reflector.

Learning Outcomes:

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

- understand the concept of plane reflector (L2).
- analyze corner reflector for various angles (L4).

Unit V: **8L**

Antenna Measurements: Introduction, Antenna ranges, radiation patterns, gain measurements, directivity measurements, radiation efficiency, impedance measurements, current and polarization measurements.

Learning Outcomes:

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

- understand the concepts of basic antenna parameters (L2).
- develop skill in the measurement of various antenna parameters (L4).

Text Book(s):

1. Contantine A. Balanis, Antenna Analysis and Design, 3/e, Wiley Publications,2009.

2. A.R. Harish, M. Sachidananda, Antennas and Wave Propagation, 1/e, OxfordUniversity Press, 2007.

References:

1. E. C. Jordan and K. G. Balmain, Electromagnetic Waves and Radiation Systems,Prentice Hall of India, 2012.
2. RajeswariChatterjee, Antenna Theory and Practice, 2/e, New Age International Publishers, 2004.
3. F. E. Terman, Electronic and Radio Engineering, McGraw Hill, 1947.

Course Outcomes:

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

- explain various broadband antennas and simulate wire antennas. (L3)
- explain the concept of travelling wave antennas(L2).
- explain the concept of frequency independent antennas(L2).
- describe miniaturization of antennas (L4).
- compute the field radiated by a corner reflector(L5).
- measure various antenna parameters(L4).

19EEC449: IOT ARCHITECTURE

L	T	P	C
2	0	2	3

This course covers the architecture of IoT, design principles and its considerations. The first unit deals with the architecture of IoT and IoT framework. The next two units connectivity of the devices to the web. The last two units cover the data management, aggregation and development of IoT applications in real time with the hardware.

Course Objectives

- To understand the fundamental knowledge about IoT with examples
- To understand the design consideration to interface devices
- To understand the connectivity with the web
- To understand the data management on the web
- To design IoT applications in real time with hardware

Unit I: **9L**

Internet of Things: An Overview, Internet of Things, IoT conceptual framework, IoT architectural view, Technology behind IoT, Sources of IoT, M2M communication, Examples of IoT.

Learning Outcomes:

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

- discuss about the overview of IoT(L1).
- describe the architecture of IoT(L2).
- summarize the purpose of IoT applications with examples(L2).
- illustrate the M2M communication (L2).
- explain the technology behind IoT(L2).

Unit II: **9L**

Design Principles for Connected Devices: Introduction, IoT/M2M systems layers and designs standardisation, Communication technologies, Data enrichment, Data consolidation and device management at gateway, Ease of Designing and Affordability

Learning Outcomes:

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

- define the M2M layers of IoT (L1).
- outline the design standards (L2).
- demonstrate the data consolidation and management (L2).
- compare the communication technologies suitable for the application (L2).
- relate the cost effecting factors (L1).

Unit III: **9L**

Web communication protocols for connected devices, Message communication protocols for connected devices, web connectivity for connected-devices network using gateway, Internet connectivity principles, IP addressing in IoT, Proxy authentication, Media Access control, Application Layer Protocols.

Learning Outcomes:

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

- demonstrate the web communication protocols for IoT connected devices (L2).
- solve web connectivity with the gateway the exception or interrupt(L3).
- apply how to assign the IP addresses in IoT devices(L3).
- make use of Media Access control(L3).
- select the protocols at application layer(L4).

Unit IV: **8L**

Data acquiring and storage, Organizing the data, Analytics, Knowledge acquiring, managing and storing processes, cloud computing paradigm for data collection storage and computing, IoT cloud based services

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

- discuss about data acquisition and storage (L2).
- demonstrate the data organizing methods(L3).
- build cloud computingwith the data (L3).
- test for cloud based services used in IoT(L4).
- choose the data analytics in IoT(L3).

Unit V: **12L**

Sensor technology (Analog sensors and Digital sensors), Actuator, Sensor data communication protocols, Radio frequency identification technology, wireless sensor networks,Introduction to Arduino, Arduino IDE, NodeMCU, Introduction to Raspberry Pi.IoT case study:Smart city street lights control and monitoring.

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

- select the sensors based on the application (L3).
- experiment the data acquisition protocols of sensors (L4).
- determinethe hardware required to develop IoT such as Arduino and Raspberry Pi(L4).
- examine software required and use of IDE(L4).
- survey the smart city and street light monitoring with IoT(L4).

Text Book(s):

1. Raj kamal, "Internet of Things architecture and design principles ", 1ed, Mc Graw Hill.

References:

1. Vijay Madisetti and ArshdeepBahga, Internet of Things (A Hands-on-Approach), 1st Edition, VPT, 2014.
2. Francis daCosta, Rethinking the Internet of Things: A Scalable Approach to Connecting Everything, 1st Edition, Apress Publications, 2013.
3. Qusay F. Hassan, Internet of Things A to Z: Technologies and Applications Hardcover, 2018.

Course Outcomes:

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

- demonstrate the IoT architecture and supported technology (L2).
- suggesthow to connect devices to the internet (L2).
- apply the knowledge of web connectivity with devices (L3).
- explain the data storage and management (L2).
- decide the hardware and software required to develop IoT applications(L5).

19EEC451: SENSORS AND TRANSDUCERS FOR REMOTE APPLICATIONS

L	T	P	C
2	0	2	3

Understanding sensor design and operation typically requires a cross-disciplinary background, as it draws from electrical engineering, mechanicalengineering, physics, chemistry, biology, etc. The emphasis of this course is the design and understanding of sensors and transducers for remote applications and to understand the role of sensors and transducers in IOT system.

Course Objectives

- To discuss about units, standards, error analysis and characteristics of measurement systems.
- To familiarize the static and dynamic characteristics of transducers.
- To describe the principle of operation, construction and characteristics of resistance, inductance, capacitance and self-generatingsensors.
- To demonstrate telemetry system.
- To explain sensors and transducers for remote applications.

Unit I: **9L**

Introduction to Sensors and Transducers, Transducers classification-sensors and actuators, Static and dynamic characteristics of measurement system. Principles of Measurement and Analysis Units and standards, Errors, Functional Elements of a Measurement System and Instruments, Applications and Classification of Instruments, Types of measured Quantities, Measures of Dispersion, Sample deviation and sample mean, Calibration and standard.

Learning Outcomes:

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

- define measurement, error, sensor and actuator (L1).
- explain functional elements of measurement system (L4).
- classify Instruments (L3).
- list out applications of Instruments (L3).
- calculate dispersion, deviation and mean (L5).

Unit II: **7L**

Resistive Sensors - Potentiometers, strain gages (piezo-resistive effect), resistive temperature detectors (RTD), thermistors, magnetoresistors, light dependent resistor (LDR), resistive hygrometers, resistive gas sensors.

Learning Outcomes:

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

- define the principle of resistive sensor (L1).
- explain the operation of various resistive sensors (L2).
- identify resistive sensors for measurement of temperature, strain and light (L2).
- compare the types of resistive sensors (L3).

Unit III: **9L**

Reactive Sensors- Inductive sensors - variable reluctance sensors, Hall effect, Eddy current sensors, Linear variable differential transformers (LVDT), variable transformers, magneto-elastic, magneto-resistive, and magnetostrictive sensors. Capacitive sensors- variable capacitor, differential capacitor.

Learning Outcomes:

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

- state the principle of capacitive and Inductive sensor (L2).
- list out different inductive and capacitive sensors (L2).
- explain the operation of various inductive sensors (L1).
- discuss capacitor used for differential measurement (L2).

Unit IV: **7L**

Self generating Sensors Thermoelectric sensors, piezo-electric sensors, pyroelectric sensors, photovoltaic sensors, electrochemical sensors.

Learning Outcomes:

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

- define the self-generating sensor (L1).
- understand thermo, piezo and pyro electric sensors (L2).
- design photovoltaic sensors (L5).
- illustrate electrochemical sensors (L4).

Unit V: **8L**

Introduction to Telemetry principles, Basic System, Classification, Non-electrical Telemetry system, Voltage and Current Telemetry System, Local transmitters and convertors, frequency telemetering, Satellite Telemetry, Fibre optic telemetry

Learning Outcomes:

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

- explain the basic telemetry system (L1).
- classify telemetry systems (L2).
- differentiate non-electrical and electrical telemetry systems (L3).
- illustrate frequency and satellite telemetry (L2).
- explain fibre optic telemetry system (L1).

Text Book(s):

1. B. C. Nakra, K.K. Choudhury, "Instrumentation, Measurement and Analysis" -3rd Edition, Tata McGraw, 2009

References:

1. A.K. Sawhney, "Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai.
2. Er. R.K. Rajput, "Electronic Measurements and Instrumentation", S. Chand & Company Ltd. 3rd Edition.
3. Bentley, John P., "Principles of Measurement Systems", 4thedition, Pearson/Prentice Hall, 2005.
4. Jon. S. Wilson, "Sensor Technology Hand Book", Elsevier Inc., 2005.
5. D Patrabnis, "Telemerty Principles", Tata McGraw Hill, 2007.

Course Outcomes:

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

- define units and standards, their conversions, characteristics and error analysis of measurement systems (L1).
- classify and describe resistive, inductive and capacitive transducers which are used for measuring various

parameters like displacement, temperature, force and pressure etc (L3).

- differentiate resistive, inductive,capacitive andself-generating transducers (L4).
- select the sensors suitable for application (L4).
- explain telemetry systems used in remote applications (L2).
- design various telemetry systems (L5).

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

19EEC461: GLOBAL POSITIONING SYSTEMS

L T P C
2 0 2 3

The course is structured to introduce students to the basic principles of positioning features on the Earth's surface. This course is designed for engineering students and gives the details of the satellite constellation, data formats and Positioning Solution algorithm. This course focuses on exploring the different sources of errors and their mitigation techniques such as atmospheric errors, multipath errors and clock errors. The course is designed to give exposure to other global navigation systems such as Galileo and GLONASS and few applications of GPS for different fields of Engineering.

Course Objectives:

- To introduce the basic principles of Global Positioning System and the satellite constellation.
- To introduce about the signal structure and modulation schemes employed.
- To understand about the different error sources that affects the positioning accuracy.
- To understand about different reference frames and coordinate systems of positioning systems.
- To Introduce about the GPS orbits and the satellite and receiver position algorithm.
- To understand about the different error sources that affects the positioning accuracy.

Unit I: **8L**

Overview of GPS: Basic concept, system architecture, space segment, user segment, GPS aided Geo-augmented navigation (GAGAN) architecture.

Learning Outcomes:

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

- understand basic concept of Global Positioning (L1).
- illustrate the system architecture (L1).
- explain the different segments of the architecture (L2).
- identify the necessity of augmented systems like GAGAN (L3).

Unit II: **8L**

GPS Signals and other constellations: Signal structure, anti-spoofing (AS), selective availability, multi constellation:GALILEO constellation and signal structure, GLONASS constellation and signal structure.

Learning Outcomes:

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

- describe the signal structure of the GPS (L2).
- employ suitable modulation schemes to the navigation systems (L3).
- illustrate the Galileo and GLONASS constellation (L3).
- analyze the signal structure of the Galileo and GLONASS (L4).

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

- well Aquitaine with different reference frames (L3).
- understand the coordinate systems of Positioning systems(L3).
- differentiate the different coordinate systems (L3).

- understand GPS Time (L3).

Unit IV: **6L**

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

- summarize various satellite orbital parameters (L3).
- structure the receiver independent exchange format (RINEX) (L4).
- identify orbital parameters from navigation message (L4).
- categorize the observation data format (L4).
- formulate the GPS position determination algorithm (L5).

Unit V: **6L**

GPS Errors: GPS error sources – clock error, ionospheric error, tropospheric error, multipath, ionospheric error estimation using dual frequency GPS receiver.

Learning Outcomes:

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

- examine the different types of error sources (L4).
- relate the ionospheric error using real time data (L4).
- adapt the tropospheric error using real time data (L5).
- revise the multipath error using real time data (L5).

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.

References:

1. B.Parkinson, J.Spilker, Jr., GPS Theory and Applications, Vol. I, II, AIAA, 370 L'Enfant Promenade SW, Washington, DC 20024, 1996.
2. James Ba, Yen Tsui, Fundamentals of GPS Receivers A Software Approach, John Wiley and Sons, 2001.

Course Outcomes:

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

- illustrate the architecture of GPS (L1).
- discuss the need of augmentation systems (L2).
- estimate at least one /two errors with real time data and can compute the position in different reference frames (L3).
- systematize the orbital parameters and able to explain at least one engineering applications of GPS (L5).

19EEC463: BIOMEDICAL SIGNAL PROCESSING

L	T	P	C
2	0	2	3

Biomedical signal processing course introduces acquisition of biological signals and analysis using signal processing techniques. The course describe the observations of physiological activities of organism and extracting significant information. This course describes the methods to analyse biological signals for filtering and removal of artifacts.

Course Objectives

- To learn various types of biomedical signals and their analysis.
- To acquire knowledge on various filters used for the removal of artifacts.
- To gain familiarity in events and waves of signal.
- To discriminate wave shape and wave form complexity.
- To interpret frequency domain characteristics of biological signals.

Unit I: **8L**

Introduction to Biomedical Signals: The nature of biomedical signals, examples of biomedical signals, the action potential, electroneurogram (ENG), electromyogram (EMG), electrocardiogram (ECG), electroencephalogram (EEG), eventrelated potentials (ERPs), phonocardiograrn (PCG), objectives of biomedical signal analysis, difficulties in biomedical signal analysis.

Learning Outcomes:

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

- understand the nature of biomedical signals (L1).
- describe various types of biomedical signals. (L2).
- estimate the difficulties in biomedical signal analysis (L2).

Unit II: **8L**

Filtering for Removal of Artifacts: Random noise, structured noise, and physiological interference, stationary versus non stationary processes, noise in eventrelated potentials, high-frequecny noise in ECG, motion artifact in the ECG, powerline interference in ECG signals, timedomain filters, frequencydomain filters.

Learning Outcomes:

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

- understand various noises present in biomedical signals (L1).
- outline various noises and interferences in ECG signals (L2).
- suggest different time domain and frequency domain filters (L2).

Unit III: **8L**

Advanced Filtering Techniques: Adaptive filters for removal of interference, the adaptive noise canceller, selecting an appropriate filter, homomorphic filtering, generalized linear filtering, homomorphic de-convolution.

Learning Outcomes:

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

- describe the adaptive filtering techniques for removal of interference (L2).
- interpret the need of adaptive noise canceller (L1).
- develop homomorphic filtering and linear filtering for noise removal (L3).

Unit IV: **8L**

Event Detection: The P, QRS, and T waves in the ECG, the first and second heart sounds, EEG rhythms, waves, and transients, detection of events and waves, methods for QRS detection, correlation analysis of EEG rhythms,coherence analysis of EEG channels, the matched filter.

Learning Outcomes:

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

- demonstrate the P, Q, R, S and T waves in ECG (L2).
- employ different methods for QRS detection (L3).
- relate the correlation analysis of EEG rhythms (L4).

Unit V: **8L**

Frequency – domain Characterization: The effect of myocardial elasticity on heart sound spectra, frequency analysis of murmurs to diagnose valvular defects, Estimation of the Power Spectral Density Function, Measures Derived from PSD.

Learning Outcomes:

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

- infer the effect of myocardial elasticity on heart sound spectra (L4).
- determine frequency analysis of murmurs to diagnose valvular defects (L4).
- Systematize the estimation of the power spectral density function (L5).

Text Book(s):

1. Rangayyam, R.M., Biomedical Signal Analysis- A Case study approach, John Wiley, 2002.
2. Tompkins, W.J. (ed.), Biomedical Signal Processing, Prentice Hall, 1993.

References:

1. Eugene N.Bruce, Biomedical Signal Processing and Signal Modeling, Wiley Publications, 2000.

Course Outcomes

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

- understands the nature of various biomedical signals (L1).
- estimate the difficulties in biomedical signal analysis (L2).
- describe various noises present in biomedical signals (L2).
- differentiate the P, Q, R, S and T waves in ECG (L4).
- employ different filtering techniques for the removal of artifacts in biomedical signals (L3).
- relate the correlation analysis of EEG rhythms (L4).
- generate frequency domain characterization techniques of biomedical signals (L5).

19EEC465: ANALOG IC DESIGN

L	T	P	C
2	0	2	3

This course introduces the student, to the fundamentals of MOS device physics and building blocks of analog integrated circuit design. This course focuses on the analysis and design of single stage and differential amplifiers. Nanometer design concepts and their effects have been introduced in this course.

Course Objectives:

- To understand the working and modeling of NMOS and PMOS transistors.
- To analyze different single-stage MOS amplifiers.
- To illustrate the working of MOS differential amplifier for different loads.
- To devise different operational amplifier topologies using MOSFET.
- To impart the design procedure for amplifiers using nanometer transistors.
- To systemize different analog layout techniques used in designing of IC amplifiers.

Unit I: **8L**

Basic MOS Device Physics: General considerations, MOS I/V characteristics, second-order effects, MOS device models.

Learning Outcomes:

After completion of this unit, the student will be able to
- understand the physical structure of MOSFET (L1).
- describe the working of MOSFET in different operating regions (L2).
- estimate the second order effects in MOSFET (L2).
- model MOSFET for high frequency and low frequency operation (L4).

Unit II: **10L**

Single Stage and Differential Amplifiers: Common-source stage, source follower, common-gate stage, cascode stage, basic differential pair, common-mode response, differential pair with MOS loads.

Learning Outcomes:

After completion of this unit, the student will be able to
- outline different amplifier configurations using MOSFET (L2).
- determine various parameters of amplifier circuits (L3).
- describe the working of differential amplifiers (L2).
- analyze differential amplifier for common-mode and differential input voltages (L4).

Unit III: **10L**

Operational Amplifiers: General considerations, one-stage op Amps, two-stage op amps, gain boosting, common-mode feedback, input range limitations, high-slew-rate op amps, power supply rejection.

Learning Outcomes:

After completion of this unit, the student will be able to
- outline different operational amplifier topologies (L2).
- distinguish between single-stage and two-stage op-amps (L2).

- illustrate the need of common-mode feedback in operational amplifiers (L3).
- analyze various parameters of operational amplifier (L4).

Unit IV: **8L**

Nanometer Design Studies: Transistor design considerations, deep-submicron effects, trans conductance scaling, tansistor design, op amp design examples, high-speed amplifier.

Learning Outcomes:

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

- describe different deep-sub micron effects in MOSFET (L2).
- illustrate the sizing of transistors in amplifiers for given specifications (L3).
- summarize the performance of operational amplifier (L2).
- structure the design of high speed amplifiers (L4).

Unit V: **6L**

Layout and Packaging: General layout considerations, analog layout techniques, substrate coupling, packaging.

Learning Outcomes:

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

- categorize different analog layout techniques (L4).
- analyze the need of substrate coupling in analog layouts (L4).
- collate different packaging techniques available in ICs (L5).

Text Book(s):

1. BehzadRazavi, Design of Analog CMOS Integrated Circuits, 2/e, Mc-Graw Hill Education, 2017.

References:

1. Adel S. Sedra, Kenneth C. Smith, Microelectronic Circuits, 7/e, Oxford University Press.
2. R. Jacob Baker, CMOS Circuit Design, Layout and Simulations, 3/e, IEEE press, 2010.
3. David A. Johns, Ken Martin, Analog Integrated Circuit Design, John Wiley & Sons.
4. Robert L. Boylestad, Louis Nashelsky, Electronic Devices and Circuits Theory, 10/e, Pearson Education, 2009.

Course Outcomes:

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

- understand the working and modelling of MOS transistors (L2).
- analyze different single-stage and differential amplifiers (L3).
- demonstrate different single-stage and two-stage op-amp topologies (L3).
- analyse the design procedure of operational amplifiers and its performance (L4).
- systemize analog layout techniques (L5).
- collate different packaging techniques in integrated circuits (L5).

19EEC467: RADAR SYSTEMS

L	T	P	C
3	0	0	3

This course introduces the basic concepts and principles used in radar system. The course also explores different types of radars and their operation with schematic and analytical approach. The course describes applications of different radars used for military and civilian applications.

Course Objectives:

- To understand the basics of radar and study the effect of various parameters on the performance of radar.
- To analyze how the Doppler frequency shift is used for measuring the velocity of a moving target.
- To estimate the position of the target using CW and MTI radars.
- To interpret various radar tracking systems.
- To determine the signal-to-noise ratio, receiver noise, probability of detection and false alarms.

Unit I: **9L**

Introduction to Radar: Radar equation, radar block diagram and operation, radar frequencies, applications of Radar, prediction of range performance, minimum detectablesignal, receiver noise, probability density functions, signal tonoise ratio, integration of radar pulses, transmitter power, Pulse repetition frequency and rangeambiguities.

Learning Outcomes:

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

- identify different segments of a pulse radar and explain the function of each block (L1).
- relate the frequency bands in which radars are operating based on the application (L1).
- outline the various applications of radar (L2).
- predict the range to the target based on the radar range equation (L3).

Unit II: **8L**

CW and FMCW Radars: The Doppler effect, CW radar, Frequency-modulated CW radar: range and Doppler measurement, FMCWaltimeter; multiple frequency CW radar.

Radar Clutter: Introduction to radar clutter, surface clutter radar equation, sea clutter, detection of targets in sea clutter.

Learning Outcomes:

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

- determine the radial velocity of a moving target from the Doppler frequency shift (L2).
- distinguish CW and FM-CW radars (L2).
- determine the range using FM-CW radar (L3).
- identify the of target in the presence of clutter (L3).

Unit III: **8L**

MTI and Pulse Doppler Radar: Introduction, Pulse radar with Doppler information, MTI radar with delay-line canceler, MTI radarwith power-amplifier and power-oscillator transmitter, Delay-line cancelers: blind speeds, double cancellation; staggered PRFs, range-gated Dopplerfilter, Limitations to MTI performance, Non-coherent MTI, pulse Doppler radar.

Learning Outcomes:

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

- explain how the moving targets can be distinguished from stationery targets using A-scope (L2).
- explain the function of each block in MTI radar (L2).
- illustrate the use of delay-line canceler to separate moving targets from clutter (L3).
- distinguish MTI and Pulse Doppler radars (L4).

Unit IV: **6L**

Tracking Radar: Tracking with radar, sequential lobing, conical scan, monopulse tracking radar amplitude comparison monopulse radar with one angular coordinate, phase comparison monopulse radar, low-angle tracking, tracking in range, comparison of trackers.

Learning Outcomes:

After completion of this unit, the student will be able to
- discuss various tracking systems (L2).
- compare conical scan and amplitude comparison monopulse tracking systems (L4).
- propose the tracking of targets using range gates (L5).

Unit V: **9L**
Radar Receivers and detection of Radar signals in noise: The radar receiver, noise figure, radar displays, duplexers, receiver protectors, matched filter receiver, pulse c ompression
Special Purpose Radars-Synthetic aperture radar (SAR), Over-The-Horizon Radar, air-surveillance radar, electronic counter-counter measures.

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

- apply different types of radar displays and analyze the parameters displayed (L2).
- explain about radar receiver (L2).
- classify different pulse compression techniques used in radar (L3).
- determine signal-to-noise ratio, receiver noise, probability of detection and false alarms (L3).
- propose various counter and counter-counter measures (L5).

Text Book(s):
1. MerillI Skolnik, Introduction to Radar Systems, 3/e, Tata McGraw Hill, 2001.

References:
1. Mark A. Richards, James A. Scheer and William A. Holm, Principles of Modern radar: Basic principles, 1/e, Yes Dee Publishing Pvt. Ltd., 2012.
2. Byron Edde, Radar: Principles, Technology, Applications,1/e, PearsonEducation, 1993.
3. Simon Kingsley, Shaun Quegan, Understanding Radar Systems, 1/e, SciTech,1999.
4. M A Richards, J A Scheer, W. A. Holm, Principles of Modern Radar-BasicPrinciples, 1/e, Yesdee, 2010.

Course Outcomes:
After successful completion of this course, the student will be able to
- identify different segments of a Pulse radar and explain the function of each block (L1).
- explain the effect of various parameters on the performance of radar (L2).
- predict the range to the target based on the radar range equation (L3).
- illustrate the concepts of CW, MTI and Pulse Doppler radars (L3).
- compare various tracking systems (L4).
- detect the of target in the presence of clutter (L4).

- determine signal-to-noise ratio, receiver noise, probability of detection and false alarms (L4).

19EEC469: TV TECHNOLOGY

L	T	P	C
3	0	0	3

This course introduces the fundamentals of digital television broadcasting system and the factors affecting broadcast system performance. This course focuses on channel coding and modulation techniques used in digital TV transmission. The course also explores different types of transmitters used in digital TV and their performance measures.

Course Objectives:

- To understand the similarities between digital and analog systems for TV transmission and also various digital television transmission standards.
- To study channel coding and modulation techniques used in digital television transmission.
- To learn the relevant technology and information need for selection, installation, operation, and maintenance of digital TV transmitters.
- To estimate the criteria for transmission line selection for digital television system.
- To interpret the methods to characterize the RF performance of a digital television system.

Unit I: **8L**

Digital Television Transmission Standards ATSC terrestrial transmission standard, vestigial sideband modulation, DVB-T transmission standard, ISDB-T transmission standard, channel allocations, antenna height and power, MPEG-2

Performance Objectives for Digital Television: System noise, external noise sources, transmission errors, error vector magnitude, eye pattern, interference, cochannel interference, adjacent channel interference, analog to digital TV, transmitter requirements

Learning Outcomes:

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

- understand the block diagram of broadcast transmission system (L1).
- outline the ATSC terrestrial transmission standard, DVB-T transmission standard, ISDB-T transmission standard (L2).
- review the vestigial side band modulation for digital TV transmission (L2).
- estimate the performance objectives like system noise, average power, transmission errors (L2.

Unit II **8L**

Channel Coding and Modulation for Digital Television: Data synchronization, randomization/scrambling, forward error correction, interleaving, inner code, frame sync insertion, quadrature modulation, 8 VSB, bandwidth, error rate, COFDM, flexibility, bandwidth

Learning Outcomes:

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

- discuss ATSC data randomizer and understand data synchronization (L2).
- estimate the data payload data rate (fp), the block code bit error rate (fb) for forward error correction code (L2).
- employ ATSC precoder, trellis encoder, and mapper and also trellis code interleaver (L3).
- apply frame sync insertion, quadrature modulation, COFDM for bandwidth calculations (L3).

Unit III: **8L**

Transmitters for Digital Television: Pre correction and equalization, up conversion, precise frequency control, RF amplifiers, solid-state transmitters, RF amplifier modules, power supplies, cooling, automatic gain or level control, ac distribution, transmitter control, tube transmitters, performance quality.

Learning Outcomes:

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

- apply adaptive equalizer that reduces linear distortion to an acceptable level (L3).
- illustrate precise frequency control, RF amplifiers and power amplifiers (L3).
- structure the block diagram of centralized transmitter control and distributed transmitter control (L4).
- compare IOT efficiency vs output powerof the tube transmitters used in digital TV transmitters (L4).

Unit IV: **6L**

Transmission Line for Digital Television: Fundamental parameters, efficiency, effect of VSWR, system AERP, rigid coaxial transmission lines, dissipation, attenuation, and power handling, higher-order modes, peak power rating, frequency response, standard lengths, corrugated coaxial cables, wind load, waveguide, bandwidth, waveguide attenuation, power rating, frequency response, size trade-offs, waveguide or coax pressurization

Learning Outcomes:

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

- debate the fundamental parameters like characteristic impedance, phase velocity and efficiency of transmission line (L4).
- analyze efficiency, VSWR, system AERP (L4).
- categorize the attenuation and power handling of the rigid coaxial transmission lines(L4).
- demonstrate frequency response and standard lengths for the transmission lines (L3).
- recognize the corrugated coaxial cables and waveguides for digital TV transmission (L5).

Unit V: 6**L**

Test and Measurement for Digital Television: Power measurements, average power measurement, calorimetry, power meters, peak power measurement, measurement uncertainty, testing digital television transmitters.

Learning Outcomes:

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

- understand the importance of average and peak power to the transmission of digital TV (L2)
- estimate power using calorimetry (L3).
- test average power, peak power of transmitters using various power meters (L4).
- test the digital television transmitters (L4).

Text Book(s):

6. Gerald w. Collins, Fundamentals of Digital Television Transmission, John Wiley, 2001.

References:

13. R. R. Gulati, Modern Television Practice, Principles, Technology and servicing, 2/e, New Age International Publishers, 2001.
14. John Arnold, Michael Frater, Mark Pickering, Digital Television Technology and Standards, John Wiley, 2007.

Course Outcomes:

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

- compare digital TV transmission standards and performance with analog TV (L3).
- illustrate channel coding and modulation techniques for Digital TV (L2).
- analyze transmitting systems for Digital TV (L4).
- identify Transmission lines and antennas suitable for Digital TV (L3).
- test a Digital TV Transmitter and receiver (L4).

19EEC471: IOT IN HEALTH CARE

L	T	P	C
2	0	2	3

The emphasis of this course is on the design of Biotelemetry systems and how the health care can be modernized using Internet of Things. The Internet of Things (IoT), has an extensive applicability in numerous areas, including healthcare. Medical diagnostic consumes a large part of hospital bills. Technology can move the routines of medical checks from a hospital (hospital-centric) to the patient's home (home-centric). The course will develop a modelling system that helps the right diagnosis and also a lessen to the need of hospitalization

Course Objectives:

- To understand the basic concepts of biotelemetry systems.
- To study the sensors used in biotelemetry systems.
- To implement the sensor technologies in building a biotelemetry system.
- To illustrate the safety issues in biotelemetry systems.
- To analyse the applications of IOT in health care.

Unit I: **6L**

Introduction to biomedical telemetry, what is biomedical telemetry, typical biomedical telemetry system, challenges in biomedical telemetry, commercial medical telemetry devices.

Learning Outcomes:

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

- define a biotelemetry system (L1).
- understand a typical biomedical telemetry system (L3).
- analyse challenges in biotelemetry systems (L5).
- study the commercial telemetry systems (L2).

Unit II: **6L**

Sensing principles for biomedical telemetry, introduction, biosensor structure, electrochemical biosensors, ampero metric electrochemical biosensors, optical biosensors, thermal/calorimetric biosensors, piezoelectric biosensors, other types of biosensors

Learning Outcomes:

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

- understand the sensing principles for biomedical telemetry (L1).
- Generalize and classify various biosensors (L2).
- distinguish various biosensors for different applications (L2).

Unit III: **8L**

Sensing technologies for biomedical telemetry, introduction, non-invasive sensors and interfaces, invasive and implantable sensors

Learning Outcomes:

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

- describe the sensing technologies for biotelemetry systems (L2).
- classify and understand non-invasive sensors and interfaces (L2).
- review the invasive sensors and their interfaces (L3).
- compare non-invasive and invasive sensors (L4).

Unit IV: **8L**

Safety issues in biomedical telemetry, introduction, operational safety, product and device hazards, patient and clinical safety, human factor and use issues, electromagnetic compatibility and interference Issues, occupational safety

Learning Outcomes:

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

- explain the safety issues in biotelemetry systems (L2).
- describe the product and device hazards (L2).
- understand issues in patient and clinical safety (L2).
- illustrate compatibility and interference issues (L3).

Unit V: **8L**

IoT in biomedical applications IoT client & IoT gateway in healthcare, IoT driven smart health care application for every day use, life critical applications, health care IOT for rural area, Use of big data and visualization in IoT, Industry 4.0 concepts, sensor mark up language

Learning Outcomes:

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

- understand the role of IOT in biomedical applications (L2).
- integrate IOT client and IOT gateway in health care (L3).
- suggest healthcare IOT for rural area (L4).
- summarize the use of big data and visualization in IOT health care (L4).

Textbook(s):

1. K S Nikitha, "Handbook of Biotelemetry", Wiley publishers, 2014
2. Samuel Greengard, "The Internet of Things", MIT Press, 1stEdition, 2015

References:

1. D Patranabis, "Telemetry Principles", Tata McGraw Hills, 2007
2. Catarina I Reis and Maria D S Maximiano, "Internet of Things and Advanced Applications in Healthcare", IGI-Global, 2017

Course Outcomes:

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

- outline the IOT health care system (L2).
- suggest different sensors for IOT healthcare applications (L2).
- explain a typical biotelemetry system (L2).
- develop sensing technologies for IOT healthcare applications (L3).
- distinguish between invasive and non-invasive sensing technologies (L4).
- structure the IOT based health care systems for rural areas (L4).
- generate IOT client and IOT gateway in healthcare systems (L5).

19EHS403: ORGANIZATIONAL BEHAVIOR

L	T	P	C
3	0	0	3

Unit 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

Unit 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.

Unit 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.

Unit 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.

Unit V

Leadership: Definition, Behavioral theories – Blake and Mounton managerial grid, Contingency theories – hersey - 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 behaviour, organization development – quality of work life (QWL).

Text Books:

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.

References:

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.

19EEC491: PROJECT PHASE I

L	T	P	C
0	0	2	1

19EEC493: INTERNSHIP

L	T	P	C
			1

19EEC495: COMPREHENSIVE SKILL DEVELOPMENT VI

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 **- 3 Hours per week**

A. Verbal and Soft Skills:

Unit	Module/ Topics	Hrs
1.	Corporate Readiness 2	4
2.	Topic-Wise Discussion of Question Papers	4
3.	Mock Tests with Solutions 2	4
4.	Company-Specific Tests with Solutions 2	3
	Total	**15**

B. Placement and Career Guidance

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

Part-2 Domain Skills - 3 Hours per week

IoT: Control of led using Raspberry Pi Azure IoT Online Simulator, Read DHT11 using Raspberry Pi Azure IoT Online Simulator and upload data to cloud.

Communications: Design and evaluate OFDM waveforms in a wireless system, Digital communication with OFDM synchronization based upon the IEEE 802.11a standard.

Microcontroller: Construction and Development of an Automated Greenhouse System using Arduino Uno, Smart Water Tank **Level monitoring system** Arduino or any Microcontroller, **High power device control with** Arduino or any Microcontroller, Distance Measurement Using Infrared Sensor with ADC0804 & 8051 Microcontroller (AT89C51)

VLSI: Full Custom and ASIC Design methodologies, design simulation, layout and verification of 1-bit full adder, concepts of simulation, logic synthesis, static timing analysis, floorplanning, placement, routing and gds2 file generation

References:

1. https://howtomechatronics.com/arduino-projects/
2. https://in.mathworks.com/discovery/ofdm.html
3. https://in.mathworks.com/help/comm/ug/ofdm-synchronization.html
4. https://rees52.com/en
5. https://microcontrollerslab.com
6. https://www.asic-world.com/examples/systemverilog/index.html

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 understand the physical foundations of biological systems
- To learn various sensors and the various electrodes used in medical field.
- To introduce the student, the various sensing and measurement devices of electrical origin and also have a detailed understanding about the various electro physiological measurements in the human body.
- To understand the basic concepts of various medical imaging techniques and their applications.
- To bring out the important and modern methods of imaging techniques.

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

- list out the physiological systems of the human body (L1).
- illustrate the functional structure of cell (L1).
- distinguish between resting and action potentials (L2).
- summarize the function of heart (L2).
- design physiological signal amplifier (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).
- describe various electrode materials used in electrodes (L3).
- differentiate various types of electrodes (L4).
- illustrate the function of various transducers (L3).

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 measurement (L2).
- summarize the cardiac output measurement (L2).
- discuss the respiration rate measurement (L2).

- analyze ECG, EEG, EMG signals (L4).
- interpret safety measures taken in medical instrumentation (L6).

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
- list out the components and their functioning in ICCU (L1).
- discuss the role of central monitoring systems (L2).
- integrate patient monitoring through biotelemetry (L5).
- illustrate the function of pacemakers (L3).
- describe the role of 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
- summarize about X-RAY machines (L3).
- discuss the principles of CT (L2).
- analyze the CT number scale scanning systems (L4).
- describe the principles of NMR (L2).
- discriminate between NMR and MRI systems (L4).

Text Book(s):

1. Biomedical Instrumentation and Measurements, Leslie Cromwell, Fred J Weibell, and Erich A Pfeiffer, PHI/Pearson Education, 2003.
2. Hand Book of Biomedical Instrumentation, RS Khandpur, TMH, 2003.

References:

1. Principles of Medical Imaging, K.KirkShung, Benjamin Tsui and Michael. B. Smith, Academic Press Inc., New York.
2. Introduction to Biomedical Equipment Technology, Joseph J Carr, John M.Brown, 4th Edition, Pearson Education, Singapore, 2001.
3. Bio-Medical Instrumentation, M.Arumugam 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 measurement of various physiological parameters (L3).
- interpret safety measures taken in medical instrumentation (L6).
- illustrate functional units in patient monitoring systems and medical assisting devices used in patient monitoring (L3).
- distinguish different medical imaging systems(L4).

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

19EEI471: ROBOTICS AND AUTOMATION

L	T	P	C
2	1	0	3

Robotics and automation is a branch of Engineering that involves the design, manufacturing, and operation of robots. It overlaps many fields of Engineering including Electronics, Computer Science, Artificial Intelligence, Automation and Nanotechnology. This course has its applications in industries related to Aerospace, Defense contractors, Entertainment, Manufacturing, Medical research (development of prosthetic parts).

Course Objectives:

- To be familiar with history of robotics, technological advances and to gain insight on different types of End Effectors.
- To learn about different robotic drive systems, actuators and their control.
- To analyze the robotic Kinematics in different degrees of freedom.
- To study the principles of various Sensors used in robotics
- To explore industrial applications of Robotics.

Unit I: **9L**

Introduction: Historical robots, robots in science fiction, future trends of robots, definitions of robots, present application status.

Robot End Effectors: Classification of end effectors, drive systems for grippers, mechanical grippers, magnetic grippers, vacuum grippers, adhesive grippers, hooks, scoops and other miscellaneous devices, active and passive grippers.

Learning Outcomes:

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

- list important developments of robot history and future trends of robots (L1).
- classify robot end effectors (L3).
- identify appropriate grippers for a given application (L2).
- compare active and passive grippers (L4).
- discuss merits and demerits of grippers (L2).

Unit II: **9L**

Robot Drives, Actuators and Control: Functions of drive systems, general types of control, pump classification, introduction to pneumatic systems, electrical drives, dc motors and transfer functions, stepper motor, drive mechanisms.

Learning Outcomes:

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

- list the functions of robot drive system (L1).
- classify robot Pump mechanisms in hydraulic system (L3).
- explain the principle operations of DC motor and stepper motor (L2).
- discuss merits and demerits of Robot actuators (L2).
- choose an apt drive mechanism for a robot application (L2).

Unit III: **7L**

Robot Kinematics: Forward and reverse kinematics of 3 degrees of freedom robot arm, forward and reverse kinematics of a 4 degree of freedom, arm manipulator in 3-D, homogeneous transformations.

Learning Outcomes:

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

- define forward and reverse kinematics of a robot (L2).
- contrast between forward and reverse kinematics of a robot (L4).
- compare a 3 degree of freedom of robot with a 4 degree of freedom of robot (L4).
- analyze the robotic Kinematics in different degrees of freedom (L4).
- apply homogenous transformation in deriving kinematics of a robot (L3).

Unit IV: **9L**

Robot Sensors: Need for sensors, types of sensors, robot vision systems, robot tactile systems, robot proximity sensors, robot speech and hearing, speech synthesis, noise command systems, speech recognition systems.

Learning Outcomes:

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

- understand the need of sensors in robot development (L2).
- classify types of sensors used in robot development (L2).
- identify appropriate sensor's for a given robot application (L2).
- explain the principles of various Sensors used in robotics (L2).
- elaborate robot vision system and speech recognition system (L2).

Unit V: **9L**

Robot Applications: Capabilities of robots, materials handling, machine, loading and unloading, machining and fettling, robot assembly, welding, future applications.

Learning Outcomes:

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

- list capabilities of robots (L1).
- classify types of sensors used in robot development (L2).
- contrast between machine loading and unloading (L4).
- explain different industrial applications of robotics (L2).
- discuss future applications of robot (L2).

Text Book(s):

1. S.R. Deb, Robotics Technology and Flexible Automation, TMH, 2010.

References :

1. Satya Ranjan, Robotics Technology and Flexible Automation, TMH, 2001.
2. James L.Fuller, Robotics: Introduction, Programming and Projects, Maxwell Macmillan, 2000

Course Outcomes:

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

- get acquainted with history of robotics, technological advances and many types of End Effectors (L2).
- gain knowledge on different robotic drive systems, actuators and their control (L2).
- understand the robotic Kinematics (Robotic movements, Position and Orientation) (L2).
- select the Sensors based on different applications (L4).
- understand industrial applications of Robotics (L2).

19EEI472: INTRODUCTION TO MEMS

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 understand the fundamentals and applications of MEMS and micro systems.
- To learn the working principles of micro sensors and actuators.
- To acquire knowledge on various micro fabrication technologies.
- To learn the fundamentals of Micro characterization methods.
- To understand 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 students will 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 students will able to

- illustrate the working principles of various MEMS sensors (L1).
- compare the differences between micro sensors and actuators (L2).
- explain the operation of MEMS accelerometers, pressure sensors and gas sensors (L2).
- summarizes the advantages and limitations of various MEMS sensors and actuators (L2).
- lists 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 students 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 students 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 students will able to

- differentiate microelectronic packaging and microsystem packaging (L4).
- describe different interfaces in microsystem packaging (L2).
- summarizes the features of three dimensional packaging (L4).
- identify materials used for microsystem packaging (L1).
- describes major steps involved in pressure sensor packaging (L2).

Text Book(s):

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", Wiley, 2008.

References:

1. Vijay K. Varadan, K. J. Vinoy, S. Gopalakrishnan, Smart Material Systemsand MEMS: Design and Development Methodologies, John Wiley, 2006.
2. Mohamed GadelHak , The MEMS Handbook, University of Notre Dame,
3. M.-H. Bao, "Micromechanical Transducers: Pressure sensors, accelrometers, and gyroscopes", Elsevier, New York, 2000
4. M.J. Madou, "Fundamentals of Microfabrication",3rd Ed, CRC, 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,students 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).

19ECS478: INTRODUCTION TO DATA SCIENCE

L	T	P	C
2	1	0	3

Data Analytics is the science of analyzing data to convert information to useful knowledge. This knowledge could help us understand our world better, and in many contexts enable us to make better decisions. While this is the broad and grand objective, the last 20 years has seen steeply decreasing costs to gather, store, and process data, creating an even stronger motivation for the use of empirical approaches to problem solving.

Course Objectives

- To an understanding of how the nature of the data collection, the data itself, and the analysis processes relate to the kinds of inferences that can be drawn
- To understand the limitations of data sets based on their contents and provenance
- To provide knowledge of data organization, management, preservation, and reuse
- To familiarize general linear models and cluster analysis methods for statistical analysis
- To describe the Data Science Process and how its components interact.
- To reason around ethical and privacy issues in data science conduct and apply ethical practices.

Unit I: **9L**

Understanding Big Data: Concepts and Terminology, Datasets, Data Analysis, Data Analytics Business Intelligence, Key Performance Indicators, Big Data Characteristics, Different Types of Data, Metadata, Case Study

Business Motivations and Drivers for Big Data Adoption: Marketplace Dynamics, Business Architecture, Business Process Management, Information and Communications Technology, Data Analytics and Data Science, Digitization, Affordable Technology and Commodity Hardware, Social Media, Hyper-Connected Communities and Devices, Cloud Computing, Internet of Everything

Learning Outcomes:

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

- understand the terminology of Big data (L2).
- list Big Data characteristics (L1).
- identify different types of data (L2).
- analyze Big data with business perspective (L4).

Unit II: **10L**

Big Data Adoption and Planning Considerations : Organization Prerequisites , Data Procurement, Privacy, Security, Provenance , Organization Prerequisites , Data Identification , Data Acquisition and Filtering, Data Extraction, Data Validation and Cleansing, Data Aggregation and Representation, Data Analysis , Data Visualization, Utilization of Analysis Results.

Enterprise Technologies and Big Data Business Intelligence: Online Transaction Processing (OLTP), Online Analytical Processing (OLAP), Extract Transform Load (ETL), Data Warehouses, Data Marts, Traditional BI, Ad-hoc Reports, Dashboards, Big Data BI, Traditional Data Visualization, Data Visualization for Big Data, Enterprise Technology, Big Data Business Intelligence.

Learning Outcomes:

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

- illustrate how to handle data and its preprocessing (L3).
- appraise the usage of OLTP Vs. OLAP and ETL (L4).
- identify what is a data warehouse (L2).

- analyze how Big Data plays a role in BI (L4).

Unit III: **8L**

Big Data Storage Concepts: Clusters, File Systems and Distributed File Systems, NoSQL, Sharding, Replication, Master-Slave, Peer-to-Peer, Sharding and Replication, Combining Sharding and Master-Slave Replication, Combining Sharding and Peer-to-Peer Replication, CAP Theorem, ACID.

Big Data Processing Concepts: Parallel Data Processing, Distributed Data Processing, Hadoop, Processing workloads, Batch Processing with MapReduce, Map and Reduce Tasks, A Simple MapReduce Example, Understanding MapReduce Algorithms, Processing in RealTime Mode, Speed Consistency Volume (SCV), Event Stream Processing, Complex Event Processing, Realtime Big Data Processing and SCV, Realtime Big Data Processing and MapReduce

Learning Outcomes:

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

- analyze file system and distributed file system (L4).
- explain Sharding and replication (L2).
- understand Big data processing concepts (L2).
- Explain Map Reduce Algorithms (L2).
- appraise complex event processing (L4).

Unit IV: **10L**

Big Data Storage Technology: On-Disk Storage Devices, Distributed File Systems, RDBMS, Databases, NoSQL Databases, NewSQL Databases, In-Memory Storage Devices, In-Memory Data Grids, In-Memory Databases.

Big Data Analysis Techniques: Quantitative Analysis, Qualitative Analysis, Data Mining, Statistical Analysis, A/B Testing, Correlation, Regression, Machine Learning, Classification (Supervised Machine Learning), Clustering (Unsupervised Machine Learning), Outlier Detection, Filtering, Semantic Analysis, Natural Language Processing, Text Analytics , Sentiment Analysis, Visual Analysis, Heat Maps, Time Series Plots, Network Graphs, Spatial Data Mapping.

Learning Outcomes:

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

- explain big data storage technology(L2).
- analyze various big data analysis techniques(L4).
- illustrate natural language processing(L3).
- appraise text analytics and sentiment analysis(L4).

Unit V: **8L**

Information Management: The Big data foundation, Big data Computing Platforms, Big data computation, More on Big Data Storage, Big data computational limitations, Big data emerging technologies

Data Privacy and Ethics: The Privacy Landscape, The Great Data Grab isn't new, Preferences, Personalization, and Relationships, rights and responsibility, playing in a global sandbox.Conscientious and Conscious responsibility, privacy may be the wrong focus, can data be anonymized? Balancing for Counterintelligence.

Learning Outcomes:

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

- understand the overview of big data (L2).
- cite big data computational limitations (L2).
- explain big data emerging technologies (L2).
- appraise data privacy and ethics (L4).

Text Book(s):

1. Thomas Erl, WajidKhattak and Paul Buhler, Big Data Fundamentals, Prentice Hall 2015.
2. Michael Minelli, Michele Chambers, AmbigaDhiraj, Big Data Big Analytics, Wiley Publishing company, 2014

References:

1. Davy Cielen, Arno D.B.Meysman, Mohamed Ali, Introducing Data Science, Dreamtech Publishers,2018

Course Outcomes:

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

- understand the terminology of Big data, its characteristics and various types of data (L2).
- analyze a data warehouse, OLTP Vs. OLAP Vs. ETL (L4).
- appraise Big Data storage and processing concepts (L4).
- examine Big Data storage technology and analysis techniques (L3).
- explain Big Data computational limitations, emerging technologies, privacy and ethics (L3).

19ECS475: INTRODUCTION TO WEB TECHNOLOGIES

L	T	P	C
2	1	0	3

This course enables the students to associate with developing websites for hosting via intranet or internet. The web development process includes web design, web content development, client-side scripting, server-side scripting. Web development is the coding or programming that enables website functionality as per the owner's requirements. It mainly deals with the non-design aspect of building websites, which includes coding and writing markup.

Course objectives

- On completion of this course, a student will be familiar with client server architecture and able to develop a web application using java technologies. Students will gain the skills and project- based experience needed for entry into web application and development careers.
- Employ fundamental computer theory to basic programming techniques.
- Use fundamental skills to maintain web server services required to host a website.
- Select and apply markup languages for processing, identifying, and presenting of information in web pages.
- Use scripting languages and web services to transfer data and add interactive components to web pages.

UNIT I **10 L**

HTML Programming: HTML elements, working with images, working with lists, Introduction to forms, working with frames, Introduction to cascading style sheets: inline, External, Internal, Style classes, multiple styles.

JavaScript Programming: Introducing JavaScript, Client-side Benefits of using JS over VB script, Embedding JavaScript in an HTML page, Handling Events, Using variables in JavaScript, Creating Objects in JavaScript, Using array in JavaScript, Using Operators, Working with control flow Statements, Working with Functions.

Learning Outcomes

After completion of this unit, student will be able to

- Analyze the uses of CSS in developing web technologies.(L4)
- determine the uses of HTML and its basic tags and their uses.(L3)
- Understand the way CSS helps us develop full-fledged graphic web pages.(L2)
- Illustrate how java script is used in our day to day life.(L4)
- determine the basics of Elements in java script(L3).

UNIT II **10 L**

PHP Programming: Introducing PHP: Creating and Running a PHP script, working with Variables and constants, Exploring data Types in PHP, Exploring operators in PHP, controlling program flow: Conditional statements, Looping statements, Break, continue and Exit statements**.**

Forms: Working with the <form> Tag and its elements, Text box, radio button, checkbox, Drop down box, processing a Web Form, Validating a form.

Learning Outcomes

After completion of this unit, student will be able to

- describe initial concepts of PHP.(L2)
- write conditional and looping statements to develop full-fledged PHP programmes.(L6)
- Understand Forms in PHP.(L2)
- explain Arrays in PHP.(L3)
- write functions and Iterators to create programs in PHP. (L6)

UNIT III **8 L**

Working with functions and arrays in PHP: User-defined functions, Built- in functions, recursive, variable and call back functions, Arrays and Types of Arrays, Traversing Arrays Using Loops and Array Iterators, Built In Array functions.

Introduction to XML: Describing DTD, Xml Schemas, Document Object Model(DOM), Extensible Style sheet Language Transformation(XSLT), Simple API for XML(SAX).

Learning Outcomes

After completion of this unit, student will be able to

- Analyze the syntaxes of XML.(L4)
- review the different XML schemas used to develop web technologies(L2)
- Understand other XML technologies like XLink, XPointer and XQuery.(L2)
- Connecting to a database using PHP and MySQL.(L4)
- Applying the concept of tables in Databases using PHP and MySQL.(L3)

UNIT IV **8 L**

Introduction to Servlets: java servlet, servlet api, Servlet object, Lifecycle of a servlet, Deploying first Servlet App, Initialization parameters, handling http request& responses, using cookies, session tracking and security issues.

Learning Outcomes

After completion of this unit, student will be able to

- explain servlets in JAVA and how servlets can be used to develop web pages.(L2)
- Review the Lifecycle of a Servlet.(L2)
- Understand the concept of cookies and session tracking(L2)

UNIT V **8 L**

Introduction to JSP: Understanding JSP: advantage over servlets, tag based Approach, JSP Lifecycle: Page translation stage, compilation stage, Loading and Initialization stage, Request handling stage, Destroying Stage, Creating simple JSP pages.

Learning Outcomes

After completion of this unit, student will be able to

- determine the uses of JSP in creating web applications.(L3)
- Understand the different stages of JSP Lifecycle.(L2)
- describe the concepts used in Programming Using JDBC.(L2)
- review the javax.sql.* package and how it is useful in JSP.(L2)
- Analyze the components of JSP and how it helps us to connect to a database.(L4)

Text book(s)

1. Web Technologies: HTML, JAVASCRIPT, PHP, JAVA, JSP, XML and AJAX, Black Book bykogent leanrning solutions, published by dreamtech.
2. Jason Hunter, William Crawford, Java Servlet Programming, 2/e, O'Reilly,2003

References

1. XML: The Complete Reference –(by Williamson Heather published by Osborne publications 1/e)(UNIT 3)

2. Robert W.Sebesta, Programming the World Wide Web, 4/e, PearsonEducation,2007.

Course Outcomes:

After completion of the course the student will be able to (L6)

- develop a dynamic webpage by the use of java script and DHTML.
- write a well formed / valid XML document.(L6)
- connect a java program to a DBMS and perform insert, update and delete operations on DBMS table.(L4)

- write a server side java application called Servlet to catch form data sent from client, process it and store it on database.(L6)
- write a server side java application called JSP to catch form data sent from client and store it on database.(L6)

19ECS474: INTRODUCTION TO CLOUD COMPUTING

L	T	P	C
2	1	0	3

This course will help the students to get familiar with Cloud Computing Fundamental concepts, technologies, architecture and state-of-the-art in Cloud Computing fundamental issues, technologies, applications and implementations.

Course Objectives:

- To impart fundamental concepts in the area of cloud computing.
- To impart knowledge in applications of cloud computing.
- To provide sound foundation of the cloud computing.
- To explore some important cloud computing driven commercial systems and other businesses cloud applications.
- Solution for the various issues in cloud computing.

UNIT I **10 L**

Introduction**:** Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity in Cloud

Learning Outcomes:

After completion of this unit, student will be able to

- apply the concept of Cloud Computing(L3)
- identify parallel computing(L1)
- describe cloud characteristics(L2)
- construct cloud(L6)
- evaluate distributed computing(L4)

UNIT II **10 L**

Cloud Enabling Technologies: Service Oriented Architecture – REST and Systems of Systems – Web Services – Publish-Subscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices

Learning Outcomes:

After completion of this unit, student will be able to

- examine SOA(L1)
- state REST. (L!)
- identify Virtualization(L1)
- formulate Types of virtualization(L6)

UNIT III **8 L**

Cloud Architecture, Services And Storage Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds – laaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3.

Learning Outcomes:

After completion of this unit, student will be able to

- describe Cloud architecture.(L2)
- apply Iaas, Paas(L3)
- compare Cloud Services((L2)
- choose Cloud storage(L3)
- evaluate Cloud Storage providers(L4)

UNIT IV **8 L**

Resource Management And Security In Cloud Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – es – Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Virtual Machine Security Security Standards.

Learning Outcomes:

After completion of this unit, student will be able to

- apply Resource Management(L3)
- interpret Resource Provisioning(L2)
- evaluate Security Overview(L4)
- determine VMS(L3)
- determine Security Standards(L3)
- explain Security Governance(L2)

UNIT V **8 L**

Cloud Technologies And Advancements: Hadoop – MapReduce – Virtual Box— Google App Engine – Programming Environment for Google App Engine—Open Stack – Federation in the Cloud – Four Levels of Federation – Federated Services and Applications.

Learning Outcomes:

After completion of this unit, student will be able to

- understand Hadoop(L2)
- describe GoogleApp Engine(L2)
- describe OpenStack(L2)
- explain Federation in cloud(L2)

Text book(s)

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2. Rittinghouse, John W., and James F. Ransome , —Cloud Computing: Implementation, Management and Security, CRC Press, 2017.

References

1. RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi, —Mastering Cloud Computing, Tata Mcgraw Hill, 2013.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing – A Practical Approach, Tata Mcgraw Hill, 2009.
3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), O'Reilly, 2009

Course Outcomes

After completing this course student will be able to

- explain the main concepts, key technologies, strengths and limitations of cloud computing.(L2)
- apply the key and enabling technologies that help in the development of cloud.(L3)
- explain use the architecture of compute and storage cloud, service and delivery models.(L2)
- explain the core issues of cloud computing such as resource management and security.(L2)
- evaluate and choose the appropriate technologies, algorithms and approaches for implementation and use of cloud.(L4)

19EME349: Total Quality Management

L	T	P	C
2	1	0	3

This Course is to introduce the applications to formulate new plans/procedures to be implemented to achieve the desired quality status by knowing about the various principles of quality management. The total quality management tools will help the student to understand the procedures in measuring the quality of the organization/process and will also enable them to identify the parameters that are improving/depriving the quality. By knowing about the quality ISO systems, the student will maintain processes/documentation properly so that the quality maintained by the organization gets recognized.

Course objectives:

1. The overall purpose of the course is to provide an understanding of the process of managing quality and managing services.
2. The principles of Quality, Quality Assurance, and Total Quality Management will provide an insight into the concepts of Excellence and Best Value and the contribution of quality to strategic management
3. Understand the usage of several techniques and quality management tools.
4. Identify the elements that are part of the quality measuring process in the industry.
5. Learn various Customer satisfaction measurement techniques

Module I: **Quality, Strategic Planning and Competitive Advantage** Number of hours(LTP) 9 0 0

Brief history, definitions of quality. Quality in manufacturing and service systems. Quality and price, quality and market share, quality and cost, quality & competitive advantages. ISO 9000, 14000.

Module II: **Managing and Organization for Quality** Number of hours(LTP) 9 0 0

Quality policy, quality objectives, leadership for quality, quality and organization culture, cross-functional teams, supplier/customers partnerships.

Module Ill: **Quality Control and Improvement Tools** Number of hours(LTP) 9 0 0

Cheek sheet, histogram, pareto chart, cause and effect diagram, scatter diagram, control chart, graph, affinity diagram, tree diagram, matrix diagram, process decision program chart, arrow diagram, acceptance sampling, process capability studies, zero defect program (POKA-YOKE)

Module IV: **Quality Circles** Number of hours(LTP) 9 0 0

Concept and total quality through bench marking, Japanese 5-S, quality management systems QS 9000, ISO 14000. Statistical process control: Control chart - X bar R, P, np and C Charts, benefits of control charts and applications (10 %)

Module V: **Customer Focus and Six sigma principles** Number of hours(LTP) 9 0 0

Customer satisfaction measurement techniques, customer relationship management techniques, Concept of Six Sigma, Six Sigma for manufacturing, Six Sigma for service, Understanding Six Sigma organization.

Text Books(s)

1. **J.M.** Juran, & F.M. Gryna, Quality Planning and Analysis, McGraw-Hill, 1993
2. Dale H.Besterfiled, et al., "Total Quality Management", Pearson Education, lnc.2003. (Indian reprint 2004).

3. Evans. J. R. & Lindsay. W, M "The Management and Control of Quality", (5thEdition),SouthWestern (Thomson Learning), 2002
4. Geoff Tennant, Six Sigma: SPC and TQM in Manufacturing and Services, 1/e, Gower Publishing Ltd., 2001.

Reference Book(s)

1. J.Bank, Essences of Total Quality Management, Prentice Hall, 2007
2. Joel E. Ross - Text & Cases, Total Quality Management, St. Lucie Press, 1995
3. D.L. Goetsch & S. Davis, Introduction to Total Quality, Prentice- Hall, 2002.
4. R. Cavanagh, R. Neuman, P. Pande, what is Design for Six Sigma, 1/e, Tata McGraw- Hill, 2005.

Course Outcomes:

1. Understand the fundamental principles of Total Quality Management
2. Choose appropriate statistical techniques for managing and improving processes in Organisations
3. Develop skills on Quality control and improvement tools
4. Understand benefits of control charts and their applications
5. Analyse Customer relationship management techniques

19EME357: Supply Chain Management

L	T	P	C
2	1	0	3

The course under Operations and supply chain management has been designed to cover the basic concepts of operations management and supply chain management. The students will understand the role of logistics, drivers and metrics in supply chain and how to design the network. The students will understand the globalization and its risks and forecasting in supply chan. The students will understand collaborative planning and replenishment strategies and how to manage uncertainties in inventory. The students shall also be able to understand the role of information technology in inventory management and transportation in supply chain.

Course objectives:

1. To introduce operations management, role and responsibilities of operations manager.
2. To explain the importance of logistics and supply chain management and the relevant drivers and metrics.
3. To demonstrate the technique of forecasting to reduce uncertainty by identifying the risks in a global supply chain setting
4. To impart knowledge of collaborative planning, forecasting and replenishment methodologies to achieve better coordination in a supply chain.
5. To summarize the importance of technology in operations, logistics and supply chain management.

Module I: **Introduction to Operations Management** Number of hours(LTP) 9 0 0

History of operations management, types of manufacturing systems, roles and responsibilities of operations manager, Product operations and service operations, Current Trends in Operations Management

Module II: **Understanding the Logistics and Supply Chain** Number of hours(LTP) 9 0 0

Introduction to supply chain, supply chain links, role of logistics in supply chain, drivers and metrics in supply chain, designing the supply chain network, online sales and distribution network, factors influencing the network design.

Module III: **Impact of Uncertainty in Network** Number of hours(LTP) 9 0 0

Globalization and supply chain, risk management in global supply chain, demand forecasting in supply chain role of information technology in forecasting.

Module IV: **Coordination in Supply Chain** Number of hours(LTP) 9 0 0

Collaborative planning and replenishment strategies, CPFR, managing uncertainties in inventory.

Module V: **Impact of Replenishment Policies in Safety Inventory** Number of hours(LTP) 9 0 0

Role of information technology in inventory management, transportation in supply chain.

Text Books(s)

1. Sunil Chopra, Supply Chain Management, Pearson Publications, 2012.

Reference Book(s)

1. Sridhara Bhatt, Logistics and Supply Chain Management, Himalaya Publishers, 2011
2. D.K Agarwal, Logistics and Supply Chain Management, Macmillan Publishers, 2013.

Course Outcomes:

1. Understand the fundamental principles of Total Quality Management
2. Choose appropriate statistical techniques for managing and improving processes in Organisations
3. Develop skills on Quality control and improvement tools
4. Understand benefits of control charts and their applications
5. Analyse Customer relationship management techniques

After successful completion of this course, the students will be able to

- identify strategic and operational frameworks to analyze supply chains (L4).
- design a supply chain network (L6).
- describe inventory control models and develop inventory control systems under deterministic and constrained scenarios (L2)
- develop inventory control systems under probabilistic scenarios (L6).
- develop a detailed knowledge of the inventory management in improving the performance of the supply chain (L6).
- outline different collaboration method in supply chain performance enhancement (L2).

Text Book(s):

1. D. Simchi-Levi, P. Kaminsky, E. Simchi-Levi, Ravi Shankar. Designing & Managing the Supply Chain: Concepts, Strategies & Case Studies, 3/e, Tata McGraw-Hill, 2007.
2. S. Chopra, P. Meindl, Supply Chain Management: Strategy, Planning & Operations, 1/e, Pearson India, 2012.

References:

1. Janet Shah, Supply Chain Management: Text and Cases, 1/e, Prentice Hall Ltd., 2009.
2. R.J. Tersine, Principles of Inventory & Materials Management, 4/e, Pearson, 1993.

19EEC442: SOFTWARE DEFINED NETWORKS

L	T	P	C
2	0	2	3

This course is to expose the students to the most recent technological developments in mobile communication systems. The course is intended to understand the basic concepts of cellular and mobile communications, various elements in the design of a cellular system and describes the advances in mobile communications. The case studies such as how to improve the coverage area, reduce the interference, frequency and channel assignment towards real time applications also developed in the course.

Course Objectives:

- To understand the basic cellular system concepts.
- To familiarize various propagation models and speech coders used in mobile communication.
- To study the basic principles of modern mobile and wireless communication systems.
- To demonstrate the operation of mobile communications systems and their generation divisions.
- To expose the students to understand mobile radio communication principles and to study the recent trends adopted in cellular systems.

Unit I

INTRODUCING SDN **8L**

SDN Origins and Evolution – Introduction – Why SDN? - Centralized and Distributed Control and Data Planes - The Genesis of SDN

Learning Outcomes:

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

- identify the difference between mobile and cellular communication (L1).
- understand the performance criteria of a cellular system (L1).
- explain the use of hexagonal shaped cells (L2).
- outline the between analog and digital cellular systems (L2).

UNIT II

SDN ABSTRACTIONS 8L

How SDN Works - The Openflow Protocol - SDN Controllers: Introduction – General Concepts - VMware - Nicira - VMware/Nicira - OpenFlow-Related - Mininet - NOX/POX - Trema - Ryu - Big Switch Networks/Floodlight - Layer 3 Centric - Plexxi - Cisco OnePK

Learning Outcomes:

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

- understand the concept of frequency channels (L2).
- estimate the co-channel interference reduction factor and C/I (L2).
- describe the concept of omnidirectional Antenna system (L2)
- interpret the concept of Cell splitting (L3).

Unit III: **8L**

PROGRAMMING SDN'S: Network Programmability - Network Function Virtualization - NetApp Development, Network Slicing

Learning Outcomes:

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

- interpret the concepts of channel assignments to cell sites and mobile units (L3).
- organize the channel sharing and borrowing, sectorization (L3).
- illustrate about dropped calls and cell splitting, types of handoff (L3).
- summarizethe concepts of digital cellular networks (L4).

UNIT IV
SDN APPLICATIONS AND USE CASES 8L
SDN in the Data Center - SDN in Other Environments - SDN Applications - SDN Use, Cases - The Open Network Operating System 3

Learning Outcomes:

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

- estimate the effect of signal reflection in flat and hilly terrain (L3).
- summarize the concept of phase difference between direct and reflected paths. (L4)
- analyze mobile propagation over water and flat open area (L4).

Unit V: 8L
SDN'S FUTURE AND PERSPECTIVES: SDN Open Source - SDN Futures -

Learning Outcomes:

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

- describe sum and difference patterns and their synthesis (L2).
- determine the interference reduction (L4).
- analyze the parameters of cell-site antennas (L4)

Textbooks:

1. Paul Goransson and Chuck Black, Software Defined Networks: A Comprehensive Approach Morgan Kaufmann Publications, 2014
2. Thomas D. Nadeau & Ken Gray, SDN - Software Defined Networks by O'Reilly, 2013

References

1. SiamakAzodolmolky, Software Defined Networking with OpenFlow Packet Publishing, 2013
2. Feamster, Nick, Jennifer Rexford, and Ellen Zegura. "The road to SDN: an intellectual history of programmable networks." ACM SIGCOMM Computer Communication Review 44.2 (2014): 87-98.
3. Kreutz, Diego, et al. "Software-defined networking: A comprehensive survey." Proceedings of the IEEE 103.1 (2015): 14-76.

Nunes, Bruno AA, et al. "A survey of software-defined networking: Past, present, and future of programmable networks." Communications Surveys & Tutorials, IEEE 16.3 (2014): 1617-1634.

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

- summarize evolution, performance criteria of cellular systems (L1).
- explain the concepts of handoff, frequency reuse, and operation of cellular systems (L3).
- analyze the antenna system, parameters, and their effects in the reduction of C/I ratio (L4).
- analyze various methodologies to improve the cellular capacity(L4).

- estimate the path loss slope and the propagation effects of signal under various environment conditions (L4)
- integrate the development and implementation of mobile communication systems (L5).

19EEC444: SPEECH PROCESSING

L	T	P	C
2	0	2	3

This course introduces the student to audio engineering, its applications and perspectives in real time environment. The morphological techniques in speech processing, homomorphic speech processing, pitch estimation, Hidden Markov models of speech processing are discussed. It familiarizes the student about different filters used in speech processing for noise less transmission and uniform transmission of speech signals from source to destination.

Course Objectives:

- To explore the applications of signal processing in audio engineering.
- To provide an understanding of hearing perception and homomorphic speech processing.
- To familiarize speech recognition systems and voice verification
- To introduce uniform lossless speech transmission, linear predictive coding of speech, delta modulation of speech and voice recognition systems

Unit I: **8L**

Introduction: Speech signal, signal processing, digital speech processing. Digital models for speech signals: Process of speech production, acoustictheory of speech production, uniform lossless tube models, digital models for speech signals, hearing and auditory perception.

Learning Outcomes:

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

- understand speech processing block diagram and acoustics (L1).
- explain uniform lossless transmission (L2).
- describe digital models for speech signals (L2).
- demonstrate hearing perception (L3).

Unit II: **8L**

Time-Domain Methods for Speech Processing: Time-dependentprocessing of speech, short-time energy and average magnitude, short-timeaverage zero-crossing rate, speech vs. silence discrimination, pitch periodestimation using the autocorrelation function. Digital representation of the speech waveform: Instantaneous quantization, adaptive quantization, general theory of differential quantization, delta modulation.

Learning Outcomes:

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

- illustrate silence versus speech discrimination (L1).
- explain short time average zero crossing rate (L2).
- describe pitch period estimation and adaptive quantization (L2).

Unit III: **8L**

Short-Time Fourier Analysis: Fourier transform interpretation, linear filtering interpretation, filter-bank summation method of short-time synthesis, spectrographic displays, analysis-synthesis systems.

Homomorphic Speech Processing: Homomorphic systems for convolution, complex spectrum of speech, pitch detection, formantestimation, homomorphic vocoder.

Learning Outcomes:

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

- describe speech signals using short-time Fourier transform (L2).
- explain filter bank analysis and synthesis (L2).
- describe Homomorphic speech processing and voice coder (L2).

Unit IV: **8L**

Linear Predictive Coding of Speech: Basic principles of linear predictive analysis, computation of the gain for the model, solution of the LPCequations, relations between the various speech parameters, synthesis of speech from linear predictive parameters, application of LPC parameters.

Learning Outcomes

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

- explain linear predictive coding of speech (L2).
- illustrate speech parameters (L2).
- summarize applications of LPC parameters (L4).

Unit V: **8L**

Voice response systems, speaker recognition systems : Speech recognition systems. Speech enhancement in noise, Single channel speech enhancement methods, beamforming with microphone array speech,distortion measurement.

Learning Outcomes:

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

- explain speech recognition and single channel speech enhancement methods (L2).
- describe beamforming with microphone array speech (L2).
- demonstrate distortion measurement (L3).

Text Book(s):

1. 1.Rabiner L.R., Schafer R.W., Digital Processing of Speech Signals, 1/e, Prentice Hall of India, 1978.

References:

1. 1.Thomas F. Quatieri, Discrete-Time Speech Signal Processing, Principles and Practice, Pearson Education, 2002.
2. Ian McLaughlin, Applied Speech and Audio Processing with MATLAB examples, Cambridge University Press, 2010.

Course Outcomes:

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

- explain the applications of speech acoustics in real time environment (L2).
- describe in detail about zero crossing rate and digital representation of speech (L2).
- use analysis and synthesis filterbanks to filter speech signals (L3).
- explain the basics of Homomorphic speech processing and its application(L5).
- apply linear predictive coding to speech signals (L3).
- debate the speech recognition systems (L4).

19EEC446: FUNDAMENTALS OF SEMICONDUCTOR DEVICES

L	T	P	C
2	0	2	3

Modern day Integrated circuit(IC) design revolves around physical effects in miniaturized semiconductor devices, and the developments in device architectures to overcome those limitations. This demands the need for gaining familiarity with basic principles and applications of semiconductor devices. This course is designed emphasizing the basic concepts and applications of semiconductor devices, along with the exposure to device design for modern day ICs.

Course Objectives:

- To understand the basic principles of semiconductor devices.
- To improve the knowledge of circuit analysis, by imparting basics of semiconductor devices.
- To inculcate intuitive thinking, for simplifying the mathematical treatment of devices.
- To get familiarity with compact models of semiconductor devices, relevant to circuit design.
- To improve the ability to analyze devices.
- To understand the importance of circuit and device simulators.

Unit I: **8L**

Crystal lattices: Periodic structures, cubic lattices, planes and directions, diamond lattice. **Atoms and Electrons:** Introduction to physical models, experimental observations, the photoelectric effect, atomic spectra. The Bohr model, Quantum mechanics, probability and the uncertainty principle, The Schrodinger wave equation, potential well problem, tunneling. excess carriers in semiconductors (qualitative treatment).

Learning Outcomes:

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

- understand the fundamentals of crystal lattice structures (L1).
- describe the principles of Quantum mechanics (L1).
- outline practical material systems (L2).

Unit II: **8L**

Energy Bands and Charge carriers: Bonding forces and energy bands in solids: Bonding forces in solids, energy bands, metals, semiconductors, and insulators, direct and indirect semiconductors. Charge carriers in semiconductors, electrons and holes, effective mass, intrinsic material, extrinsic material. carrier concentrations, the Fermi level, electron and hole concentrations at equilibrium, temperature dependence of carrier concentrations, compensation and space charge neutrality. Drift of carriers, conductivity and mobility, drift and resistance, effects of temperature and doping on mobility, high field effects, Hall effect.

Learning Outcomes:

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

- understand various types of materials and their band structures (L1).
- outline semiconductor physics and mechanisms (L2).
- distinguish between electrical properties of Silicon and Germanium (L2).

Unit III: **6L**

P-N Junctions: Equilibrium conditions: The contact potential, equilibrium fermi levels, space charge at a junction. Forward and reverse biased junctions, steady state conditions, qualitative description of current flow at a junction, carrier injection, reverse bias. Reverse-bias breakdown: Zener breakdown, avalanche breakdown. Transient and ac conditions, time variation of stored charge, reverse recovery transient, switching diodes, capacitance of p-n junctions. Deviations from the simple theory

Learning Outcomes:

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

- understand equilibrium, forward and reverse bias conditions (L1).
- describe the operation of P-N junction diode (L2).
- illustrate application of P-N Junction diode as switch (L3).
- develop various circuits using P-N junction diode (L3).

Unit IV: **8L**

Field Effect Transistor: The metal-insulator-semiconductor FET: Basic operation, the ideal MOS capacitor, effects of real surfaces, threshold voltage, MOS capacitance-voltage analysis.

The MOS Field-Effect Transistor: Output characteristics, transfer characteristics, mobility models, short channel MOSFET I-V characteristics, control of threshold voltage, substrate bias effects, sub threshold characteristics, equivalent circuit for the MOSFET

Learning Outcomes:

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

- understand the electrostatics of MOS capacitor (L1).
- illustrate parameter extractions from Capacitance-Voltage curves (L3).
- develop the electrostatics of MOS Transistor (L3).
- distinguish long-channel and short-channel MOSFET characteristics and parameters (L4).

Unit V: **6L**

Bipolar Junction Transistors: Fundamentals of BJT Operation, amplification with BJTs, minority carrier distributions and terminal currents, solution of the diffusion equation in the base region, evaluation of terminal currents, approximations of the terminal currents, current transfer ratio. Generalized Biasing, the coupled-diode model, charge control analysis. Switching, cutoff, saturation, the switching cycle, and specifications for switching transistors. Small-signal equivalent circuit.

Learning Outcomes:

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

- understand the physical operation of BJT (L1).
- illustrate applications of BJT as switch (L3).
- distinguish various physical models of BJT (L4).

Text Book(s):

1. Ben G. Streetman, Solid State Electronic Devices, 6/e, Prentice Hall India, 2009.
2. Robert F.Pierret, Semiconductor device fundamentals, Pearson Publications, 2006.

References:

1. Yuan Taur, Tak.H. Ning, Fundamentals of Modern VLSI Devices, Cambridge University Press, 1998
2. Donald Neamen, Semiconductors Physics and Devices, Tata Mc Graw Hill, 2003
3. Tyagi, Introduction to Semiconductor Materials and Devices, Wiley Publications, 2002.
4. S.M. Sze (Ed), Physics of Semiconductor Devices, 2/e, Wiley Publications, 1998
5. Jasprit Singh, Semiconductor Devices, Basic Principles, Wiley Student Edition, 2001

Course Outcomes:

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

- understand the principles of Quantum mechanics (L2).
- to analyze semiconductor devices (L4).
- understand and develop compact models for semiconductors (L3).
- analyze and design various circuits using P-N junction diode (L4).
- analyze the characteristics of MOSFET and BJT (L4).

19EEC448: EMI AND EMC TECHNIQUES

L	T	P	C
3	0	0	3

Electromagnetic Pollution is a major concern in today's world. This course is designed for understanding Electro Magnetic Interference and to provide knowledge related to sources of EMI and aspects of EMC measurements about radiated emissions and radiated susceptibility are necessary to know about radiation levels. This course focuses on understanding the concept of coupling mechanisms of EMI and immunity to conducted EMI and EMC standards.

Course Objectives:

- To understand the concepts of electro-magnetic interference and electro-magnetic compatibility.
- To impart the knowledge of sources of EMI and their constraints.
- To illustrate concepts of EMC mesurements.
- To develop the skill to analyze Electro-Magnetic Interference and aspects of EMC and its Standards.

Unit I: **8L**

Natural and Nuclear Sources of EMI/EMC: Electromagnetic environment, history, concepts, practical experience and concerns, frequency spectrum conservations, an over-view of EMI/EMC, natural and nuclear sources of EMI

Learning Outcomes:

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

- state the concept of electromagnetic environment (L1).
- illustrate about sources of EMI and their constraints (L1).
- describe various sources of EMI (L2).
- determine frequency spectrum space (L3).

Unit II: **8L**

EMI from Apparatus,circuits and Open Area Test Sites : Electromagnetic emissions, noise from relays and switches,non-linearities in circuits, passiveinter-modulation, cross-talk in transmission lines, transients in power supply lines, electromagnetic interference (EMI), open area test sites and measurements

Learning Outcomes:

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

- understand the concept of non-linearities in circuits (L2).
- analyze noise from relays and switches (L2).
- estimate cross-talk in transmission lines (L3).
- describe EMI/EMC measurements using open area test sites (L3)
- calculate induced voltages and currents due to transients (L4).
- determine surges on mains power supply (L4).

Unit III: **8L**

Radiated and Conducted Interference Measurements and ESD: Anechoic chamber, TEM cell, GH TEM cell, characterization of conductionCurrents/voltages, conducted EM noise on power lines, conducted EMI fromEquipment, immunity to conducted EMI detectors and measurements. ESD, Electrical fast transients/bursts, electrical surges

Learning Outcomes:

After completion of this unit, the student will be able to
- understand the laboratory approach for EMI/EMC measurements (L1).
- describe EMI/EMC measurements using TEM cell (L2).
- determine quality ofanechoic chamber (L3).
- conduct EMI/EMC measurements using Giga-Hertz TEM cell (L3).
- estimate conduction currents and voltages (L3).
- illustrate pulsed mode of interferences (L3).

Unit IV: **8L**
Grounding, Shielding, Bonding and EMI Filters: Principles and t ypes of grounding, shielding and bonding, characterization of filters, power lines filter design

Learning Outcomes:

After completion of this unit, the student will be able to
- understand techniques to control EMI (L1).
- determine shielding effectiveness (L3).
- illustrate about characterization of filters (L3).
- design power line filter (L4).

Unit V: **9L**
Cables, Connectors, Components and EMC standards: EMI suppression cables, EMC connectors, EMC gaskets, isolation transformers, optoisolators, national and international EMC standards

Learning Outcomes:

After completion of this unit, the student will be able to
- understand several EMI suppression devices and components (L1).
- illustrate the working principle of isolation transformers (L2).
- demonstrate about EMC gaskets (L3).
- describe about Opto-Isolators (L4).
- identifythe significance of EMC standards (L4).

Textbook(s):

1. V.P. Kodali, Engineering Electromagnetic Compatibility, 2/e, IEEE Press, 2000

References:

1. Clayton R Paul, Introduction to Electromagnetic Compatibility, John Wiley and Sons, 2010
2. Electromagnetic Interference and Compatibility IMPACT series, IIT Delhi (Units1- 9)

Course Outcomes:
After successful completion of this course, the student will be able to
- describe the electromagnetic interference and the concept of different coupling mechanisms of EMI (L1).
- understand how to conduct radiated and conducted interference measurements (L2).
- explain about characteristics of EMI filters (L2).
- describe the significance of EMC standards (L3).
- determine EMI from apparatus and circuits (L3).

19EEC450: EMBEDDED SYSTEMS

L	T	P	C
2	0	2	3

This course introduces the student to the basic concepts and building blocks of Embedded systems Embedded systems are all over homes, offices, cars, factories, hospitals and consumer electronics in today's world. The course describes how the systems are literally embedded in all electronic products, from consumer electronics to office automation, automotive, medical devices and communications. The course explores the methods to make the products smart, connected and are responsible for differentiating the products in the market.

Course Objectives:

- To understand the basic concepts, building blocks of embedded systems.
- To explore the fundamentals on board and external bus communication in embedded systems.
- To discuss the embedded software tools, different phases and modeling of embedded system.
- To develop on processor scheduling algorithms, basics of real time operating system.
- To familiarize the concepts required to make the products smart.

Unit I: 8L

Introduction To Embedded Systems: Embedded systems vs general computing systems, history of embedded systems, classification of embedded systems, major application of embedded systems, purpose of embedded systems, elements of an embedded systems, core of the embedded systems, memory.

Learning Outcomes:

After completion of this unit, the student will able to

- define embedded systems (L1).
- recall the difference between embedded system and general computing system (L1).
- select the hardware components in embedded systems (L1)
- describe the purpose of an embedded systems (L2)

Unit II: 8L

Communication buses in embedded systems: On board communication interfaces,I2C ,SPI bus, 1Wire bus, parallel interface, external communication interfaces, RS-232, RS-485, USB,IEEE 1394 fire wire bus, IrDA, bluetooth, Wi-Fi, zigbee.

Learning Outcomes:

After completion of this unit, the student will able to

- identify the buses required for the application (L1).
- demonstrate the use of communication buses in an embedded system (L2).
- differentiate the on board and external buses (L4).
- outline the wired vs wireless bus interfaces (L4).

Unit III: 8L

Software Development Tools: Software development environment-IDE, assembler, compiler, linker, simulator, debugger, in-circuit emulator, target hardware debugging, need for hardware-software partitioning and co-design, overview of UML, scope of UML modeling, conceptual model of UML, architectural, UML basic elements-diagram- modeling techniques - structural, behavioral, activity diagrams

Learning Outcomes:

After completion of this unit, the student will able to

- select the software tools required to develop embedded system (L1).

- explain the structural and behavioral modeling (L2).
- develop UML diagrams (L3).
- plan the software and hardware co-design (L5).

Unit IV: **6L**

Introduction to real-time operating systems: A brief history of operating systems, defining an RTOS, the scheduler, introduction to task, task states and scheduling, round-robin scheduling algorithm, co-operative scheduling algorithm, preemptive scheduling algorithm, introduction to semaphores.

Learning Outcomes:

After completion of this unit, the student will able to

- compare operating system required for embedded system (L2).
- determine the scheduling algorithm suitable for the application (L3).
- categorize the task and its states (L4).
- distinguish semaphores (L4).

Unit V: **6L**

Embedded system application development: Objectives, different phases and modeling of the embedded product development life cycle (EDLC), case studies on smart card- adaptive cruise control in a car -mobile phone software for key inputs.

Learning Outcomes:

After completion of this unit, the student will able to

- develop mobile phone software for key inputs (L3).
- determine the different phases involved in developing the embedded systems (L4).
- build the adaptive cruise car control (L5)
- compile the smart card case study (L5).

Text Book(s):

1. Rajkamal, Embedded system-Architecture, Programming, Design, 3e, TMH, 2017.
2. Shibu.K.V, Introduction to Embedded Systems, Tata McGraw Hill, 2017

References:

1. Peckol, Embedded system Design, John Wiley & Sons, 2010
2. Lyla B Das, Embedded Systems-An Integrated Approach, Pearson,2013

Course Outcomes:

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

- understand the software tools required to develop an embedded systems (L1).
- describe the differences between the general computing system and the embedded system, the classification of embedded systems (L3).
- design real time embedded systems using the concepts of RTOS (L5).
- design a system component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability (L5).

19EEC452: MEMS AND NANOSENSORS

L	T	P	C
3	0	0	3

Preamble: *Miniaturization in electronic systems has led to reduce the size of sensors. MEMS and nanosensors are miniaturized devices compatible with microelectronics. This course introduces the fundamentals and applications of MEMS and Nanosensors. The course emphasizes the working principles, fabrication technologies and packaging methods of MEMS and Microsystems. This course also deals with a brief introduction to various types of nanosensors.*

Course Objectives:

- To understand the fundamentals and applications of MEMS and microsensors.
- To derive the engineering mechanics for microsystems design.
- To acquire knowledge on various micro fabrication technologies.
- To learn the fundamentals of nanosensors and their applications.
- To visualize the future trends of nanosensors.

Unit I: **6L**

Introduction to MEMS and Microsystems: Evolution of microfabrication, Microsystems and microelectronics, Microsystems and miniaturization, Applications of MEMS in the health care, consumer products and telecommunications. **Microsensors:** Acoustic wave sensors, Biomedical sensors and Biosensors, optical sensors, pressure sensors, thermal sensors

Learning Outcomes:

After completion of this unit, the student will able to

- get an overview of MEMS and microsystems (L1).
- state the need for miniaturization (L1).
- list the applications of MEMS (L2).
- differentiate microsystems and microelectronics (L2).
- compare macro and microsensors (L2).

Unit II: **8L**

Engineering Mechanics for microsystems design: Static bending of thin plates, mechanical vibration, Thermo-mechanics, Fracture mechanics, Thin film mechanics, Overview of finite element stress analysis.

Learning Outcomes:

After completion of this unit, the student will able to

- illustrate the static bending of thin plates (L1).
- demonstrate design theory of micro accelerometers (L2).
- explain the thermal effects on mechanical strength of materials (L1).
- state interfacial fracture mechanics (L1).
- use the finite element stress analysis in microsystem design (L3)

Unit III: **10L**

Fabrication processes for MEMS and microsystems: Introduction to microfabrication, photolithography, ion implantation, diffusion, oxidation, CVD, PVD-sputtering, etching. Bulk micromachining, Surface micromachining, LIGA process

Learning Outcomes:

After completion of this unit, the student will able to

- list the various fabrication processes in MEMS design and development (L2).
- describe photolithography, ion implantation and diffusion (L2).
- explain CVD and sputtering (L1).
- distinguish chemical and plasma etching (L4).

- compare bulk and surface micromachining processes (L2).

Unit IV: **8L**

Nano Sensors: Definition and classification of nano-sensors, physical, chemical and biological nano-sensors, examples of nano-sensors-CNT nano sensors, nano scaled thin film sensors, microcantilever and nanocantilever enabled sensors.

Learning Outcomes:

After completion of this unit, the student will able to

- define nanosensors (L1).
- classify nanosensors (L2).
- illustrate a CNT nanosensor (L2).
- explain a nano scaled thin film sensor (L1).
- compare microcantilever and nanocantilever enabled sensors (L3).

Unit V: **8L**

Future trends of nano sensors: interfacing nano sensors with human beings, three main types of nano sensors, using the response properties of the same nanomaterials in different types of nanosensors, nano biosensors, in vivo nanosensor problems, interfacing issues for nano sensors

Learning Outcomes:

After completion of this unit, the student will able to

- explain the future trends of nanosensors (L1).
- use the engineering dynamics in microsensor design (L2).
- use the response properties of nanomaterials in different types of nanosensors (L3).
- illustrate in-vivo nanosensor problems (L4).
- describe the interfacing issues for nanosensors (L2).

Text Book(s):

3. Tai-Ran Hsu, "MEMS & Microsystems – Design and Manufacture", TataMcGraw Hill Education Private Limited, 2012
4. Vinod kumar Khanna, "Nanosensors-physical, chemical and biological", CRC press, Taylor and Francis group, 2012.

References:

6. G.K. Ananthasuresh, K.J. Vinoy, S. Gopalakrishnan, K.N. Bhat, V.K. Aatre, Micro and Smart Systems, Wiley India, 2010.
7. Tai-Ran Hsu, "MEMS and Microsystems: Design and Manufacture", Wiley, 2008.
8. Vinod Kumar Khanna, Nano sensors: Physical, Chemical and Biological, Series in Sensors, CRC press Taylor and Francis Group, 2012.
9. Mohamed Gadel Hak , The MEMS Handbook, University of Notre Dame,

Course Outcomes:

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

- understand MEMS and list various microsensors (L1).
- acquires knowledge on micro sensors (L2).
- illustrate various MEMS fabrication processes (L3).
- differentiate micro and nanosensors (L4).
- explain the interface of nanosensors with human beings (L1).

19EEC492: PROJECT PHASE II

L	T	P	C
0	0	12	6

HSMCH102 - UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY

L T P C
2 1 0 3

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 four fold:

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)

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