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

REGULATIONS AND SYLLABUS

of

Master of Technology

in

CAD/CAM

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

A University Committed to Excellence

M.Tech. in CAD/CAM

REGULATIONS

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

1. ADMISSION

Admission into M.Tech. in CAD/CAM program of GITAM (Deemed to be University) is governed by GITAM admission regulations.

2. ELIGIBILITY CRITERIA

2.1 A pass in B.E./B.Tech./AMIE in Mechanical/Production/Industrial Engineering branch of Engineering or its equivalent.

2.2 Admissions into M.Tech. will be based on the following:

(i) Score obtained in GAT (PG), if conducted.

(ii) Performance in Qualifying Examination / Interview.

(iii) Candidates with valid GATE score shall be exempted from appearing for GAT (PG).

2.3 The actual weightage to be given to the above items will be decided by the authorities at the time of admissions.

3. CHOICE BASED CREDIT SYSTEM

3.1 Choice Based Credit System (CBCS) was introduced with effect from 2015-16 admitted batch and revised with effect from academic year 2019-20 in order to promote:

- Student centered Learning
- Activity based learning
- Students to learn courses of their choice
- Cafeteria approach

3.2 Learning objectives and outcomes are outlined for each course to enable a student to know what he/she will be able to do at the end of the program.

4. STRUCTURE OF THE PROGRAM

4.1 The Program Consists of

i) Core Courses (compulsory) which give exposure to a student in core subjects related area.

ii) Program Electives.

iii) Open Electives

iv) Mandatory and Audit Courses

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 four semesters M.Tech. program is designed to have a total of 68 credits for the award of M.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 for the courses in each semester at the time specified in the 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 semester-end 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 to the students whose attendance is between 65% and 74% on genuine grounds and on payment of prescribed fee.

8. EVALUATION

8.1 The assessment of the student'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 student has to secure a minimum of 40% in any theory course in the two components (ref. 8.1) put together to be declared to have passed the course, subject to the condition that the student 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/ Project Work/ Viva voce/ Seminar etc. course are completely assessed under Continuous Evaluation for a maximum of 100 marks, and a student has to obtain a minimum of 40% to secure Pass Grade. Details of Assessment Procedure are furnished below in Table 1.

8.4 Audit courses are assessed through continuous evaluation for satisfactory or not satisfactory only. No credits will be assigned.

Table 1: Assessment Procedure

S.No.	Component of Assessment	Marks Allotted	Type of Assessment	Scheme of Evaluation
	Theory Courses	40	Continuous Evaluation	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
		60	Semester-end Examination	
	Total	100		
2	Practical Courses	100	Continuous Evaluation	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	Technical Seminar (II Semester)	100	Continuous Evaluation	Through five periodic seminars of 20 marks each
4	Project Work (III Semester)	100	Continuous Evaluation	i) Forty (40) marks for periodic assessment 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	Project Work (IV Semester)	50	Continuous Evaluation	i) Twenty (20) marks for periodic assessment on originality innovation, sincerity and progress of the work, assessed by the project supervisor. ii) Fifteen (15) marks for mid-term evaluation for defending the project, before a panel of examiners*. iii) Fifteen (15) marks for interim report presentation and viva-voce.
		50	Semester-end Examination	Fifty (50) marks for final project report and viva-voce examination assessed by external examiners.
	Total	100		
6	Audit Courses	100	Continuous Evaluation	Audit courses are assessed for PASS or FAIL only. No credits will be assigned to these courses. If a student secures a minimum of 40 out of 100 marks during continuous evaluation, he / she will be declared PASS, else FAIL. PASS grade is necessary to be eligible to get the degree

**Panel of Examiners shall be appointed by the concerned Head of the Department*

9. PROVISION FOR ANSWER BOOK VERIFICATION AND CHALLENGE EVALUATION

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

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

10. SUPPLEMENTARY AND SPECIAL EXAMINATIONS

10.1 The odd semester supplementary examinations will be conducted after conducting regular even semester examinations during April/May.

10.2 The even semester supplementary examinations will be conducted after conducting regular odd semester examinations during October/November.

10.3 A student who has secured 'F' Grade in Project work shall have to improve his/her work and reappear for viva-voce after satisfactory completion of work approved by panel of examiners.

10.4 A student who has completed period of study and has "F" grade in final semester courses is eligible to appear for special examination.

11. MASSIVE OPEN ONLINE COURSES (MOOCs)

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 up to first semester are permitted to register for MOOCs in second semester up to a maximum of 6 credits from program elective / open elective/audit 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).

12. GRADING SYSTEM

12.1 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

Sl.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	-

12.2 A student who earns a minimum of 4 grade points (P grade) in a course is declared to have successfully completed the course, and is deemed to have earned the credits assigned to that course, subject to securing a GPA of 5.0 for a Pass in the semester.

13. GRADE POINT AVERAGE

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

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

where, C = number of credits for the course,
G = grade points obtained by the student in the course.

13.2 The Cumulative Grade Point Average (CGPA), is calculated using the above formula considering the grades obtained in all the courses, in all the semesters up to that particular semester.

13.3 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 the first attempt.

14. ELIGIBILITY FOR AWARD OF THE M.Tech. DEGREE

14.1 Duration of the program: A student is ordinarily expected to complete the M.Tech. Program in four semesters of two years. However a student may complete the program in not more than four years including study period.

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

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

a) Registered and successfully completed all the courses and project works.

b) Successfully acquired the minimum required credits as specified in the curriculum corresponding to the branch of his/her study within the stipulated period.

c) Has no dues to the Institute, Hostels, Libraries, NCC / NSS etc, and

d) No disciplinary action is pending against him / her.

15. 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.

M.Tech. in CAD/CAM
Department of Mechanical Engineering
Effective from academic year 2019-20 admitted batch

Semester I

S.No	Course Code	Course Title	Category	L	T	P	C
1	19EME711	Computer Numerical Control and Adaptive Control	PC	3	0	0	3
2	19EME713	Robotics and Automation	PC	3	0	0	3
3	19EME705	Computer Aided Design	PC	3	0	0	3
4	19EME7XX	Program Elective I	PE	3	0	0	3
5	19EME7XX	Program Elective II	PE	3	0	0	3
6	19EME721	Material Testing and Characterization Lab	PC	0	0	3	2
7	19EME723	Computer Aided Design Lab	PC	0	0	3	2
8	19EMC741	Research Methodology and IPR	MC	2	0	0	2
9	19EAC7XX	Audit Course I	AC	2	0	0	0
							21

Semester II

S.No	Course Code	Course Title	Category	L	T	P	C
1	19EME712	Metrology and Computer Aided Inspection	PC	3	0	0	3
2	19EME714	Flexible Manufacturing Systems	PC	3	0	0	3
3	19EME7XX	Program Elective III	PE	3	0	0	3
4	19EME7XX	Program Elective IV	PE	3	0	0	3
5	19EOE7XX	Open Elective	OE	3	0	0	3
6	19EME722	Computer Aided Engineering Lab	CE	0	0	3	2
7	19EME726	Computer Aided Manufacturing Lab	CE	0	0	3	2
8	19EME792	Technical Seminar	PC	0	0	4	2
9	19EAC7XX	Audit Course II	AC	2	0	0	0
							21

Semester III

	Course Code	Course Title	Category	L	T	P	C
1	19EME891	Project Work I	PW	0	0	26	13
							13

Semester IV

S.No	Course Code	Course Title	Category	L	T	P	C
1.	19EME892	Project Work II	PW	0	0	26	13
							13

Number of Credits

Semester	I	II	III	IV	**Total**
Credits	21	21	13	13	**68**

PROGRAMME ELECTIVES –M.Tech. (CAD/CAM)

Programme Elective I

S.No	Course Code	Course Title	Category	L	T	P	C
1	19EME741	Computational Methods in Engineering	PE	3	0	0	3
2	19EME761	Design of Experiments	PE	3	0	0	3
3	19EME763	Reliability Engineering	PE	3	0	0	3

Programme Elective II

S.No	Course Code	Course Title	Category	L	T	P	C
1	19EME765	Concurrent Engineering	PE	3	0	0	3
2	19EME767	Advanced Materials Processing	PE	3	0	0	3
3	19EME769	Design of Material Handling Systems	PE	3	0	0	3

Programme Elective III

S.No	Course Code	Course Title	Category	L	T	P	C
1	19EME762	Artificial Intelligence in Manufacturing	PE	3	0	0	3
2	19EME764	Machine Vision and its Applications	PE	3	0	0	3
3	19EME766	Computer Aided Process Planning	PE	3	0	0	3
4	19EME768	Additive Manufacturing	PE	3	0	0	3

Programme Elective IV

S.No	Course Code	Course Title	Category	L	T	P	C
1	19EME770	Management of Finance, Marketing and Personnel	PE	3	0	0	3
2	19EME772	Optimization Methods in Engineering	PE	3	0	0	3
3	19EME774	Computer Integrated Manufacturing	PE	3	0	0	3

Open Electives

S.No	Course Code	Course Title	Category	L	T	P	C
1	19EOE742	Business Analytics	OE	3	0	0	3
2	19EOE744	Industrial Safety	OE	3	0	0	3
3	19EOE746	Operations Research	OE	3	0	0	3
4	19EOE748	Cost Management Of Engineering Projects	OE	3	0	0	3
5	19EOE752	Waste To Energy	OE	3	0	0	3

Audit Course I and II

S.No	Course Code	Course Title	Category	L	T	P	C
1	19EAC741	English For Research Paper Writing	AC	2	0	0	0
2	19EAC742	Disaster Management	AC	2	0	0	0
3	19EAC743	Sanskrit For Technical Knowledge	AC	2	0	0	0
4	19EAC744	Value Education	AC	2	0	0	0
5	19EAC745	Constitution Of India	AC	2	0	0	0
6	19EAC746	Pedagogy Studies	AC	2	0	0	0
7	19EAC747	Stress Management By Yoga	AC	2	0	0	0
8	19EAC748	Personality Development Through Life Enlightenment Skills	AC	2	0	0	0
9	19EAC750	Developing Soft Skills and Personality	AC	2	0	0	0

19EME711: COMPUTER NUMERICAL CONTROL AND ADAPTIVE CONTROL

L	T	P	C
3	0	0	3

This course exposes the students to understand the standard terminologies, conventions, processes, operations, design and operational characteristics of key hardware components, programming techniques, applications, merits and demerits of computer numerical control (CNC) machines. This course helps the students to develop the programming skills, able to operate the CNC machines so that the need of automation in manufacturing industries can be satisfied.

Course objectives:

- To introduce the basic concepts in numerical control and CNC machine tools.
- To explain the basic standard terminologies/ conventions, hardware, applications, merits and demerits of general NC, CNC and DNC technology.
- To familiarize the knowledge regarding adaptive control of CNC machines.
- To expose the students to Automatic/ Computer Assisted NC tool path programming using G codes and M codes for complicated machining applications.
- To impart the knowledge regarding various CNC programming languages and learn about the automated part programming (APT).

Unit I **10L**

Introduction: NC, DNC, CNC, Programmed Automations, Machine control unit, Part program, NC tooling. NC machine tools: Nomenclature of NC machine axes, Types of NC machine tools, Machining centers, Automatic tool changes (ATC), Turning centers.

Learning Outcomes:

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

- recognize the need of automation in manufacturing industries. [**L1**]
- know differences among NC, CNC and DNC systems. [**L1**]
- understand the nomenclature of NC machine axis and types of NC machine tools. [**L2**]
- demonstrate the NC tooling, machining centers and turning centers used in CNC machine tools. [**L2**]

Unit II **12L**

Machine control unit & tooling: Functions of MCU, NC actuation systems, Part program to command signal, MCU organization, Computerized numerical control, Transducers for NC machine tools, Tooling for NC machining centers and NC turning machines, Tool presetting. Adaptive control of CNC machine tools – SMART manufacturing, Programmable logic controllers (PLC) – Hardware, ladder logic programming of PLCs using basic functions – timers and counters – Advanced programming with control and arithmetic instructions.

Learning Outcomes:

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

- acquaint knowledge regarding CNC machine hardware components like MCU, actuation systems and transducers. [**L1**]
- understand how the part program will be converted into command signal which is required to operate CNC machine. [**L2**]
- comprehend the different concepts of adaptive control of CNC machine tools. [**L2**]

Unit III **12L**

Manual part programming: Part program instruction formats, Information codes: Preparatory function, Miscellaneous functions, Tool code and tool length offset, Interpolations, Canned

cycles, Manual part programming for milling operations, turning operations, parametric subroutines.

Learning Outcomes:

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

- summarize the preparatory functions (G- Codes) and Miscellaneous functions (M-Codes). [**L2**]
- create the part drawings and prepare the manual part programs for different machining operations. [**L3**]
- learn the advanced part programming features like parametric subroutines. [**L3**]
- operate the CNC machines to manufacture the different complicated and complex profiles. [**L6**]

Unit IV **12L**

APT programming: APT language structure, APT geometry: Definition of point, time, vector, circle, plane, patterns and matrices. APT motion commands: setup commands, point-to-point motion commands, continuous path motion commands. Post processor commands, complication control commands, Macro subroutines, Part programming preparation for typical examples.

Learning Outcomes:

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

- know the differences between manual part programming and APT programming. [**L1**]
- comprehend the APT language structure, APT geometry and motion commands. [**L2**]
- develop the APT part programs for typical examples. [**L3**]

Unit V **10L**

Computer aided part programming: NC languages: APT, NELAPT, EXAPT, GNC, VNC, Preprocessor, Post processor.

Learning Outcomes:

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

- study the need of computer assisted part programming. [**L2**]
- learn the different types of NC languages to solve different complex issues in manufacturing industries. [**L3**]
- understand the need of Preprocessor and Post processor commands in computer assisted part programming. [**L2**]

Text Books

1. P.N. Rao, CAD/CAM, 3rd edition, Tata McGraw-Hill Company Limited, New Delhi, 2012.
2. M.M.M. Sarcar, K. Mallikarjuna Rao, K. Lalit Narayan, Computer Aided Design and Manufacturing, 2nd Edition, Prentice Hall of India, 2012.

References

1. S.K Sinha, CNC Programming using Fanuc Custom Macro B, McGraw Hill Education, 2010.
2. Mike Mattson, CNC Programming: Principles and Applications, 1st edition, Delmar publishers, 2013.

Course Outcomes:

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

- obtain the knowledge regarding need of automation and fundamentals of NC, CNC and DNC systems. [L1]
- understand the design configurations, operational characteristics and control of CNC machine systems. [L2]
- understand the significance of adaptive control of CNC machine tools. [L2]
- compile and execute standard CNC programs for multi-axis machine tools in both high level language and code format, including canned cycles and subroutines. [L3]
- work individually and/or with an interdisciplinary team for the purpose of selection, design and use of NC technology for manufacturing applications. [L4]

19EME713: ROBOTICS AND AUTOMATION

L	T	P	C
3	0	0	3

This course exposes the students to deal with the application of mechanical, electronic, and computer-based systems to operate and control production. automation and robotics are two closely related technologies. This course aims at learning the basics of automation, flexible manufacturing systems, automated materials handling and storage systems, robot kinematics, robot programming and its industrial applications.

Course Objectives

1. Introduce the robotic systems and their applications in flexible or agile manufacturing.
2. Discuss the concepts of robot kinematics, Dynamics and Trajectory planning.
3. Demonstrate the functioning of sensors and actuators.
4. Impart knowledge of mathematics, science, and Engineering and to expand this knowledge into the vast area of robotics.
5. Familiarize the students with the robotic programming languages.

Unit I **13L**

Introduction and Robot Kinematics: Definition need and scope of Industrial robots – Robot anatomy – Work volume – Precision movement – End effectors – Sensors. Robot Kinematics – Direct and inverse kinematics – Robot trajectories – Control of robot manipulators – Robot dynamics – Methods for orientation and location of objects.

Learning Outcomes:

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

- understand the significance of robotics **(L1)**
- comprehend the concept of direct and inverse kinematics **(L3)**

Unit II **10L**

Robot Drives and Control: Controlling the Robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves – Electro hydraulic servo valves, electric drives – Motors – Designing of end effectors – Vacuum, magnetic and air operated grippers

Learning Outcomes:

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

- understand the significance of drives and controls in robots **(L1)**
- utilize the concept of different end effectors and grippers **(L3)**

Unit III **10L**

Robot sensors: Transducers and Sensors – Sensors in Robot – Tactile sensor – Proximity and range sensors – Sensing joint forces – Robotic vision system – Image Grabbing – Image processing and analysis – Image segmentation – Pattern recognition – Training of vision system. Vision: Low level and higher level vision- fundamentals, image acquisition, recognition, interpretation- few basic examples in Robotics.

Learning Outcomes:

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

- understand the functioning of sensors and actuators **(L1)**
- applicability of machine vision and various image processing methods **(L5)**

Unit IV **11L**

Robot Cell Design and Application: Robot work cell design and control – Safety in Robotics – Robot cell layouts – Multiple Robots and machine interference – Robot cycle time analysis, Industrial application of robots.

Learning Outcomes:

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

- acquaint the knowledge of robot work cell design and control **(L2)**
- applicability of robot cycle time analysis in industries **(L5)**

Unit V **12L**

Robot Programming: Methods of Robot Programming – Robot motion planning - configuration space concepts, Robot programming concepts - off line programming and simulation-Case studies in assembly, machine loading/unloading, palletizing, deburring etc.

Learning Outcomes:

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

- comprehend the knowledge of programming and motion planning in robotics **(L3)**
- applicability of palletizing and deburring in real time analysis **(L5)**

1.

Text Book:

1. Deb, S.R., Robotics Technology and Flexible Automation, 2nd edition, Tata McGraw-Hill, 1994.

References:

1. K.S.Fu, R.C. Gonzalez and C.S.G. Lee, Robotics Control, Sensing, Vision and Intelligence, McGraw Hill, July, 1987.
2. YoramKoren, Robotics for Engineers,McGraw-Hill, 1987.
3. Kozyrey, Yu. ―Industrial Robots, MIR Publishers Moscow, 1985.
4. Richard. D, Klafter, Thomas, A, Chmielewski, Michael Negin, Robotics Engineering – An Integrated Approach, 1st edition, Prentice-Hall of India Pvt. Ltd., 2009.
5. Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey, Industrial Robotics Technology, Programming and Applications, 1st edition, McGraw-Hill, Int. 1986.

Course Outcomes:

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

1. identify various robot configuration and components and their applications in agile manufacturing.(L1)
2. comprehend to select appropriate actuators and sensors for a robot based on specific application (L2)
3. understand the principles of operation for mobile robots and robot cell layout.(L1)
4. understand the real-time control and programming issues.(L1).
5. make transparent judgments` with regards to the design or issues related to engineering problems.(L5)

19EME705: COMPUTER AIDED DESIGN

L	T	P	C
3	0	0	3

Computers have become inevitable in today era and find their application in various stages of product development. This course intends to introduce students to use of computers in the phases of product design viz. conceptualization, geometric modeling, graphical representation and finite element analysis. The concept of computer aided design (CAD) using computers to control the various stages of design process from the beginning. CAD demonstrates the usage of engineering mathematics related to geometry to understand concepts. This subject gives a scope for applying CAD concepts to product design and development.

Course Objectives

- To provides an overview of how computers are being used in mechanical component design.
- To impart knowledge on computer graphics which are used routinely in diverse areas as Science, engineering, medicine, etc.
- Acquire fundamental understanding of the principles of CAD, including engineering drawing, geometric and surface modeling, and feature-based design.
- Apply computer aided manufacturing principles to perform manual and computer aided numerical control programming.

Unit I **12L**

Fundamentals of CAD: Introduction, Design process, Application of computer for design, Benefits of CAD, CAD tools, CAD hardware, CAD software, Mechanical applications of CAD.

Geometric modeling - Types and Mathematical Representations of Curves: Wireframe models, wireframe entities, curve representation, parametric representation of analytic curves and synthetic curves, simple problems.

Learning outcomes

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

- describe basic structure of CAD workstation, Memory types, input/output devices and display devices and computer graphics **(L2).**
- learn the rudiments of computer aided design (CAD) and CAD systems **(L1).**

Unit II **10L**

Geometric modeling - Types and Mathematical Representations of Surfaces: Surface models, surface entities, surface representation, parametric representation of analytic surfaces and synthetic surfaces, simple problems.

Learning outcomes

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

- apply geometric transformations on the created wireframe, surface and solid models **(L3).**
- use engineering mathematics related to geometry to understand CAD **(L3).**

Unit III **10L**

Geometric modeling - Types and Mathematical Representations of Solids: Solid models, solid entities, solid representation, fundamentals of solid modeling, half spaces, Boundary Representation (B-rep), Constructive Solid Geometry (CSG), Sweep Representation, Analytic Solid Modeling (ASM).

Learning outcomes

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

- understand mathematical aspects of geometrical modeling **(L2).**

- use 3D modeling software to accurately generate and easily modify graphical representations of the product **(L3).**

Unit IV **12L**

Graphics Concepts - Geometric Transformations: Transformation of geometric models, mappings of geometric models, inverse transformations and mappings, projections of geometric models. **Graphics Concepts - Visual realism**: Model clean-up, hidden line removal, hidden surface removal, hidden solid removal, Shading, Coloring.

Learning outcomes

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

- apply geometric transformations on the created wireframe, surface and solid models **(L4).**
- apply algorithms of graphical entity generation. **(L5)**

Unit V **12L**

Mechanical assembly: Assembly modeling, representation schemes, generation of assembly sequence, assembly analysis. Mass property calculations: Geometrical property formulation, mass property formulation, property evaluation, properties of composite objects.

Learning outcomes

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

- Use algorithmic foundation for solving problems by writing computer programs. **(L3).**
- Develop program algorithms for calculation of various properties **(L4).**

Text Book:

1. CAD/CAM Theory and Practice by I. Zeid, 1st edition, Tata McGraw-Hill, 1991.

References:

1. P. N. Rao, CAD/CAM: Principles and Applications, 3rd edition, Tata McGraw Hill Publishing Company Ltd., 2010.
2. M. P. Groover and E. W. Zimmer, CAD/CAM Computer Aided Design and Manufacturing, 1st edition, Pearson Education, 2003.
3. Computer Integrated Design and Manufacturing by D. D. Bedworth, M. R. Henderson, P. M. Wolfe, McGraw-Hill, 1991.

Course Outcomes:

After completing the course, the student will be able to

- apply engineering knowledge, techniques, skills and modern tools to analyze problems in design (L3).
- integrate the role of graphic communication in the engineering design process (L4).
- develop mathematical models to represent curves, surfaces and solids (L4).
- implement 2D and 3D transformations for positioning/shaping objects, or to change viewing positions (L5).
- formulate the parametric representation of standard conic shapes, 2D and 3D freeform curves and surfaces in the most efficient manner (L4).
- describe various techniques of computer simulated reality i.e. virtual realism (L3).

19EME741: COMPUTATIONAL METHODS IN ENGINEERING

L	T	P	C
3	0	0	3

This course provides an introduction to the computational methods to solve various kinds of equations that students encounter in the field of engineering. The student will develop his/her own programs/subroutines for the computational schemes taught in the course.

Course Objectives

- To study root finding methods and linear algebraic equation solving methods.
- To familiarize various methods to solve system of linear and nonlinear equations.
- To analyze integration and differentiation problems numerically.
- To analyze initial value and boundary value ordinary differential equations.
- To expose the students to partial differential equations and study transform equations.

Unit I **10L**

Modeling, Computers, and Error Analysis: Mathematical Modeling and Engineering Problem Solving, Approximations and Round-Off Errors, Truncation Errors and the Taylor Series. **Roots of Equations**: Bracketing Methods – Bisection Method, False Position Method, Incremental searches and Determining Initial Guesses; Open Methods – Fixed Point Iteration, Newton-Raphson Method, Secant Method; Roots of Polynomials – Muller's Method, Barstow's method; Application to practical problems – Ideal and Non-ideal gas laws, Vibration Analysis.

Learning Outcomes:

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

- identify the various errors encounter in solving numerical problems. [**L2**]
- estimate the Roots of linear and nonlinear equations by various root finding methods.[**L2**]

Unit II **8L**

Linear Algebraic Equations: Gauss Elimination – Solving Small Numbers of Equations, Naïve Gauss Elimination, Pitfalls, Techniques for improving Solutions, Nonlinear Systems of Equations, Gauss-Jordan; LU Decomposition and Matrix Inversion, Special Matrices and Gauss-Seidel, Application to practical problems – Analysis of a Statically Determinate Truss, Spring Mass Systems.

Learning Outcomes:

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

- identify the system of linear and nonlinear equations in engineering applications.[**L2**]
- estimate the unknowns in system of linear and nonlinear equations by various methods[**L2**]

Unit III **10L**

Numerical Differentiation and Integration: Newton-Cotes Integration Formulas – Trapezoidal Rule, Simpson's Rules, Integration with Unequal Segments, Multiple Integrals; Integration of Equations - Newton-Cotes Algorithms for Equations, Romberg Integration, Gauss Quadrature; Numerical Differentiation – High Accuracy Differentiation Formulas, Richardson Extrapolation, Derivatives of Unequally spaced Data; Application to practical problems – Integration to Determine the Total Quantity of Heat, Computation of Work.

Learning Outcomes:

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

- recognize the Differentiation and Integration applications in engineering applications.[**L2**]
- compute the differentiation and integration problems numerically by various methods[**L2**]

Unit IV **10L**

Ordinary Differential Equations: Runge-Kutta Methods – Euler's Method, Improvement of Euler's Method, Runge-Kutta Methods, Systems of Equations, Adaptive Runge-Kutta Methods; Stiffness and Multistep Methods, Boundary-12 Value and Eigenvalue Problems, Application to practical problems – The Swinging Pendulum.

Learning Outcomes:

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

- identify the role of Ordinary Differential Equations in engineering applications.[**L2**]
- solve Ordinary Differential Equations numerically by various methods[**L2**]

Unit V **8L**

Partial Differential Equations: Finite Difference: Elliptic Equations – The Laplace Equation, Solution Techniques, Boundary Conditions, The Control Volume Approach; Finite Difference: Parabolic Equations – The Heat Conduction Equation, Explicit Methods, a Simple Implicit Method, The Crank-Nicolson Method; Application to practical problems - Finite-Element Solution of a Series of Springs.

Learning Outcomes:

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

- identify the role of Partial Differential Equations in engineering applications.[**L2**]
- solve the Partial Differential Equations problems numerically by various methods[**L2**]

Text Book(s):

1. Numerical Methods for Engineers by S. C. Chapra and R. P. Canale, 6/e, Tata McGraw-Hill Company Ltd., 2010.

References:

1. S. C. Chapra, Applied Numerical Methods with MATLAB for Engineers and Scientists, 3/e, McGraw-Hill Company Ltd., 2011.
1. M. L. James, G. M. Smith and J. C. Wolford, Applied Numerical Methods for Digital Computation, 2/e, Harper & Row Publishers, 1977.

Course Outcomes:

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

- demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems. [L1]
- apply Computational methods to obtain approximate solutions to engineering problems [L3]
- calculate the physical properties of rigid bodies required for the analysis of engineering systems. [L3]
- derive computational methods for various mathematical operations and tasks, such as differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations. [L4]
- analyse and evaluate the accuracy of common numerical methods. [L4]

19EME761: DESIGN OF EXPERIMENTS

L	T	P	C
3	0	0	3

This course covers the statistical design of experiments to systematically examine how a system functions. This course enables the student with tool to design, conduct, analyze and interpret experimental data. They would be able to design a system or process with economic, social, environmental constraints. A well-designed experiment can lead to reduced development lead time for new processes and products, improved manufacturing process performance, and products that have superior function and reliability.

Course Objectives

- Define a comparative experiment and identify important aspects from a described experiment.
- Explain appropriate randomization procedures for all experiments considered.
- List the fundamental principles of design and explain their importance in comparative experiments.
- Explain the difference between fixed and random block effects and how they impact the analysis and conclusions.
- Perform detailed analysis using statistical measure and ANOVA

Unit I **8L**

Introduction: The scientific method, The role of statistics in the advancement of science, The phases of an experiment, Specifying the problem and the hypotheses, Experimental designs, Analyses of experiments, Statistical inference, Estimation-Properties of estimators, Confidence intervals, Hypothesis testing, The Z-test, the T-test, the X2-test, and the F-test. Sample size.

Learning Outcomes:

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

- recognize the significance of planning experiments. [**L1**]
- list guidelines for designing experiments[**L2**].
- calculate test parameters.[**L3**]
- formulate hypothesis. [**L3**]

Unit II **8L**

Completely Randomized Design: The one-factor experiments in a CRD, Linear model, Partitioning of the total sum of squares, the analysis of variance table, Orthogonal contrasts, Multiple range tests, Scheffe's test, Confidence intervals on means, Fixed and random models, Estimation of variance components. **Randomized Complete Block Design-**The model and assumptions, The ANOVA table, Tests after ANOVA.

Learning Outcomes:

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

- comprehend randomized design concept. [**L2**]
- list assumptions of model design. [**L2**]
- analyze the randomized design. [**L4**]

Unit III **8L**

Latin Square and Related Designs: Latin squares and two-way restrictions on randomization, the linear model and assumptions for a one-factor experiment fitted in a Latin square design, ANOVA table.

Learning Outcomes:

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

- identify the two way restrictions. [**L2**]
- calculate the variance . [**L3**]
- understand the concepts Latin Square design. [**L2**]
- determine ANOVA. [**L3**]

Unit IV **8L**

Factorial Experiments: Complete factorial experiments in CRD's, Main effects and interactions, one observation per treatment combination, linear model and analysis, the error term and pooling, the meaning of a significant interaction, the case of n observations per treatment combination. Complete 2f factorial experiments in CRD's, Special notation, average effect of main effects and interaction, orthogonal contrasts and sum of squares, Yates's algorithm.

Learning Outcomes:

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

- develop complete factorial designs. [**L3**]
- plot main effects and interaction effects. [**L4**]
- analyze models. [**L3**]

Unit V **8L**

Fixed, Random And Mixed Models: Single and two factor models, EMS rules, Pseudo-F test, Nested and Nested – Factorial Experiments: Nested experiments, Nested-factorial experiments, Repeated-measures design and nested-factorial experiments, Factorial experiment in a randomized block design.

Learning Outcomes:

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

- apply factorial experiments in design. [**L4**]
- utilize nested factorial experiments and analyze it. [**L3**]
- make use factorial experiments for block designs. [**L4**]

Text Books:

1. Hicks and Turner, Fundamental Concepts in the Design of Experiments, 5th Edition, Oxford University Press, 1999.
2. Douglas C. Montgomery, Design and Analysis of Experiments, 8th edition, John Wiley and Sons Inc., 2012.

References:

1. C. R. Kothari, Research Methodology: Methods and Techniques, 3rd edition, New Age International publishers, New Delhi, 2013.
2. Mark J. Anderson and Patrick J. Whitcomb, DOE Simplified: Practical Tools for Effective Experimentation, 2nd Edition, Productivity Press, USA, 2007.

Course Outcomes:

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

- obtain a basic understanding of design principles of experiments. [L1]
- comprehend the significance of the concepts of analysis of variance. [L2]
- understand the factorial experimental design.[L2]
- calculate the statistical measures for comparison. [L3]
- apply the design models. [L3]
- Implementing randomized blocks, Latin square designs. [L4]

19EME763: RELIABILITY ENGINEERING

L	T	P	C
3	0	0	3

This course covers key concepts of reliability, availability and maintainability of system and components. The student would be able to design reliability models. They can find the faults of a system systematically using tools. They would assess the reliability of components. They would be able to implement best design for improving reliability.

Course Objectives

- Understand the concepts of reliability, availability and maintainability.
- Develop hazard-rate models to know the behavior of components.
- Build system reliability models for different configurations.
- Assess reliability of components and systems using field and test data.
- Implement strategies for improving reliability of repairable and non-repairable systems

Unit I **12L**

Reliability: Definition; Probability Concept; Addition of Probabilities; Complimentary Events; Kolmogorov Axioms. Failure Data Analysis: Introduction, Mean Failure Rate, Mean Time to Failure (MTTF), Mean Time between Failures (MTBF), Graphical Plots, MTTF in terms of Failure Density, MTTF in Integral Form**.**

Learning Outcomes:

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

- define reliability. [**L1**]
- list Kolmogorov Axioms. [**L2**]
- calculate MTBF,MTTR.**[L3]**
- Comprehend failure types. [**L3**]

Unit II **12L**

Hazard Models: Introduction, Constant Hazard; Linearly Increasing Hazard, the Weibull Model, Density Function and Distribution Function, Reliability Analysis, Important Distributions and their Choice, Standard Deviation and Variance. Conditional Probability: Introduction, Multiplication Rule, Independent Events, Vernn Diagram, Hazard Rate as conditional probability, Bayes Theorem.

Learning Outcomes:

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

- comprehend hazard model concept. [**L2**]
- list probability distribution function. [**L2**]
- apply multiplication rule of conditional probability. [**L3**]
- analyze the hazard rate. [**L4**]

Unit III **10L**

System Reliability: Series. Parallel and Mixed Configurations, Complex Systems, Logic Diagrams, Markov Models. Reliability Improvement & Repairable Systems: Redundancy, Element, Unit and standby systems.

Learning Outcomes:

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

- draw reliability block diagrams. [**L2**]
- understand the concept of redundancy. [**L2**]
- analyze the Markov models. [**L3**]

- determine reliability of state dependent system. [**L3**]

Unit IV **10L**

Redundancy, Optimization; Reliability – cost trade- off, Introduction to Repairable Systems, Instantaneous Repair Rate, MTTR, Reliability and Availability Functions, Important Applications.

Learning Outcomes:

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

- understand the economics of reliability. [**L2**]
- calculate MTTR. [**L3**]
- list the availability functions. [**L2**]
- list the applications of availability. [**L2**]

Unit V **10L**

Fault-Tree Analysis and Other Techniques: Fault-tree Construction, Calculation of Reliability, Tie- set and Minimal Tie-set. Maintainability and Availability: Introduction, Maintenance Planning, Reliability and Maintainability trade – off.

Learning Outcomes:

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

- construct fault tree. [**L3**]
- analyze the fault tree. [**L3**]
- calculate the reliability. [**L4**]
- understand the concept of reliability, maintainability .[**L2**]

Text Books:

1.L.S. Srinath, Reliability Engineering, 4th edition, Affiliated East-West Press, New Delhi, 2005.

References:

1. D.J. Smith, K.C. Kapur and L.R. Lamberson, Reliability in Engineering Design, Wiley Publications, 2009.
2. A.K.Govil, Reliability Engineering, Tata Mc-Graw Hill, New Delhi, 1983.
3. George E. Dieter, Engineering Design, McGraw-Hill, 2009.

Course Outcomes:

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

- obtain a basic understanding of reliability design principles. [L-1]
- comprehend the significance of the concepts of reliability, availability and maintainability . [L-2]
- calculate the distribution functions for hazard model analysis. [L-3]
- apply the design models. [L-3]
- construct and analyze the failure mode effect analysis diagrams. [L-4]

19EME765: CONCURRENT ENGINEERING

L	T	P	C
3	0	0	3

This course exposes the students to an advanced engineering method in which several teams within an organization work simultaneously to develop new products and services. On studying Concurrent Engineering (CE) course makes students to understand how the amount of time involved in getting a new product to the market can be decreased significantly.

Course Objectives

- Explain the importance utilization of resources simultaneously.
- Expose to different applications and fields where CE is applicable.
- Explain various strategies in implementing the CE in an Industry.
- Analyze various issues that industry faces and solutions offered by CE
- Expose to case studies, working models, products design and Assembly layouts etc.

Unit I **10L**

Introduction: Concurrent design of products and systems - Product design - Fabrication and assembly system design - designing production systems for robustness and structure.

Learning Outcomes:

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

- recognize the significance of CE in the manufacturing industry. [**L1**]
- identify different applications of CE. [**L2**]
- comprehend basic concepts of CE [**L2**]

Unit II **12L**

Strategic approach and technical aspects of product design: Steps in the strategic approach to product design - Comparison to other product design methods - Assembly sequence generation - Choosing a good assembly sequence - Tolerances and their relation to assembly - Design for material handling and part mating - Creation and evaluation of testing strategies.

Learning Outcomes:

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

- comprehend different strategic approaches of Product design [**L2**]
- design and test various designs for material handling and product sequence. [**L4**]
- differentiate and compare verities of product design methods. [**L2**]

Unit III **10L**

Basic issues in manufacturing system design: System design procedure - Design factors - Intangibles - Assembly resource alternatives - Task assignment - Tools and tool changing - Part feeding alternatives - Material handling alternatives - Floor layout and system architecture alternatives.

Learning Outcomes:

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

- find various system alternatives to build CE [**L4**]
- identify basics problems in the system design. [**L2**]
- develop tools to resolve the issues in manufacturing system design. [**L3**]

Unit IV **12L**

Design of automated fabrication systems: Objectives of modern fabrication system design - System design methodology - Preliminary system feasibility study - Perform detailed work

content analysis - Define alternative fabrication configurations - Configuration design and layout - Human resource considerations - Evaluate technical performance of solution.

Learning Outcomes:

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

- identify different objectives of modern fabrication system design. [**L2**]
- design various fabrication configurations. [**L3**]
- analyze and evaluate Human resource considerations. [**L4**]

Unit V **12L**

Assembly workstation design: Strategic issues - Technical issues analysis. Case studies: Automobile air conditioning module - Robot assembly of automobile rear axles.

Learning Outcomes:

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

- recognize and resolve Strategic issues - Technical issues. [**L1**]
- comprehend different case studies [**L2**]
- develop new models and implement CE in applications. [**L3**]

Course outcomes:

After the successful completion of this course, the students will be able to

- Students will have the ability to understand the importance of product design in leveraging both manufacturing cost and product lifecycle cost (L1).
- Students shall have the ability to plan and implement a product development program (L2).
- graduates shall have the ability to design and conduct experiments to ensure that the product design is robust and compatible with the capability of the manufacturing process (L3).

Text Book:

1. L. Nevins and Daniel E. Whitney, Concurrent Design of Product and Processes by James McGraw-Hill Publishing Company, 1989.

References:

1. John R. Hartley, Concurrent Engineering, Productivity Press, 1998.
2. Andrew Kusiak, Kusiak, Andrew Kusiak, Concurrent Engineering: Automation, Tools, and Techniques, 1st edition, Wiley-interscience, 1992.

19EME767: ADVANCED MATERIALS PROCESSING

L	T	P	C
3	0	0	3

This course is extension of basic materials processing methods which gives inputs regarding composite materials and its behavior followed with heat treatment applications. Further testing of the composite materials and enhancement of properties are discussed. To realize the full potential of a composite material, an appropriate processing method should be selected and optimum processing conditions followed. Moreover, it is necessary to understand the science behind the processing method so that appropriate processing parameters can be selected.

Course Objectives

- To explain about the crystallinity of the metallic structure and phase diagrams
- To understand the heat treatment of ferrous and non-ferrous alloys
- To apply various techniques to process polymeric materials
- To understand the techniques involved in processing ceramic materials
- To evaluate the advance different techniques on processing advance application

Unit I **10L**

Atoms-molecules-bonds in solids-crystallinity-defects in metallic structure-dislocations and plastic deformations-fracture-iron-carbon-equilibrium diagrams-steels and cast irons-transformation.

Learning outcomes:

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

- recognize the significance of crystallinity of the metallic structure. **[L1]**
- analyze the phase diagrams. **[L2]**
- utilize the concept of imperfection. **[L3]**

Unit II **12L**

Hardening in steels-TTT diagrams-other heat treatment processes -formation of alloys in steel and cast irons-nonferrous alloys and their applications, special alloys.

Learning outcomes:

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

- comprehend the concept of TTT diagrams. **[L1]**
- analyze the heat treatment processes. **[L2]**
- identify the special alloys. **[L3]**

Unit III **12L**

Polymers and polymerization-structure and properties of thermoplastics and thermosets-engineering applications property modifications-mechanical, thermal behavior-composites with polymer matrix

Learning outcomes:

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

- develop the structure and properties of thermoplastics and thermosets **[L1]**
- analyze the mechanical, thermal behavior-composites with polymer matrix. **[L2]**

Unit IV **10L**

Ceramics glasses-glass ceramics-fabrication methods-metal matrix and ceramic matrix composites.

Learning outcomes:

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

- analyze the fabrication methods-metal matrix. **[L1]**

- analyze the fabrication methods ceramic matrix. **[L2]**

Unit V **12L**

Processing of polymers-fabrication of composites-processing of ceramics-thermal spraying-ion beam machining-laser and electron beam processing-superplastic forming-thin films and their deposition-diamond coating techniques-tribological applications.

Learning outcomes:

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

- recognize the processing of polymers-fabrication of composites-processing of ceramics. **[L1]**
- analyze the advanced techniques. **[L2]**
- utilize the concept of tribological applications. **[L3]**

Text Books:

1. L.H.VanVleck, Material Science and Engineering, 5th edition, Addision Wesley, 1985.
2. R.M.Rose, L.A.Shepard and J.Wulff, Structure and properties of Materials, Vol.1-4 John Willey, 1966.

References:

1. A.G.Guy, Essentials of Material Science, McGraw Hill, 1976.
2. D.R.Askeland,The Science and Engineering Materials, 2nd Edition, Chapman and Hall, 1990.
3. William D. Callister, Jr., Material Science and Engineering – An Introduction, 5th Edition, John Wiley and Sons Inc., 2000.
4. R.E Small man and AHW Ngan, Physical Metallurgy and advanced materials, 7thedition, Elsevier, 2007.

Course Outcomes:

At the completion of the course, the students should able to

- identify and describe the concepts of crystallinity of the metallic structure, imperfection, and phase diagrams. [L3]
- identify a range of Hardening in steels, heat treatment processes, nonferrous alloys and their applications. [L3]
- analyze the role of polymers and polymerization-structure and properties of thermoplastics and thermosets. [L4]
- analyze the art of ceramics glasses-glass ceramics-fabrication methods-metal matrix methods. [L4]
- evaluate Processing of polymers-fabrication of composites-processing with new applications. [L4]

19EME769: DESIGN OF MATERIAL HANDLING SYSTEMS

L	T	P	C
3	0	0	3

This course exposes the students to deal with the organization of material handling to optimize the material flow and to achieving objectives efficiently, economically and safely. This course aims at learning the basics of hoisting appliances, load handling equipment & brakes, surface & overhead transportation equipment, elevating and conveying equipment.

Course Objectives

- Explain the concept and applications of material handling equipment of hoisting appliances.
- Understanding of different load handling equipment and types of brakes in load handling.
- Demonstrate the functioning of different types of surface and overhead transportation equipment.
- Possess the knowledge on industrial and passenger elevating equipment.
- Identify and design of the conveying equipment

Unit I **10L**

Flexible Hoisting Appliances: Type, selection and applications of material handling equipment, choice of material handling equipment – hoisting equipment – components and theory of hoisting equipment – chain and ropes – selection of ropes, pulleys, pulley systems, sprockets and drums.

Learning Outcomes:

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

- understand the concepts and types of flexible hoisting appliances. **[L1]**
- comprehend the concept of theory of hoisting equipment of different types of chain and ropes **[L2].**

Unit II **12L**

Load Handling Equipment and Brakes: Forged standard hooks – forged Ramshorn hooks – solid triangular eye hooks – crane grabs, electric lifting magnetic – grabbing attachments for loose materials. Arresting gear – brakes: shoe, band and cone types – elements of shoe brakes – thermal calculation in shoe brakes.

Learning Outcomes:

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

- understand the concepts load handling equipment such as diverse types of hooks **[L1]**
- acquired the knowledge of different types of breaks used in load handling equipment **[L3]**

Unit III **12L**

Surface and Overhead Transportation Equipment: Hand operated trucks – powered trucks – tractors – electronically controlled tractors - hand truck on rails – industrial railroad equipment: locomotives - winches – capstans – turntables – monorail conveyors –pipe rail systems – flat bar monorails. Rail traveling mechanism, cantilever and monorail cranes, cogwheel drive, monocable tramways- reversible tramways.

Learning Outcomes:

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

- understand and remember the concepts of surface transport equipment **[L1]**
- comprehend the concept of different types of overhead transportation equipment. **[L2]**

Unit IV **12L**

Elevating Equipment: Continuous-motion vertical conveyors – reciprocating-motion vertical conveyors – stackers – work levelers and tail gates – industrial lifts – passenger lifts – freight elevators – mast type elevators – vertical skip hoist elevators, bucket elevators: design, loading and bucket arrangements.

Learning Outcomes:

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

- understand and remember the concepts elevating equipment for industrial and passengers **[L1]**
- choose different types of elevators**[L3]**

Unit V **10L**

Conveying Equipment: Belt conveyors - chain conveyors – apron conveyors – escalators – flight conveyors – roller conveyors - oscillating conveyors. design of belt conveyors, screw conveyors and pneumatic conveyors.

Learning Outcomes:

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

- understand and remember the different types of conveyors **[L1].**
- synthesis of belt, screw and pneumatic conveyors **[L4]**

Text Books:

1. Spivakovsky. A.O and Dyachkov. V.K., Conveying Machines, Volume I and II, MIR Publishers, 1985
2. Alexandrov, M., Materials Handling Equipments, MIR Publishers, 1981

References:

1. Rudenko. N., Materials Handling Equipment – MIR Publishers, 1969.
2. Boltzharol, A., Materials Handling Handbook, The Ronald Press Company, 1958.

Course Outcomes:

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

- select appropriate equipment for material handling and understand the basic roles of the different equipment [L1].
- illustrate the load handling equipment and Surface and Overhead Transportation equipment [L3].
- apply appropriate techniques for choose elevating equipment for industrial and passengers [L3].
- design of belt, screw and pneumatic conveyors [L4].

19EME721: MATERIAL TESTING CHARACTERIZATION LAB

L	T	P	C
0	0	3	2

1. On UTM static and dynamic properties evaluation Toughness, ductility, Resilience and stiffness
a. Tensile
b. Compression
2. Fatigue test
3. Forming Limit diagrams (FLD)
4. 3 - point bending test
5. 2-point bending test
6. Wear test on Pin on disc
7. Damping properties evaluation
8. Friction and Wear test on four ball tester
9. Micro structure characterization
10. Residual test

19EME723: COMPUTER AIDED DESIGN LAB

L	T	P	C
0	0	3	2

1. Introduction to Modeling packages – Pro-Engineer, Ideas, CATIA, Unigraphics, Solid Works.
2. 2D-drawings using sketcher options - 3 Exercises
3. 3D-modelling using form features - 3 Exercises
4. Assembly – 3 Exercises
    a) Flange coupling
    b) Knuckle joint
    c) Oldham coupling
5. Drafting - 3 Exercises
6. Introduction to pre-processing software - Hyper mesh
7. 2D-Meshing - 3 Exercises
8. 3D-Meshing - 3 Exercises

19EMC741: RESEARCH METHODOLOGY AND IPR

L	T	P	C
2	0	0	2

This course introduces the student, to the fundamentals of research, research process, technical writing and intellectual property rights. Students will be able to use this knowledge to gain interest in their subject area and pursue their career in research.

Course Objectives

- To familiarize the meaning, objectives and sources of research
- To acquaint the student with the importance and methods of literature review/research ethics
- To impart the knowledge of technical writing for preparing reports, presentations, research proposals, conference/journal publications
- To introduce the terminology and process of obtaining intellectual property rights
- To expose the intricacies in the process of obtaining patent rights

Unit I **5L**

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Learning Outcomes

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

- define the meaning of a research problem
- list the different sources of research problem
- enumerate the different criteria of good research and list the different errors in selecting research problem
- contrast the different approaches of research
- compare the different methods for data collection and analysis

Unit II **5L**

Effective literature studies approaches, analysis Plagiarism, Research ethics

Learning Outcomes

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

- list and elaborate the different steps of the research process
- explain the importance of carrying out an effective literature review
- identify the research gaps from literature review
- describe the ethical principles to be following during research process and authorship
- define the terminology and list the methods to avoid being accused of plagiarism
- list the different types of research misconduct

Unit III **5L**

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Learning Outcomes

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

- list the attributes, reasons and guidelines for effective technical writing
- contrast between conference paper, technical presentation and journal paper
- choose a particular research contribution for patenting or journal publication
- define the terminology related to citation, citation index, h-index etc

Unit IV **5L**

Nature of Intellectual Property: Patents, Designs, Trademarks and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. **International Scenario**: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Learning Outcomes

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

- describe the codes and standards in building intellectual property rights
- list the subject, importance and requirements for of patentability
- explain the process of patenting and commercialization in academia
- enumerate the procedure for application preparation, filing and grant of Patents
- define the terminology related to citation, citation index, h-index etc.

Unit V **8L**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Learning Outcomes

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

- explain the scope of patent rights
- describe the process for licensing and transfer of technology
- identify the sources of patent information and databases
- elaborate the administration of patent system
- describe the new developments in IPR in computer software, biological systems etc

Text Book(s):

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for Science and engineering students”, Tata Mcgraw Hill India, 2013.
2. Ranjit Kumar, “Research Methodology: A Step by Step Guide for beginners”, 2/e, Prentice Hall of India, 2013.

References:

1. Halbert, “Resisting Intellectual Property”, Taylor and Francis Limited, 2007.
2. Mayall, “Industrial Design”, McGraw Hill, 1992.
3. Niebel, “Product Design”, McGraw Hill, 1974.
4. Asimov, “Introduction to Design”, Prentice Hall, 1962.
5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016
6. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand Publishers, 2008.

Course Outcomes:

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

- define the meaning, sources, approaches for research problems
- explain the guidelines for carrying out effective literature review and identify research gaps
- describe effective guidelines for preparing technical reports, research publications, presentations and research proposals
- describe the codes, standards and process of obtaining intellectual property rights
- enumerate the new developments of IPR in engineering systems

19EME712: METROLOGY AND COMPUTER AIDED INSPECTION

L	T	P	C
3	0	0	3

This course provides an exposure to the modern technologies adopted in the measuring instruments and knowledge on assessing the suitability of various measuring instruments to ensure the quality of manufactured components.

Course Objectives

- Introduce various concepts of metrology and measurement methods.
- Demonstrate the importance of metrology in manufacturing
- Explain the concepts of various measuring tools and their practical applications.
- Expose with various latest technologies in measuring instruments
- Familiarize various non-contact and contact inspection methods.

Unit I **12L**

Metrology concepts - Abbe's principle - need for high precision measurements - problems associated with high precision measurements. Standards for length measurement - Shop floor standards and their calibration - Light interference - Method of coincidence - Slip gauge calibration – Measurement errors.

Learning Outcomes:

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

- identify important standards in measurements. **[L2]**
- identify the concepts of calibration. **[L2]**

Unit II **10L**

Various tolerances and their specifications, gauging principles, selective assembly, comparators. Angular measurements - principles and Instruments. Gear and Thread measurements.

Learning Outcomes:

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

- Will demonstrate the ability to apply the principle of limits, fits and tolerance while designing and manufacturing the components of their requirement.**[L3] .**
- explain the principles of gear measuring instruments. **[L2]**
- gain knowledge and apply it for measuring screw thread and gear profiles. **[L3]**

Unit III **8L**

Surface and form metrology - flatness, roughness, waviness, roundness, cylindricity etc., Computer Aided Metrology- Principles and interfacing, software metrology.

Learning Outcomes:

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

- have knowledge and can interpret various forms of measurements.**[L2]**
- have basic idea about software's used in metrology and apply them for measurements.[**L3]**

Unit IV **12L**

Laser metrology - Applications of Lasers in precision measurements - Laser interferometer, speckle measurements, Laser scanners.

Learning Outcomes:

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

- gain knowledge and can identify the use of laser in measurements. **[L2]**
- apply the knowledge on lasers for making new measuring instruments.**[L3]**

Unit V **12L**

Coordinate Measuring Machine - Types of CMM - Probes used - Applications - Non contact CMM using Electro optical sensors for dimensional metrology - Non contact sensors for surface finish measurements, Image processing and its application in Metrology.

Learning Outcomes:

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

- have knowledge and identify various contact and non-contact measuring instruments. [**L2**]
- identify the tools and methods for measurement and analyze screw thread, gear profiles. [**L3**]

Text Book(s):

1. I.C. Gupta, A Text Book of Engineering Metrology, 4th edition Dhanpat Rai & sons, Delhi 1994.

References:

1. A.S. T.M.E. Hand Book of Industrial Metrology, Prentice Hall of India, New Delhi .
2. Technology of the metal Trade, Wiley Eastern Limited.

Course Outcomes:

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

- obtain understanding the measurement techniques.[L1]
- List various measuring instruments used in metrology. [L1]
- Examine geometry of screw threads and gear profiles.[L4]
- gain knowledge and apply measuring & gauging techniques. [L3]
- apply their knowledge on developing automated inspection systems.[L3]

19EME714: FLEXIBLE MANUFACTURING SYSTEMS

L	T	P	C
3	0	0	3

This course exposes the students to the basic knowledge about flexible manufacturing system in industrial applications for automation and it deals with help of group technology and just in time concepts.

Course Objectives

- Introduce the concepts and implementation of flexible manufacturing system.
- Explain the concept of GIT and GT design and planning on FMS.
- Demonstrate the tool database management systems in CAD/CAM
- Analyze the clamping devices and fixtures for FMS data base
- Illustrate the application of industrial robots and automated guided vehicles (AGV) in FMS.
- Possess the knowledge on inspection and cleaning stations aspects in the flexible machining cells and flexible assembly systems.

Unit I **10L**

Introduction: The economic justification of FMS, The basic components of FMS and their integration in the data processing system, the concept of the 'total system'. The FMS relational: Economic and technological justification for FMS Management decisions during FMS project planning, design and implementation: Designing the FMS, Data processing design, FMS project and software documentation.

Learning Outcomes:

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

- understand the components of FMS **[L1]**
- understand the justification of FMS in planning, design and implementation. **[L1]**
- comprehend the concept of total system, design and project & software documentation of FMS **[L2]**

Unit II **10L**

Design and Planning of FMS: the role of associated technologies such as GT, JIT and simulation Installation, Operation and evaluation scheduling problems. Control aspects of FMSDNC of machine tools, cutting tools, robots, quality control and inventories.

Learning Outcomes:

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

- utilize the concept GT, JIT, simulation Installation, Operation and evaluation scheduling in Design and Planning of FMS. **[L2]**
- understand the control aspects of FMSDNC. **[L1]**

Unit III **12L**

Distributed processing in FMS: Introduction to database management systems (DBMS) and their application in CAD/CAM and FMS, Distributed systems in FMS, Distributed tool data bases in FMS: The distributed tool data structure with a general purpose tool description facility, Implementation of the FMS tool data base, Application possibilities of the FMS tool data base.

Learning Outcomes:

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

- understand the concept of database management systems (DBMS) and their application in CAD/CAM. **[L1]**
- comprehend the concept of Distributed tool data bases in FMS **[L2]**

Unit IV **12L**

FMS database for clamping devices and fixtures: The FMS clamping device and fixture data base, the analysis and calculation of pallet alignment and work mounting errors, mating surface description methods for automated design and robotized assembly, Application of industrial robots in FMS, The application of automated guided vehicle (AGV) systems.

Learning Outcomes:

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

- comprehend the concept of clamping devices and fixtures in FMS data base. **[L2]**
- understand the application of industrial robots and automated guided vehicle (AGV) systems in FMS. **[L1]**

Unit V **12L**

Inspection and Cleaning stations Personnel and infrastructural aspects Flexible machining cells and islands Flexible assembly Systems; structure, control and applications FMS in action: Typical case studies, Future prospects.

Learning Outcomes:

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

- Understand the concept of Inspection and Cleaning stations. **[L1]**
- Apply the knowledge on typical case studies on FMS machining cells and assembly systems. **[L4]**

Text Book:

1. Paul Ranky, The Design and Operations of FMS, IFS Publications Ltd., UK, 1983.

References:

1. Joseph Talavage and Roger G. Hannam, Flexible Manufacturing Systems in Practice Marcel Dekker Inc., New York.
2. S.R. Deb, Robotics Technology and Flexible Automation 2nd edition Tata McGraw Hill Company Ltd, 2010.

Course Outcomes:

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

- obtain the concepts and implementation of flexible manufacturing system. [L1]
- comprehend the significance concepts of the JIT and GT design and planning on FMS [L2]
- analyze the concept of tool database management systems, clamping devices and fixtures for FMS data base.[L4]
- applying knowledge on industrial robots and automated guided vehicles (AGV) in FMS.[L3]
- understand the concept of inspection and cleaning stations aspects in the flexible machining cells and flexible assembly systems.[L1]

19EME762: ARTIFICIAL INTELLIGENCE IN MANUFACTURING

L	T	P	C
3	0	0	3

This course exposes the students to the latest trends in manufacturing, automation, machine-learning. This course makes the students to understand how Artificial Intelligence is transforming manufacturing industry in producing defect free products, reducing wastage of materials, performing predictive maintenance, achieving high production rate etc. This course gives wide scope for students to fit into ever changing global manufacturing.

Course Objectives

- Explain applications and goals of Artificial Intelligence.
- Teach techniques and structure of Expert Systems.
- Explain the role of computers and electronics in Artificial Intelligence.
- Analyze case studies how Artificial Intelligence can be used in industry
- Expose to various technologies which are integral part of Artificial Intelligence

Unit I **8L**

Artificial Intelligence - Definition Components - Scope - Application Areas; Goals of artificial intelligence – AI techniques – problem representation in AI – Problem reduction and solution techniques

Learning Outcomes:

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

- recognize the significance of Artificial Intelligence in manufacturing. [**L1**]
- identify areas of application where Artificial Intelligence can be used. [**L2**]
- Comprehend the fundamental AI techniques[**L**2]

Unit II **8L**

Knowledge Based Systems (Expert Systems) - Definition - Justification - Structure – Characterization

Learning Outcomes:

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

- comprehend Knowledge Based Systems. **[L2]**
- analyze structure of Expert Systems. [**L4**]
- identify characteristics of any given ES. [**L2**]

Unit III **8L**

Knowledge Sources – Expert - Knowledge Acquisition- Knowledge Representation - Knowledge Base - Inference Strategies - Forward and Backward Chaining; Expert System Languages - ES Building Tools or Shells; Typical examples of shells.

Learning Outcomes:

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

- utilize Expert System Languages. [**L3**]
- comprehend Knowledge Sources and Inference Strategies . [**L2**]
- apply different ES building tools. [**L3**]

Unit IV **8L**

Expert Systems Software for Manufacturing applications in CAD, CAPP, MRP, Adaptive Control, Robotics, Process Control, Fault Diagnosis, Failure Analysis; Process Selection, GT etc. Linking Expert Systems to other software such as DBMS, MIS, MDB; Process Control and Office Automation.

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

- recognize the significance sub-components of AI. [**L1**]
- identify the relationship among various components. [**L2**]
- apply all the tools wherever necessary. [**L3**]

Unit V **8L**

Case studies of typical applications in Tool selection, Process selection, Part classification, Inventory control, Process Planning etc.

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

- utilize the AI and its tools in solving different problems in manufacturing [**L3**]
- analyze various case studies and apply the knowledge to the new challenges. [**L4**]
- find the applications of AI through case studies [**L4**]

Text book:
1. Russell, Artificial Intelligence: A Modern Approach, 2/E, Pearson Education Inc., 2009.
2. Intelligent manufacturing systems – Andrew Kusiak, Prentice Hall, 1990.

References:
1. M. Tim Jones, Artificial Intelligence: A Systems Approach, Jones and Bartlett Publishers, Canada, 2009.
2. Robotics Technology and Flexible Automation by Deb, S.R. TMH, 1994.

Course Outcomes:
Upon successful 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]

19EME764: MACHINE VISION AND ITS APPLICATIONS

L	T	P	C
3	0	0	3

This course provides an introduction to Machine vision including fundamentals of image formation, camera imaging geometry, feature detection and matching, stereo, motion estimation and tracking, image classification and scene understanding. We'll develop basic methods for applications that include finding known models in images, depth recovery from stereo, camera calibration, image stabilization, automated alignment, tracking, boundary detection, and recognition. The focus of the course is to develop the intuitions and mathematics of the methods in lecture, and then to learn about the difference between theory and practice in the projects.

Course objectives:

- To introduce students the fundamentals of image formation
- To introduce students the major ideas, methods, and techniques of computer vision and pattern recognition
- To understand Hough Transform and its applications to detect lines, circles, ellipses
- To understand three-dimensional image analysis techniques
- To provide the student with programming experience from implementing computer vision and object recognition applications.

Unit I **8L**

Introduction to Machine Vision basics of picture processing, Binary and grey scale images.

Learning Outcomes

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

- understand the possibilities and limitations and application of image processing and computer vision.**[L1]**
- apply the theoretical knowledge about computer vision and their application in selected technical and industrial tasks. **[L2]**
- Analyze the solutions of projects in the industry, traffic, and state offices. **[L3]**

Unit II **12L**

Preprocessing concepts Digital image, Image representation –Image sampling, Digitization and quantization– Image transforms. Geometrical correction, Grey scale modification, Sharpening and smoothing the images.

Learning Outcomes

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

- understand the principals the Digital Image Processing terminology used to describe features of images.**[L1]**
- understand the mathematical foundations for digital manipulation of images; image acquisition; preprocessing; segmentation; Fourier domain processing, compression and analysis. **[L1]**
- learn and understand the Image Enhancement in the Spatial Domain. **[L2]**

Unit III **10L**

Edge detection – Thresholding – Spatial smoothing – Boundary and Region representation – Shape features – Scene matching and detection – Image classification. Extraction of line descriptions.

Learning Outcomes

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

- understand the Image Enhancement in the Frequency Domain.**[L1]**

- understand the Image Restoration, Compression, Segmentation, Recognition, Representation and Description. **[L1]**
- identification and location of sharp discontinuities in an image. **[L3]**

Unit IV **12L**

Software for measurement and pattern recognition applications with examples Two and three dimensional measurements, Fourier transform for pattern recognition applications, Image operation studies

Learning Outcomes of Module-IV:

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

- write programs using Matlab language for digital manipulation of images; image acquisition; preprocessing; segmentation; Fourier domain processing; and compression.**[L4]**
- have knowledge of the Digital Image Processing Systems.**[L3]**
- able to use MATLAB Digital Image Processing Toolbox (IPT).**[L5]**

Unit V **12L**

Interfacing a robot with a Vision system. Basics of hardware for Vision systems. Types of cameras for Machine Vision and their principles.

Learning Outcomes

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

- ability to integrate research programmes and involve in a process of lifelong learning.**[L5]**

Text Book:

1. Digital Image Processing by Gonzalez, R.C. and Woods, R.E., Addison Wesley Publications.

References:

1.Robot Vision by Prof. Alan Pugh (Editor), IFS Ltd., U.K.
2. Digital Image Processing by A. Rosenfled and A. Kak, Academic Press.
3. The Psychology of Computer Vision by P. Winstan, McGraw-Hill.
4 Algorithms for Graphics and Image Processing by T. Pavidis, Springer Verlag.

Course Outcomes:

After completing the course you will be able to: ·

- identify basic concepts, terminology, theories, models and methods in the field of computer vision [L3]
- describe known principles of human visual system [L2]
- describe basic methods of computer vision related to multi-scale representation, edge detection and detection of other primitives, stereo, motion and object recognition [L2]
- suggest a design of a computer vision system for a specific problem [L4]

19EME766: COMPUTER AIDED PROCESS PLANNING

L	T	P	C
2	1	0	3

This course exposes the primary purpose of process planning to translate the design requirements into manufacturing process details. The course has expanded coverage of process planning software's, optimization and group technology. It helps in exploring integrated process planning systems.

Course Objectives

- Introduce process planning importance in manufacturing of a product.
- Expose to the concept of Group technology and its importance.
- Familiarize with types of process planning procedures.
- Expose to various software's related to process planning.
- Explain the significance of integrated process planning system.

Unit I

INTRODUCTION **8L**

Introduction to Process Planning and Production Planning – Process Planning in the Manufacturing cycle - Process Planning and Concurrent Engineering, CAPP, Group Technology.

Learning Outcomes:

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

- study the basic concepts of process planning and production planning. **[L1]**
- outline the significance of concurrent engineering in manufacturing cycle. **[L2]**
- acquaint knowledge in grouping of parts according to its geometry. **[L1]**

Unit II

PART DESIGN REPRESENTATION **12L**

Design Drafting - Dimensioning - Conventional tolerance - Geometric tolerance - CAD – input / output devices - topology - Geometric transformation - Perspective transformation – Data structure - Geometric modeling for process planning - GT layout, GT- coding - The optiz system - The MICLASS system- CODE system.

Learning Outcomes:

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

- acquaint with design drafting. **[L2]**
- study the concept of group technology. **[L1]**
- train themselves in group technology coding. **[L3]**

Unit III

PROCESS ENGINEERING AND PROCESS PLANNING **12L**

Experienced, based planning - Decision table and decision trees - Process capability analysis – Process boundaries – Process parameters – Process optimization. Process Planning - Variant process planning - Generative approach - Forward and Backward planning, Input format, AI.

Learning Outcomes:

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

- study about process engineering and process planning. **[L1]**
- outline the process parameters and process optimization. **[L2]**
- utilize the concept of generative approach of process planning. **[L3]**

Unit IV

COMPUTER AIDED PROCESS PLANNING SYSTEMS 12L

Logical Design of a Process Planning - Implementation considerations –manufacturing system components, production Volume, No. of production families - CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP.

Learning Outcomes:

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

- acquaint with implementation considerations of process planning. **[L1]**
- choose the production volume of production using computer aided process planning systems. **[L4]**
- design process planning systems using different software's. **[L3]**

Unit V

AN INTERGRADED PROCESS PLANNING SYSTEMS 12L

Totally integrated process planning systems - An Overview – TIPPS Design philosophy- CAD Interface, Modulus structure – Interactive surface identification, Process knowledge- Description language - Data Structure, operation - Input and Display of CAD model- surface identification - select process- select process parameters- Report Generation- Testing results, Expert process planning.

Learning Outcomes:

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

- outline total integrated process planning systems. **[L1]**
- select suitable process and its parameters for surface identification. **[L3]**
- develop expert process planning based on tests and its reports. **[L4]**

Text Book:

1. Gideon Halevi and Roland D. Weill, ―Principles of Process Planning ", A logical approach, Chapman & Hall, 1995.
2. Automation, Production systems and computer integrated manufacturing by Mikell P. Groover, PHI, 2007.

References:

1. Tien-Chien Chang, Richard A.Wysk, "An Introduction to automated process planning systems ", Prentice Hall, 1985.
2. Chang, T.C., ―An Expert Process Planning System ", Prentice Hall, 1985.
3. Nanua Singh, "Systems Approach to Computer Integrated Design and Manufacturing ", John Wiley & Sons, 1996.
4. Rao, P.N. ―Computer Aided Manufacturing ", Tata McGraw Hill Publishing Co., 2001.

Course Outcomes:

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

- study the basic concepts of process planning and production planning. [L1]
- outline the significance of concurrent engineering in manufacturing cycle. [L2]
- train themselves in group technology coding. [L3]
- utilize the concept of generative approach of process planning. [L3]
- choose the production volume of production using computer aided process planning systems. [L4]
- design process planning systems using different software's. [L3]
- develop expert process planning based on tests and its reports. [L4]

19EME716: ADDITIVE MANUFACTURING

L	T	P	C
3	0	0	3

Additive manufacturing (AM), broadly known as 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

- Demonstrate the broad range of AM processes, devices, capabilities
- Expose the basics of additive manufacturing/rapid prototyping and its applications in various fields, reverse engineering techniques.
- Analyze the different processes in rapid prototyping systems.
- 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:

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

- demonstrate the knowledge of Additive Manufacturing and Rapid Prototyping technologies. [**L1**]
- 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:

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

- recognize the significance of software's 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:

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

- identify the significance of Liquid based systems in 3D design. [**L-1**]
- calculate the material required for making of an actual part. [**L-3**]
- differentiate the object manufacturing to utilize the concepts [**L-3**]

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:

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

- differentiate the SLS process **[L1]**
- 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:

Upon successful completion of the course, 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:

Upon successful 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]

19EME768: MANAGEMENT OF FINANCE, MARKETING AND PERSONNEL

L	T	P	C
3	0	0	3

Management of finance, marketing and personnel has wide application in industry. As finance, marketing and personnel are the most important asset of the organization, this subject guides us in their optimum utilization. Right from the entry till the exit in the organization, they need to be properly taken care of, guided and controlled if the organization is to get the best out of them. This objective can be achieved with the knowledge of this subject. In fact, this subject provides immense career opportunities in any type of industry as finance, marketing and personnel are the part & parcel of each & every industry.

Course Objectives:

- Explain the effect of financial management and financial statements.
- Demonstrate the issues with working capital, capital budgeting.
- Explain the marketing functions, pricing strategies and consumer behavior.
- Analyze the steps in product development.
- Appraise the functions of personnel department and manpower planning.

Unit I **12L**

Introduction to financial management, Organization of the financial management functions, Business Environment, Financial Environment. Financial Statements: Balance sheet, funds flow statement, Cash flows, forecasting, cash flow estimates, forecasting of financial statements.

Learning Outcomes:

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

- recall the significance of financial management. [**L1**]
- develop the balance sheet. [**L3**]
- Illustrate cash flow estimates. [**L2**]
- Estimate the financial statements using the concept of forecasting. [**L5**]

Unit II **10L**

Issues with working capital, financing current assets, Capital budgeting, Generating investment project proposals, Project evaluation, selection and monitoring. Intermediate and long-term financing, Term loans and leases, Provision of loan agreements, equipment financing, Lease financing and its evaluation.

Learning Outcomes:

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

- distinguish working capital management and capital budgeting. [**L4**]
- analyze the projects for selection. [**L4**]
- interpret term loans and leases. [**L2**]
- estimate the equipment financing and lease financing [**L5**]

Unit III **12L**

Introduction to Marketing: Marketing Concepts, Marketing functions, Marketing Environment, Marketing mix variables and their importance. Pricing Strategies: Meaning of pricing, Importance, Objectives, Factors influencing price determination. Consumer Behavior: Factors influencing Consumer Behavior, Decision making process in buying, perceived risks.

Learning Outcomes:

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

- list functions of marketing. [**L1**]
- analyze factors influencing price determination. [**L4**]

- interpret consumer behavior decision making in buying. [**L2**]
- estimate the price of the product [**L5**]

Unit IV **10L**

Product Development: Idea generation, Concept development and Testing, Market Testing, Commercialization. Advertising Management: Purpose, Factors in advertising, Advertising Portfolio Selection.

Learning Outcomes:

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

- list steps of product development. [**L1**]
- categorize the factors of advertising the product. [**L4**]
- interpret advertising portfolio. [**L2**]
- estimate the market value of the product [**L5**]

Unit V **12L**

Introduction to personnel management: concept of labour, organization and function of the personnel department, personnel policies. Manpower planning: Selection, Recruitment, Training, Performance appraisal, Wage and Salary, Administration: Job evaluation and merit rating.

Learning Outcomes:

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

- list functions of personnel department. [**L1**]
- categorize the factors of performance appraisal. [**L4**]
- interpret job evaluation and merit rating. [**L2**]
- estimate training requirements of personnel [**L5**]

Text Books:

1. Van Horne James C, Financial Management and policy, 12/e, Pearson Education India, 2002.
2. Philip Kotler, Marketing Management - Analysis, Planning, Implementation and Control, 9/e,Prentice-Hall,1997.
3. Monappa,Personnel Management,2/e, Tata McGraw-Hill Education, 1996.

References:

1. Edward Russell, The Fundamentals of Marketing, Bloomsbury Publishing,2017.
2. Harold Koontz, Heinz Weihrich, Essentials of Management,8/e,Tata McGraw-Hill Education, 2010.
3. James C. Van Horne, John M. Wachowicz, Jr.,Fundamentals of Financial Management,11/e, Prentice Hall, 2000.

Course outcomes:

After the successful completion of this course, the students will be able to

- Students will be able to demonstrate the applicability of the concept of Financial Management to understand the managerial Decisions and Corporate Capital Structure (L1).
- Students will be able to analyse the complexities associated with management of cost of funds in the capital Structure (L2).
- Students will be able to analyse the strategic issues and strategies required to select and develop manpower resources (L3).

19EME772: OPTIMIZATION METHODS IN ENGINEERING

L	T	P	C
3	0	0	3

This course exposes the evaluation of best possible solution for various engineering planning and design problems. The aim of the course is to train the students to develop a mathematical model and to solve the model by applying an appropriate mathematical programming technique. This course covers all advanced optimization techniques like geometric, dynamic, integer, stochastic and unconventional optimization techniques.

COURSE OBJECTIVES

- To illustrate the importance of advanced optimization techniques in theory and practice.
- To formulate and solve engineering design problems in the industry for optimal results
- To test the analytical skills in solving realistic engineering problems by applying appropriate optimization technique.
- To demonstrate various advanced and unconventional optimization techniques being developed in recent times.
- To develop and promote research interest in problems of Engineering and Technology

Unit I **12L**

Geometric programming (G.P): Unconstrained minimization problem, Solution of an unconstrained geometric programming, differential calculus method and arithmetic method, Primal dual relationship and sufficiency conditions. Solution of a constrained geometric programming problem (G.P.P), Complementary Geometric Programming, constrained minimization.

Learning Outcomes:

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

- formulate the geometric programming problem [**L5]**
- evaluate the optimal solution to geometric programming problem [**L6]**

Unit II **10L**

Dynamic programming (D.P): Multistage decision processes, Concepts of sub optimization, computational procedure in dynamic programming calculus method and tabular methods. Linear programming as a case of D.P and Continuous D.P.

Learning Outcomes:

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

- formulate the given linear/non-linear programming problem as a dynamic programming problem [**L5]**
- evaluate the optimal solution to dynamic programming problems using multi-stage decision process [**L6**]

Unit III **12L**

Integer programming (I.P): Integer linear programming, Graphical representation, Gomory's cutting plane method, Bala's algorithm for zero-one programming problem, Integer non linear programming, Branch-and-bound method, sequential linear discrete programming, generalized penalty function method

Learning Outcomes:

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

- formulate the integer and/or binary programming problem [**L5]**
- evaluate the optimal solution to integer and/or binary programming problem [**L6]**

Unit IV **10L**

Stochastic Programming (S.P): Basic concepts of Probability Theory, Stochastic linear programming, stochastic non-linear programming.

Learning Outcomes:

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

- define random variables and formulate the stochastic programming problem [**L1 & L5]**
- analyze the optimal solution to given problem under uncertainty [**L4**]

Unit V **12L**

Unconventional optimization techniques: Multi-objective optimization - Lexicographic method, Goal programming method, Genetic algorithms, Simulated Annealing, Neural Networks based Optimization.

Learning Outcomes:

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

- formulate the multi-variable optimization problem [**L5]**
- Evaluate the optimal solution to multi-variable optimization problem [**L6]**

Text Book:

1. Rao S.S., Engineering Optimization - Theory and Practice, 3rd edition, New Age International (P) Ltd. Publishers, 1996.

References:

1. Ravindran, Phillips and Solberg, Operations Research- Principles and Practice, 2nd edition, JohnWiely, 2007.
2. Hiller and Lieberman, Introduction to Operations Research, 7th edition, McGraw Hill, 2002.
3. James P. Ignizio, Goal Programming and Extensions, 2nd edition, Lexigton Books, 1976.
4. David E. Goldberg, Genetic Algorithms - In Search, Optimization and Machine Learning, 1st edition, Addison-Wesley Longman (Singapore) Pvt. Ltd., 1989.

Course outcomes:

After the successful completion of this course, the students will be able to

- to formulate and solve geometric programming problems [L5 & L3]
- to solve any complex optimization problem as a dynamic programming problem and analyze its solution [L3 & L4]
- to recognize the significance of integer and/or binary solutions and apply suitable algorithm for better decision making [L1 & L3]
- to formulate and solve stochastic optimization problems for decision making under uncertainty [L5 & L3]
- to formulate and solve multi-objective optimization problems; to propose various modern unconventional optimization techniques. [L5 & L3]

19EME774: COMPUTER INTEGRATED MANUFACTURING

L	T	P	C
3	0	0	3

This course provides basic knowledge about computer integrated manufacturing and it deals with grouping technology which is one of the most important technology followed in leading industries. CIM provides the basic knowledge of Computer aided process planning, Artificial Intelligence, Integrative Manufacturing Planning and Control. CIM combines various technologies like computer-aided design (CAD) and computer-aided manufacturing (CAM) to provide an error-free manufacturing process that reduces manual labor and automates repetitive tasks.

Course Objectives

- To introduce the concepts of automation, group technology integrated to Computer aided design and manufacturing.
- To obtain an overview on computer aided process planning and artificial intelligence process planning.
- To impart the knowledge of forecasting, scheduling capacity planning, shop-floor control in manufacturing systems and the concept of JIT manufacturing.
- To impart the basic knowledge of quality control, inspection methods and computer-aided testing.
- To classify and summarize the manufacturing systems, and integration of CAQC with CAD/CAM.

Unit I **8L**

Introduction: Scope of computer integrated manufacturing, product life cycle, production automation. Group technology: Role of group technology in CAD/CAM integration, methods for developing part families, classification and coding, examples of coding systems, facility design using group technology, economics of group technology.

Learning Outcomes:

- Understand importance and scope of CIM in fabrication/ manufacturing industry. **[L1]**
- Demonstrate automated production and assembly lines. **[L2]**
- Identify the stages of the product life cycle and related challenges. **[L2]**
- To learn the importance of group technology. **[L1]**

Unit II **8L**

Computer Aided Process Planning: Approaches to process planning, manual, variant, generative approach, process planning systems - CAPP, DCLASS, CMPP, criteria for selecting a CAPP system, part feature recognition, artificial intelligence in process planning.

Learning Outcomes:

- Demonstrate automated storage/retrieval system. **[L1]**
- Understand the computer aided process planning. **[L1]**
- Acquiring the knowledge of different forms of learning**. [L3]**
- Understanding the concept of part feature recognition. **[L2]**
- Demonstrate artificial intelligence in process planning. **[L1]**

Unit III **9L**

Integrative Manufacturing Planning and Control: Role of integrative manufacturing in CAD/CAM integration, over view of production control, forecasting, master production schedule, capacity planning, MRP, order release, shop-floor control, quality assurance, planning and control systems, cellular manufacturing, JIT manufacturing philosophy.

Learning Outcomes:

- Application of industrial engineering theory and practice to the area of operations management and production planning/control. **[L3]**
- Analysis and understanding of forecasting, aggregate planning, capacity planning, materials requirement planning, inventory management, short-term scheduling and sequencing. **[L2]**
- Ability to use and compare various statistical forecasting models **[L2]**
- Knowledge of lean manufacturing, tools, techniques and implementation outcomes. **[L1]**
- Understanding of just-in-time systems. **[L1]**

Unit IV **8L**

Computer Aided Quality Control: Terminology in quality control, contact inspection methods, noncontact inspection methods, computer aided testing, integration of CAQC with CAD/CAM.

Learning Outcomes:

- Demonstrate automated inspection system. **[L2]**
- Apply the knowledge of inspection techniques. **[L3]**
- Understand the concept of integration of CAQC with CAD/CAM. **[L2]**
- Apply knowledge about computer aided quality control and process planning. **[L3]**

Unit V **9L**

Computer Integrated Manufacturing Systems: Types of manufacturing systems, machine tools and related equipment, material handling systems, computer control systems, FMS.

Learning Outcomes:

- Demonstrate flexible manufacturing system. **[L2]**
- Demonstrate automated material handling system**. [L2]**
- Understand processing stations and material handling systems used in FMS environments. **[L1]**
- Implement FMS concept in a manufacturing environment **[L3]**
- Identify the various elements and their activities in the Computer Integrated Manufacturing Systems. **[L1]**

Text Book(s)

1. Mikell P. Groover, Automation, Production Systems, and Computer Aided Manufacturing, 2/e., Prentice Hall, 2001.
2. Mikell P. Groover, and Zimmers, CAD/CAM: Principles and Applications, 3/e, Tata-McGraw hill, 2010.

References

1.M.M.M. Sarcar, K. Mallikarjuna Rao, K. Lalit Narayan, Computer Aided Design and Manufacturing, 2/e, Prentice Hall of India, 2008.

Course Outcomes:

- To understand the concepts of Production Automation, Process Planning & Quality control in Computer Integrated Manufacturing Systems. [L1]
- To acquire the knowledge on quality control; computer aided testing and inspection methods. [L3]
- To analyze the Computer Aided Process Planning &Control, Material handling, and Artificial intelligence in FMS. [L4]

- To design and solve the problems of Forecasting, Scheduling, and capacity planning in manufacturing and assembling. [L5].
- To integrate computer aided design and computer aided manufacturing protocols to manufacture products. [L5]

19EME722: COMPUTER AIDED ENGINEERING LAB

L	T	P	C
0	0	3	2

1. Introduction to Finite Element Analysis software – ANSYS / NISA / Nastran
2. Static Structural Analysis of 1D problems – bars, trusses, beams and frames
3. Static Structural Analysis of 2D problems – plane stress, plane strain, axisymmetric
4. Static Structural Analysis of 3D problems – various brackets
5. Dynamic Structural Analysis of 1D problems – beams and frames
6. Steady State Thermal Analysis of 1D and 2D models
7. Transient Thermal Analysis of 1D and 2D models
8. Couple Field (Thermal/Structural) Analysis

19EME726: COMPUTER AIDED MANUFACTURING LAB

L	T	P	C
0	0	3	2

1. Preparation of manual part programme for turning, drilling and milling
2. To Generate NC programme using Master CAM simulation software for a turning Job using Lathe Version.
    a) Step turning, taper turning, drilling
    b) Thread cutting, grooving,
3. To Generate NC programme using Master CAM simulation software for a 3-axis machining Milling Version.
    a) Face milling, pocketing, drilling, contouring
    b) Gear cutting.
4. To Generate NC & APT programme using CATIA Manufacturing software for Lathe Machine.
5. To Generate NC & APT programme using CATIA Manufacturing software for Prismatic Machining.
6. Machining of one job on CNC Lathe.
7. Machining of one job on CNC Drilling.
8. Robot programming through computer / teaching box method.

19EOE742: BUSINESS ANALYTICS

L	T	P	C
3	0	0	3

This course introduces students to the science of business analytics. The goal is to provide students with the foundation needed to apply data analytics to real-world challenges they confront daily in their professional lives. Students will learn to identify the ideal analytic tool for their specific needs; understand valid and reliable ways to collect, analyze, and visualize data; and utilize data in decision making for managing agencies, organizations or clients in their workspace

Course Objectives

- To familiarize the scope, process and advantages of business analytics
- To acquaint the student with the modeling and problem solving skills in business analytics
- To impart the organization and management of business analytics
- To introduce the forecasting models and techniques used in analytics
- To expose the formulation and decision strategies used in business analytics

Unit I **8L**

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modeling, sampling and estimation methods overview

Learning Outcomes

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

- define the scope and process of business analytics (L1)
- choose an organizational structure to implement a business analytics process (L3)
- describe the statistical tools and methods used for data modeling and analysis (L2)
- identify the sampling and estimation requirements for data analysis (L1)

Unit II **8L**

Trendiness and Regression Analysis: Modeling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Learning Outcomes

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

- identify the relationships and trends in data (L1)
- utilize linear regression methods for identifying data relationships (L4)
- list the types of data and their models used for business analytics (L1)
- describe the methods for visualization and exploration of data (L2)

Unit III **8L**

Organization Structures of Business analytics: Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Learning Outcomes

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

- describe the management issues in the organization structures (L2)
- define the designing information policy and its usage (L1)
- list the methods for ensuring data quality measuring contribution (L1)
- explain the use of data mining methodologies for predictive analytics analysis (L3)
- describe the use of prescriptive analytics methods in business analytics process (L2)

Unit IV **10L**

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

Learning Outcomes

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

- classify and describe the use of forecasting models (L3)
- model the use of regression forecasting with casual variables (L5)
- identify the appropriate forecasting model for a given data (L5)
- explain the use of Monte Carlo simulation for forecasting and identify the involved risk (L2)

Unit V **8L**

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Learning Outcomes

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

- formulate decision problems (L2)
- list the decision strategies with and without probabilities (L1)
- use the decision trees for analysis (L4)
- describe the value of information, utility and its use in decision making (L4)

Textbook(s):

1. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Business analytics Principles, Concepts, and Applications Pearson FT Press, 2014.
2. James Evans, Business Analytics, Pearson Education, 2013.

Course Outcomes:

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

- define the scope, process and advantages of business analytics (L1)
- explain the modeling and problem solving skills in business analytics (L2)
- describe the organization and management of business analytics (L3)
- utilize the forecasting models and techniques used in analytics (L4)
- enumerate and utilize the formulation and decision strategies (L2)

19EOE744: INDUSTRIAL SAFETY

L	T	P	C
3	0	0	3

Safety by design or prevention through design is in the core for maintaining engineering systems safe. The students will be equipped with concepts of engineering systems safety, dimensions of engineering systems safety, safety design and analysis mathematics, design for engineering systems safety and control for safety, and integrating safety with other operational goals such as quality and reliability

Course Objectives

- to impart knowledge on different facets and aspects of industrial systems safety
- to familiarize the student with tools, techniques and methodologies needed for prevention of occurrences of unsafe operations and accidents under different industrial settings
- to impart the knowledge of definition, function and types of maintenance activities
- to familiarize the different wear and corrosion mechanisms and their prevention methods
- to expose the students to different faults and their tracing mechanisms
- to impart the art of planning periodic and preventive maintenance mechanisms

Unit I **8L**

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc., Safety color codes. Fire prevention and firefighting, equipment and methods.

Learning Outcomes

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

- list the different types of mechanical and electrical hazards in industrial systems(L1)
- enumerate the salient points of factories act 1948(L2)
- describe the health and safety measures to be enforced for industrial safety(L3)
- elaborate the different fire prevention and firefighting arrangements to be made(L2)

Unit II **8L**

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Learning Outcomes

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

- define the meaning and aim of maintenance engineering(L1)
- elaborate the primary and secondary functions of maintenance department(L2)
- classify the different types and applications of maintenance(L3)
- relate the replacement economy with maintenance cost(L5)
- estimate the service life of equipment from the specifications of individual components(L4)

Unit III **8L**

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Learning Outcomes

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

- explain the different types, causes and effects of Wear(L2)
- elaborate the different methods for reducing wear(L2)
- list the different types of lubricants and mention their applications(L1)
- define the principle and factors affecting corrosion(L1)
- classify the different types of corrosion and identify their prevention methods(L3)

Unit IV **8L**

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Learning Outcomes

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

- explain the different types, causes and effects of Wear(L2)
- use the concept of decision tree for fault tracing in machine tools(L4)
- build decision trees for different machine tools including pump, air compressor etc(L4)
- classify the different types of faults in machine tools and their causes(L3)

Unit V **10L**

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Learning Outcomes

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

- explain the concept of periodic inspection and its need(L2)
- list the common troubles and remedies of electric motor(L1)
- define the need for preventive maintenance and list its steps(L3)
- elaborate the steps/procedure of periodic and preventive maintenance of diesel generating sets, pumps etc. (L2)

Text Book(s):

1. Lindley R. Higgins, Lester Coridon Morrow, Maintenance Engineering Handbook, Da Information Services, 1977.
2. H. P. Garg, Maintenance Engineering, S. Chand and Company, 1987.
3. Audels, Pump-hydraulic Compressors, Mc Graw Hill Publication, 1992.
4. Winterkorn, Hans, Foundation Engineering Handbook, Chapman & Hall London, 1975

Course Outcomes:

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

- describe the different facets and aspects of industrial systems safety(L2)
- demonstrate the use of tools, techniques and methodologies needed for prevention of occurrences of unsafe operations and accidents under different industrial settings(L4)
- define the function and list the types of maintenance activities(L1)
- describe the concept of wear and corrosion mechanisms and their prevention methods(L2)
- enumerate the different faults and their tracing mechanisms (L3).
- elaborate the planning periodic and preventive maintenance mechanisms needed for industrial safety(L4)

19EOE746: OPERATIONS RESEARCH

L	T	P	C
3	0	0	3

Optimization problems arise in all walks of human activity- particularly in engineering, business, finance and economics. The simplest optimization problems are linear in nature which may be subject to a set of linear constraints. This course will equip the student with the expertise to mathematically model real life optimization problems as Linear Programming (Optimization) Problems and subsequently educate the student to solve these models with the help of the available methods.

Course Objectives

- to impart knowledge on developing mathematical formulation for linear programming and transportation problem
- to familiarize the student in the construction of the required activities in an efficient manner to complete it on or before a specified time limit and at the minimum cost.
- to expose the development of mathematical model for interactive decision-making situations, where two or more competitors are involved under conditions of conflict and competition.
- to illustrate PERT and CPM techniques for planning and implementing projects.
- To impart the knowledge of formulating and analysis of real life problems using advanced tools and techniques for resource optimization
- to provide frameworks for analyzing waiting lines using advanced queuing theory concepts

Unit I **8L**

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Learning Outcomes

After completing this unit, the student will be able to

- identify and develop operational research models from the verbal description of the real system. **[L4]**
- understand the classification systems of effective Inventory control models**[L2]**

Unit II **8L**

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Learning Outcomes

After completing this unit, the student will be able to

- translate a real-world problem, given in words, into a mathematical formulation. **[L2]**
- utilize the mathematical tools that are needed to solve optimization problems. **[L2]**

Unit III **8L**

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Learning Outcomes

After completing this unit, the student will be able to

- describe the need and origin of the optimization methods**[L2]**
- classify optimization problems to suitably choose the method needed to solve the particular type of problem**[L3]**

Unit IV **8L**

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Learning Outcomes

After completing this unit, the student will be able to

- choose linear programming problems to suitably choose the method needed to solve the particular type of problem**[L1]**
- identify industrial problems involved in inventory, MRP and scheduling**[L2]**

Unit V **8L**

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Learning Outcomes

After completing this unit, the student will be able to

- identify the values, objectives, attributes, decisions, uncertainties, consequences, and trade-offs in a real decision problem**[L2]**
- Apply the models to incorporate rational decision-making process in real life situations.**[L3]**
- Analyze various modeling alternatives & select appropriate modeling techniques for a given situation.. **[L3]**

Text Book(s):

1. H.A. Taha, Operations Research, An Introduction, Prentice Hall of India, 2008
2. H.M. Wagner, Principles of Operations Research, Prentice Hall of India, Delhi, 1982.
3. J.C. Pant, Introduction to Optimization: Operations Research, Jain Brothers, 2008
4. Hitler Libermann Operations Research: McGraw Hill Publishers, 2009
5. Pannerselvam, Operations Research: Prentice Hall of India, 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India, 2010

Course Outcomes:

After the successful completion of the course, the students will be able to:

- Understand the basic concepts of different advanced models of operations research and their applications. (L2)
- Solve linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained and translate solutions into directives for action. (L4)

- Apply the models to incorporate rational decision-making process in real life situations. (L4)
- Analyze various modeling alternatives & select appropriate modeling techniques for a given situation. (L3)
- Validate output from model to check feasibility of implementations. (L5)
- Create innovative modeling frameworks for a given situation. (L6)
- Conduct and interpret post-optimal and sensitivity analysis and explain the primal-dual relationship. (L3)

19EOE748: COST MANAGEMENT OF ENGINEERING PROJECTS

L	T	P	C
3	0	0	3

This course will equip the student with the expertise to mathematically model engineering projects and use effective methods and techniques to plan and execute engineering activities.

Course Objectives

- to introduce the basic principles of strategic cost management and the related terminology
- to familiarize the project planning and execution process involving technical/nontechnical activities
- to acquaint the student with detailed engineering activities and their cost management analysis
- to impart the knowledge of cost analysis and profit planning of engineering projects
- to familiarize the quantitative techniques for optimization of budget allocation

Unit I **8L**

Introduction and Overview of the Strategic Cost Management Process, Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Learning Outcomes

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

- describe the cost concepts in decision making(L2)
- define the various costs involved in the cost management process(L2)
- list the objectives of cost control(L2)
- identify the different fields of a database for operational control(L2)

Unit II **8L**

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities.

Learning Outcomes

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

- define the meaning of a project and list the different types(L2)
- identify the measures to manage cost overruns(L2)
- describe the various stages of project execution from conception to commissioning(L2)
- plan the proper order of technical/nontechnical activities as part of project execution(L2)

Unit III **8L**

Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

Learning Outcomes

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

- identify the different clearance norms required in the pre-project execution phase(L2)
- describe the hierarchy of project team and identify the role of each member(L2)
- list the different contents of project contracts(L2)
- present the project cost control and planning through bar charts, network diagrams etc(L2)

Unit IV **8L**

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis.

Learning Outcomes

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

- describe the cost behavior and profit planning(L2)
- distinguish between marginal costing and absorption costing(L2)
- analyze the variance of standard costing(L2)
- analyze the pricing strategies in project costing(L2)
- identify the quality measures satisfying the appropriate constraints(L2)

Unit V **10L**

Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing. Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory

Learning Outcomes

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

- define and compare the different budgeting strategies(L2)
- model the cost management as a linear programming problem(L2)
- measure the divisional profitability and decide the appropriate pricing(L2)

Textbook(s):

1. Charles T. Horngren, Srikant M. Datar, George Foster, Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi, 2006.

References:

1. Charles T. Horngren, George Foster, Advanced Management Accounting, Greenwood Publishing, 2001.
2. Robert S Kaplan, Anthony A. Alkinson, Management & Cost Accounting, 1998.
3. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting, Wheeler Publisher, 2004.
4. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book, 2006.

Course Outcomes:

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

- list the basic principles of strategic cost management and define the related terminology(L1)
- plan the project execution process involving technical/nontechnical activities(L4)
- describe the detailed engineering activities and their cost management analysis(L2)
- carry out the cost analysis and profit planning of engineering projects(L5)
- utilize quantitative techniques for optimization of budget allocation(L6)

19EOE752: WASTE TO ENERGY

L	T	P	C
3	0	0	3

This course introduces the basic principles and different technologies of converting waste to energy. Student will be able to appropriately identify the methods and build biomass gasification systems of different capacities depending on application requirements.

Course Objectives

- to introduce the classification of waste for its usefulness in preparing different fuels
- to familiarize the biomass pyrolysis process and its yield issues
- to acquaint the student with biomass gasification processes and construction arrangements
- to impart the types and principles of biomass combustors
- to familiarize the calorific values and composition of biogas resources

Unit I **8L**

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Learning Outcomes

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

- distinguish between different types of waste (L1)
- classify the different types of waste for manufacturing different types of fuel (L3)
- identify the different conversion devices and their applications(L4)

Unit II **8L**

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyro-lytic oils and gases, yields and applications.

Learning Outcomes

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

- classify the different types of pyrolysis methods based on speed(L1)
- describe the different methods of manufacturing charcoal (L2)
- explain the chemical processes involved in the manufacture of pyro-lytic oils and gases(L2)

Unit III **8L**

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Learning Outcomes

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

- explain the design, construction and operation of different gasifiers(L2)
- describe the burner arrangement for thermal heating(L2)
- elaborate the gasifier engine arrangement for equilibrium and kinetic considerations(L3)

Unit IV **8L**

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Learning Outcomes

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

- explain the basic principle of biomass combustors(L2)
- classify different combustors based on their capacity and efficiency(L3)
- describe the construction and operation of fixed bed inclined grate, fluidized bed combustors (L2)

Unit V **10L**

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

Learning Outcomes

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

- list the properties of biogas(L1)
- elaborate the design, construction and operation of biogas plant(L2)
- classify the different biomass resources and their conversion process(L3)
- distinguish between different biogas plants and identify their applications(L5)

Text Book(s)

1. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Course Outcomes:

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

- classify different types of waste for their usefulness in preparing different fuels(L3)
- describe the biomass pyrolysis process and its yield issues(L2)
- outline the different biomass gasification processes and their construction arrangements(L3)
- explain the types and principles of biomass combustors(L2)
- analyze the calorific values and composition of biogas resources(L5)

19EAC741: ENGLISH FOR RESEARCH PAPER WRITING

L	T	P	C
2	0	0	0

This course introduces the student, to the different aspects of research paper writing including planning, preparation, layout, literature review write-up etc. Specifically the perspective and style of writing in different sections of a research paper is highlighted. Students will exposed to English language skills relevant to research paper writing.

Course Objectives:

- To write clearly, concisely and carefully by keeping the structure of the paper in mind.
- To use standard phrases in English and further improve his command over it.
- To write with no redundancy, no ambiguity and increase the readability of the paper.
- To plan and organize his paper by following a logical buildup towards a proper conclusion.
- To decide what to include in various parts of the paper.
- To write a suitable title and an abstract in order to attract the attention of the reader.
- To identify the correct style and correct tense.
- To retain the scientific value of the paper by using minimum number of words.

Unit I **5L**

Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

Learning Outcomes:

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

- To know the expectations of various journals and referees
- To know the typical structure of a paper
- Learn to put words in a sentence in the correct order
- To write short and clear sentences from the very beginning of the paper
- To increase the readability of the paper by making it easy to read and 100% clear
- Learn to be concise without losing any important content
- To avoid some typical grammar mistakes made in research papers

Unit II **5L**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction.

Learning Outcomes:

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

- Learn to make useful contribution worth recommending for publication
- Learn good use of language to make readers notice the key findings
- Learn to anticipate or predict possible objections to the claims made in the paper
- To understand what is plagiarism, and how to paraphrase other people's work
- Learn to attract the right kind of readers with a suitable title
- Learn to sell the abstract to potential readers by attracting their curiosity

Unit III **6L**

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check. key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

Learning Outcomes:

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

- have a deep knowledge about everything that has been previously written on the topic and decide what is important to know in Introduction.
- Learn to provide the right amount of literature regarding the sequence of events leading up to the current situation in the Literature review

Unit IV **6L**

Writing Skills: skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

Learning Outcomes:

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

- Learn to describe the materials used in experiments and/or the methods used to carry out the research
- The key skill is in reporting the results simply and clearly
- Learn to structure the Discussion and satisfy the typical requirements of the referees
- Learn to provide a clear and high-impact take-home message in the conclusion

Unit V **6L**

Good Paper Writing: Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Learning Outcomes:

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

- Learn various lists of frequently used phrases that have a general acceptance in all disciplines and use in specific sections of the paper
- Learn various kinds of things one should look for when doing the final check

Text Book (s)**:**

1. Goldbort R, Writing for Science, Yale University Press, 2006
2. Day R, How to Write and Publish a Scientific Paper, Cambridge University Press, 2006
3. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM, Highman, 1998.

References:

1. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

Course Outcomes:

By the end of the course the students will be able to:

- Frame the structure of the paper precisely. (L2).
- Improve his command over English by using standard phrases. (L3).
- Avoid repetition and mistakes in the paper and increase its readability. (L3).
- Organize the paper logically towards a proper conclusion. (L4).

- Decide on the content to be included in various parts of the paper. (L5).
- Identify whether to use personal or impersonal style in the paper. (L5).
- Express the content in a clear and concise way. (L6).
- Attract the attention of the reader by providing a suitable title and an appropriate abstract. (L6).

19EAC742: DISASTER MANAGEMENT

L	T	P	C
2	0	0	0

This course is intended to provide fundamental understanding of different aspects of Disaster Management. It will expose the students to the concept and functions of Disaster Management and to build competencies of Disaster Management professionals and development practitioners for effective supporting environment as put by the government in legislative manner. It would also provide basic knowledge, skills pertaining to Planning, Organizing and Decision-making process for Disaster Risk Reduction.

Course Objectives

- to provide students an exposure to disasters, their significance, types & Comprehensive understanding on the concurrence of Disasters and its management.
- to ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention, risk reduction and the basic understanding of the research methodology for risk reduction measures.
- equipped with knowledge, concepts, and principles, skills pertaining to Planning, Organizing, Decision-making and Problem solving methods for Disaster Management.
- to develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity.

Unit I **5L**

Introduction Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Learning Outcomes

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

- define the meaning, list the factors and mention the significance of disaster
- distinguish between hazard and disaster
- compare manmade and natural disaster
- list the types of disaster and describe their magnitude

Unit II **5L**

Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

Learning Outcomes

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

- define the meaning, list the factors and mention the significance of disaster
- distinguish between hazard and disaster

- compare manmade and natural disaster
- list the types of disaster and describe their magnitude

Unit III **6L**

Disaster Prone Areas in India Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.

Learning Outcomes

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

- describe the seismic zones and their characteristics
- identify the areas prone to floods and droughts
- distinguish between landslides and avalanches
- identify areas prone to cyclonic and costal hazards
- enumerate the post disaster diseases and epidemics

Unit IV **6L**

Disaster Preparedness and Management Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, media reports: governmental and Community Preparedness.

Learning Outcomes

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

- describe the monitoring of phenomena triggering a disaster/hazard
- evaluate the risk with the use of remote sensing and meteorological data
- list the governmental and community measures for disaster preparedness

Unit V **6L**

Risk Assessment Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

Learning Outcomes

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

- define and list the elements of disaster risk
- enumerate the measures for risk reduction
- apply the techniques of risk assessment
- identify the means of people's participation in risk assessment

Text Book(s):

1. R. Nishith, Singh A.K., Disaster Management in India: Perspectives, issues and strategies, New Royal Book Company., 2008.
2. Sahni, Pardeep, Disaster Mitigation Experiences and Reflections, Prentice Hall of India, New Delhi., 2012
3. Goel S. L., Disaster Administration and Management Text and Case Studies", Deep and Deep Publication, 2007.

Course Outcomes:

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

- Identify management activities in pre, during and post phases of Disasters (L2).
- Plan disaster management activities and specify measure for risk reduction (L3)
- apply risk assessment techniques in real life disaster scenarios(L4).

19EAC743: SANSKRIT FOR TECHNICAL KNOWLEDGE

L	T	P	C
2	0	0	0

This course is intended to expose the student to the fundamentals of Sanskrit language and its technical utility in forming the core principles of many engineering branches. Students taking this course shall be able to relate the core principles of engineering branches to semantics of Sanskrit language

Course Objectives

- to provide the knowledge of Sanskrit alphabets
- to expose the students to the basic grammar and sentence formation in past/present/future tenses
- to provide a classification of Sanskrit literature and its associated roots
- to demonstrate the relation of core engineering principles to the roots of Sanskrit literature

Unit I **9L**

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences.

Learning Outcomes

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

- define and list the elements of disaster risk
- enumerate the measures for risk reduction
- apply the techniques of risk assessment

Unit II **9L**

Order, Introduction of roots, Technical information about Sanskrit Literature.

Learning Outcomes

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

- classify the different branches of Sanskrit literature
- describe the order and roots of Sanskrit literature
- relate the applicability of Sanskrit literature to technical principles

Unit III **9L**

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Learning Outcomes

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

- relate the technical concepts of engineering to principles of electrical technology
- relate the technical concepts of engineering to principles of mechanical engineering
- apply the use of Sanskrit knowledge to describe the mathematical principles

Text Book(s):

1. Dr.Vishwas, Abhyaspustakam, Samskrita Bharti Publication, New Delhi, 2005.

2. Vempati Kutumb Shastri, Teach Yourself Sanskrit, Prathama Deeksha, Rashtriya Sanskrit
Sansthanam, New Delhi Publication, 2003.
3. Suresh Soni, India's Glorious Scientific Tradition, Ocean books, New Delhi, 2011.

Course Outcomes:

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

- get a working knowledge in illustrious Sanskrit, the scientific language in the world **(L1).**
- get a Learning of Sanskrit to improve brain functioning **(L3).**
- develop the logic in mathematics, science & other subjects with principles of Sanskrit **(L2)**.
- explore the huge knowledge from ancient literature with the help of Sanskrit **(L4)**.

19EAC744: VALUE EDUCATION

L	T	P	C
2	0	0	0

This course is intended to expose the student to the need for human values and methods to cultivate them for leading an ethical life with good moral conduct. Students taking this course will be able to experience a change in personal and professional behavior with these ethical principles guiding him throughout life

Course Objectives

- to expose the student to need for values, ethics, self-development and standards
- to make the student understand the meaning of different values including duty, devotion, self-reliance etc.
- to imbibe the different behavioral competencies in students for leading an ethical and happy life
- to expose the student to different characteristic attributes and competencies for leading a successful, ethical and happy profession life.

Unit I **7L**

Values and self-development –social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements

Learning Outcomes

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

- define the social values and individual attitudes for self-development
- describe the Indian vision of humanism
- distinguish between moral and non-moral acts
- list the standards and value principles for moral conduct

Unit II **7L**

Importance of cultivation of values. Sense of duty. Devotion, self-reliance. Confidence, concentration. Truthfulness, cleanliness. Honesty, humanity. Power of faith, national unity. Patriotism, love for nature, discipline.

Learning Outcomes

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

- describe the importance of cultivating values
- list the different traits of self-developed individual
- explain the need for loving nature/country/humanity

Unit III **7L**

Personality and Behaviour Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs

suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature.

Learning Outcomes

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

- describe the benefits of positive thinking, integrity and discipline
- list the different methods for avoiding fault finding, anger
- explain the methods to overcome suffering, religious intolerance, self-destructive habits

Unit IV **7L**

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.

Learning Outcomes

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

- describe the science of reincarnation
- explain the relation between self-management and good health
- elaborate the role of different religions in reaching the common goal
- list the different techniques for mind-control to improve personality and studies

Text Book(s):

1. Chakroborty S.K., "Values and ethics for organizations: Theory and Practice", Oxford University Press, 1998.

Course Outcomes:

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

- appreciate the need for human values and methods for self-development.
- elaborate the different traits and benefits of a self-developed individual.
- list the different attributes of self-developed individual.
- elaborate the role and scope of books/faith/health/religions in character building and competence development.

19EAC745: CONSTITUTION OF INDIA

L	T	P	C
2	0	0	0

This course is intended to expose the student to the philosophy of Indian constitution. Students will be able to understand their fundamental rights/duties and governance structure. Students also appreciate the role of election commission in establishing a democratic society.

Course Objectives

- to familiarize the student about the need for a constitution
- to make the student understand the role of constitution in a democratic society
- to acquaint the student with key constitutional features and fundamental rights of a citizen
- to impart the organs of governance and local administration hierarchy and their responsibilities
- to familiarize the student with the role, responsibilities and administration hierarchy of election commission

Unit I **5L**

History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working). **Philosophy of the Indian Constitution**: Preamble, Salient Features

Learning Outcomes

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

- list the outline of drafting committee and their roles in the making of Indian constitution
- describe the need and role of a constitution in a democratic society
- elaborate the salient features of Indian constitution

Unit II **5L**

Contours of Constitutional Rights & Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

Learning Outcomes

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

- list the fundamental rights of a citizen
- explain the intricacies in the different rights
- elaborate the fundamental duties of a citizen
- describe the principles of state policy

Unit III **6L**

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

Learning Outcomes

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

- present the hierarchy of governance
- list the role/responsibilities/powers of different organs of governance
- elaborate the guidelines for appointment/transfer of judges

Unit IV **6L**

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Panchayat raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

Learning Outcomes

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

- describe the administrative organizational hierarchy of municipalities and panchayats
- appreciate the role/responsibilities/powers of mayor, CEO, elected officials
- appreciate the importance of grass root democracy

Unit V **6L**

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

Learning Outcomes

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

- describe the administrative hierarchy of election commission
- elaborate the roles/responsibilities/powers of election commissioners at different levels of hierarchy
- outline the welfare activities of SC/ST/OBC/Women by different bodies

Text Book(s):

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. S. N. Busi, Dr. B. R. Ambedkar, Framing of Indian Constitution, 1/e, 2015.
3. M. P. Jain, Indian Constitution Law, 7/e, Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes:

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

- describe the philosophy and salient features of Indian constitution.
- list the constitutional rights and duties of a citizen.
- elaborate the central and local administrative hierarchy and their roles.
- describe the roles/responsibilities/powers of different governing and administrative bodies.
- explain the structure/functioning and power of election commission.

19EAC746: PEDAGOGY STUDIES

L	T	P	C
2	0	0	0

This course is aimed to familiarizing the student with pedagogical principles, practices and methodologies. This course is intended for students interested in pursuing a career in teaching and research.

Course Objectives

- to familiarize the student about the need for pedagogy studies, background and conceptual framework
- to expose the student to pedagogical practices in formal/informal classrooms
- to acquaint the student with type of curriculum and guidance materials for effective pedagogy
- to familiarize the student with classroom practices and curriculum assessment procedures
- to make the student understand the effect of undertaking research on teaching quality

Unit I **5L**

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Overview of methodology and Searching.

Learning Outcomes

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

- define the aim and rationale behind teacher education
- classify the different theories of learning
- elaborate the need and role of curriculum, teacher education

Unit II **5L**

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

Learning Outcomes

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

- describe the different pedagogical practices used by teachers in formal and informal classrooms
- explain the pedagogical practices employed in developing countries
- enumerate the duties of faculty in terms of teaching, research, consultancy, administration

Unit III **6L**

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices.

Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

Learning Outcomes

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

- list the measures for effective pedagogy
- identify the different documentation required to formalize curriculum implementation and quality assessment
- describe the teachers attitudes and beliefs in pedagogic strategies

Unit IV **6L**

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes.

Learning Outcomes

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

- define the organizational hierarchy in a school administration system
- list the different barriers to learning
- enumerate the methods to overcome limited resources and handle large class sizes
- describe the follow-up support and peer-support in classroom practices

Unit V **6L**

Research gaps and future directions: Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

Learning Outcomes

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

- explain the need for and role of research in teaching profession
- list the different research activities to be taken up by teachers
- describe the impact of research on teaching quality and learning process

Text Book(s):

1. Ackers J, Hardman F, Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261, 2001
2. Agrawal M, Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379, 2004.
3. Akyeampong K, Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID., 2003.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J, Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282., 2013.
5. Alexander RJ, Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell., 2001.

Chavan M, Read India: A mass scale, rapid, 'Learning to Read' campaign., 2003.

Course Outcomes:

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

- describe the theories of learning and conceptual framework of pedagogy
- explain the pedagogical practices used by teachers in formal and informal classrooms
- visualize the administrative hierarchy of schools and colleges and define the role
- appreciate the need for research and define the future direction of teaching career
- describe the impact of curriculum and assessment on the teaching learning process of a student

19EAC747: STRESS MANAGEMENT BY YOGA

L	T	P	C
2	0	0	0

This course is aimed to familiarize the student with basic principles of yoga and different physical/mental practices for managing mind and body. This course helps the student in managing stress during education, home and workplace. Further, principles learnt in this course help in building overall personality for a stress-free, happy and independent life.

Course Objectives

- to familiarize the student about eight parts of yoga and their significance
- to expose the student to the importance and meaning of Yam and Niyam
- to make the student understand the meaning and importance of yogic principles including Ahimsa, Satya, Astheya etc
- to introduce the different yogic poses with a knowledge of their benefits for mind and body
- to familiarize the effect of different types of breathing techniques in concept and in activity

Unit I **9L**

Definitions of Eight parts of yoga (Ashtanga).

Learning Outcomes

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

- list the eight parts of yoga
- describe the effects of different parts of yoga on mind and body
- elaborate the importance of yoga in stress management and personality development

Unit II **9L**

Yam and Niyam.

Do`s and Don't's in life.

i) Ahinsa, satya, astheya, bramhacharya and aparigraha
ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.

Learning Outcomes

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

- elaborate the importance of Yam and Niyam
- describe the meaning and significance of Ahinsa, satya, astheya etc
- explain the need for shaucha, santosh, tapa, swadhyay in leading a healthy and fruitful life

Unit III **9L**

Asan and Pranayam

i) Various yog poses and their benefits for mind & body
ii) Regularization of breathing techniques and its Effects-Types of pranayam.

Learning Outcomes

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

- demonstrate the different physical asanas and explain their physical and phychological effects
- demonstrate the different breathing techniques and describe their physical and mental effects
- distinguish between different types of pranayamam

Text Books

1. Janardan, Yogic Asanas for Group Tarining-Part-I, Swami Yogabhyasi Mandal, Nagpur
2. Swami Vivekananda, "Rajayoga or conquering the Internal Nature", Advaita Ashrama, Kolkata

Course Outcomes:

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

- describe the eight parts of yoga and their significance
- explain the the importance and meaning of Yam and Niyam
- define the meaning and importance of yogic principles including Ahimsa, Satya, Astheya etc.
- demonstrate the different yogic poses and explain their benefits for mind and body
- demonstrate the different types of breathing techniques and explain their physical and mental benefits

19EAC748: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

L	T	P	C
2	0	0	0

This course is aimed to familiarize the student with life enlightenment skills for personality development. This course helps the student in building his holistic personality through human values, ethics and spiritual attributes.

Course Objectives

- to familiarize the student to good personality traits through moral stories
- to make the student understand the goal of human life and importance of good personality in reaching the goal
- to expose the student to the study of Shrimad-Bhagwad-Geeta for developing his/her personality and achieve the highest goal in life
- to familiarize the student to leadership skills for driving nation and mankind to peace and prosperity
- to expose the role of Neetishatakam for developing versatile personality of students.

Unit I **9L**

Neetisatakam-Holistic development of personality
Verses- 19,20,21,22 (wisdom)
Verses- 29,31,32 (pride & heroism)
Verses- 26,28,63,65 (virtue)
Verses- 52,53,59 (dont's)
Verses- 71,73,75,78 (do's).

Learning Outcomes

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

- describe the moral stories illustrating the traits of good personality
- define the meaning and importance of wisdom, pride, heroism, virtue etc
- identify do and donts in life from the foundations of human morals/ethics

Unit II **9L**

Approach to day to day work and duties.
Shrimad BhagwadGeeta: Chapter 2-Verses 41, 47,48,
Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
Chapter 18-Verses 45, 46, 48.

Learning Outcomes

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

- describe the characteristics and principles of bhakti yogam, jnana yogam and karma yogam
- identify the use of different yogic characteristics in different activities of daily life/duties

- apply the use of yogic principles for leading a stress-free, happy and fruitful life with good developed personality

Unit III **9L**

Statements of basic knowledge.
Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68
Chapter 12 -Verses 13, 14, 15, 16,17, 18
Personality of Role model. Shrimad BhagwadGeeta:
Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
Chapter 4-Verses 18, 38,39
Chapter18 – Verses 37,38,63

Learning Outcomes

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

- list the characteristics of role model proposed by verses of bhagavad gita
- explain the methods for obtaining life enlightenment through the practice of four yoga appropriately
- describe the characteristics of karma yogi/jnana yogi for developing leadership personality

Text Book(s):

1. Swami Swarupananda, "Srimad Bhagavad Gita", Advaita Ashram (Publication Department), Kolkata
2. P. Gopinath, Bhartrihari's Three Satakam (Niti-Sringar-vairagya), Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes:

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

- List the different parables of neethisathakam and identify their morals
- enumerate the different traits of human personality for life enlightenment
- describe the leadership attributes for driving nation and mankind to peace and prosperity
- explain the applicability of different types of yoga to day-to-day work and duties resulting in responsible personality

19EAC750: DEVELOPING SOFT SKILLS AND PERSONALITY

L	T	P	C
3	0	0	0

Soft skills comprise pleasant and appealing personality traits as self-confidence, positive attitude, emotional intelligence, social grace, flexibility, friendliness and effective communication skills. The course aims to cause a basic awareness within the students about the significance of soft skills in professional and inter-personal communications and facilitate an all-round development of personality.

Course Objectives

- to familiarize the student to the criteria for self-assessment and significance of self-discipline
- to expose the student to attitudes, mindsets, values and beliefs
- to acquaint the student to plan career and goals through constructive thinking
- to enable the student to overcome barriers for active listening and persuasive speaking
- to familiarize the skill of conducting meetings, writing minutes and involving in active group discussions

Unit I **8L**

Self-Assessment; Identifying Strength & Limitations; Habits, Will-Power and Drives; Developing Self-Esteem and Building Self-Confidence, Significance of Self-Discipline

Learning Outcomes

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

- identify strengths & limitations through self-assessment(L3)
- list the attributes of personalities will good will-power and self-drives(L1)
- describe the reasons for building self-esteem and self-confidence(L2)
- explain the significance of self-discipline (L2)

Unit II **8L**

Understanding Perceptions, Attitudes, and Personality Types: Mind-Set: Growth and Fixed; Values and Beliefs

Learning Outcomes

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

- define the characteristics of different perceptions, attitudes and personality types(L1)
- distinguish between fixed and growing mindsets (L3)
- define the importance and meaning of values and beliefs(L2)

Unit III **8L**

Motivation and Achieving Excellence; Self-Actualization Need; Goal Setting, Life and Career Planning; Constructive Thinking

Learning Outcomes

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

- describe the need for having high motivation and achieving excellence(L2)
- define the need for self-actualization(L1)

- plan the life and career goals based on self-assessment(L4)
- explain the attributes of constructive thinking(L2)

Unit IV **8L**

Communicating Clearly: Understanding and Overcoming barriers; Active Listening; Persuasive Speaking and Presentation Skills.

Learning Outcomes

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

- self-assess the barriers for communicating clearly (L4)
- list the attributes of active listening(L1)
- describe the minimal aspects of effective presentation(L2)
- organize ideas resulting a persuasive talk(L3)

Unit V **8L**

Conducting Meetings, Writing Minutes, Sending Memos and Notices; Netiquette: Effective E-mail Communication; Telephone Etiquette; Body Language in Group Discussion and Interview.

Learning Outcomes

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

- describe the format and structure of writing meeting minutes(L2)
- identify the essential components of memos and notices(L3)
- explain the principles of effective email communication(L2)
- list the basic etiquette of telephone conversation(L1)
- describe the effective body traits during group discussion and interviews(L2)

Text Books

1. Dorch, Patricia. What Are Soft Skills? New York: Execu Dress Publisher, 2013.
2. Kamin, Maxine. Soft Skills Revolution: A Guide for Connecting with Compassion for Trainers, Teams, and Leaders. Washington, DC: Pfeiffer & Company, 2013.
3. Klaus, Peggy, Jane Rohman& Molly Hamaker. The Hard Truth about Soft Skills. London: HarperCollins E-books, 2007.
4. Petes S. J., Francis. Soft Skills and Professional Communication. New Delhi: Tata McGraw-Hill Education, 2011.
5. Stein, Steven J. & Howard E. Book. The EQ Edge: Emotional Intelligence and Your Success. Canada: Wiley & Sons, 2006.

Course Outcomes:

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

- carry out self-assessment and describe the significance of self-discipline (L4).
- define, classify and compare attitudes, mindsets, values and beliefs (L3).
- plan career and goals through constructive thinking and personal assessment (L4).
- overcome barriers for active listening and persuasive speaking (L5)
- conduct meetings, write minutes and involve in active group discussions (L3)

19EME792: TECHNICAL SEMINAR

L	T	P	C
0	0	4	2

Each student shall survey a technical topic related to a chosen specialization and prepare/submit a report in a specified format. It is advisable for students to choose a topic of interest to be continued as M.Tech Project in the 3rd & 4th Semester. The guidelines to carry out the research shall include the following:

1. Literature Review
2. Identification of Gap
3. Objectives and Expected Outcomes
4. Methodology / Innovative solution

Each student has to prepare a power point presentation on a selected technical topic with a novelty and get it evaluated by the faculty assigned for this purpose.

19EME891: PROJECT WORK I

L	T	P	C
0	0	26	13

Each student is required to submit a report of first part of project work i.e. about the problem definition, literature review and methodology to be adopted including experiments and tests to be performed on topic of project as per the guidelines decided by the department. The project work is to be evaluated through Presentations and Viva-Voce during the semester end.

19EME892: PROJECT WORK II

L	T	P	C
0	0	26	13

Each student is required to submit a detailed project report about the work on topic of project as per the guidelines decided by the department. The project work is to be evaluated through Presentations and Viva-Voce during the semester and Final evaluation will be done at the end of semester as per the guidelines decided by the department from time to time. The candidate shall present/publish one paper in national/international conference/seminar/journal of repute. However candidate may visit research labs/institutions with the due permission of chairperson on recommendation of supervisor concerned.