R.V.R. & J.C. COLLEGE OF ENGINEERING :: GUNTUR
(Autonomous)

REGULATIONS (R-18) FOR
Four Year BACHELOR OF TECHNOLOGY (B.Tech.) Degree Program

(w.e.f. the batch of candidates admitted into First Year B.Tech. from the academic year 2018-2019).

1 MINIMUM QUALIFICATIONS FOR ADMISSION

A candidate seeking admission into First Year of B.Tech. Degree Program should have passed either Intermediate examination conducted by the Board of Intermediate Education, Andhra Pradesh with Mathematics, Physics, and Chemistry as optional subjects (or any equivalent examination recognized by the Acharya Nagarjuna University) or A candidate seeking admission into Second Year of B.Tech. Degree Program should have passed either Diploma in Engineering in the relevant branch conducted by the State Board of Technical Education & Training of Andhra Pradesh (or equivalent Diploma recognized by Acharya Nagarjuna University).

The selection is based on the rank secured by the candidate at the EAMCET / ECET (FDH) examination conducted by A.P. State Council of Higher Education. The candidate shall also satisfy any other eligibility requirements stipulated by the University and / or the Government of Andhra Pradesh from time to time.

2 BRANCHES OF STUDY

The B.Tech. Course is offered in the following branches of study:

1. Computer Science & Business Systems
2. Chemical Engineering
3. Civil Engineering
4. Computer Science & Engineering
5. Electrical & Electronics Engineering
6. Electronics & Communication Engineering
7. Information Technology
8. Mechanical Engineering

3 DURATION OF THE COURSE AND MEDIUM OF INSTRUCTION

3.1 The duration of the course is Four academic years consisting of two semesters in each academic year. The medium of instruction and examination is English.

3.2 The duration of the course for the candidates (Diploma Holders) admitted under lateral entry into Second Year B.Tech. is Three academic years consisting of two semesters in each academic year. The medium of instruction and the examination is English.

4 MINIMUM INSTRUCTION DAYS

Each semester shall consist of a minimum number of 90 days of instruction excluding the days allotted for tests, examinations and preparation holidays.

5 REGISTERING THE COURSES

5.1 A candidate has to register and secure 160 credits which include laboratory courses and project work. However, the candidate admitted under lateral entry has to register and secure 122 credits, which includes laboratory courses and project work.

5.2 A candidate has to register and secure at least minimum pass grade in Mandatory Courses, for which no credits are awarded.

5.3 A candidate has to secure at least minimum pass grade in Value Added Courses offered by the individual departments, for which no credits are awarded.

5.4 MOOCS (Massive Open Online Course):

- A student will be eligible to get Under Graduate degree if he/she completes atleast one MOOCS course. However the student can register and complete more number of MOOCS courses within the stipulated time, which will be reflected in Consolidated Grade Sheet.
- Enrollment of MOOCS course will be initiated from the date of commencement of class work for Semester III [Second Year].
- MOOCS course completion certificate(s) must be submitted on or before the last instruction day of Semester VII [Fourth Year], otherwise his / her Semester End Examination results will not be declared.
- List of organisations offering MOOCS course(s) will be announced by the respective Board of Studies at the time of commencement of class work for Semester III [Second Year].

5.5 Internship / Industrial Training (6 to 8 weeks in two spells) :

- Enrollment of Internship / Industrial Training will be initiated at the end of Semester IV [Second Year] and Semester VI [Third Year].
- Internship / Industrial Training completion certificate(s) must be submitted on or before the last instruction day of Semester VII [Fourth Year], otherwise his / her Semester End Examination results will not be declared.

6 EVALUATION

The performance of the candidates in each semester shall be evaluated Course wise.

6.1 The distribution of marks between Sessional Examination (based on internal assessment) and Semester End Examination is as follows:

Nature of the Courses	Sessional Marks	Semester End Exam. Marks
Theory Courses / Design and / or Drawing / Practicals	40	60
Mini Project / Term paper / Mandatory Course / Value Added Course	100	---
Project work	40	60 (Viva voce)

6.2 In each of the Semesters, there shall be two Mid Term examinations and two Assignment Tests in every theory course. The Sessional marks for the midterm examinations shall be awarded giving a weightage of 15 marks out of 18 marks (80% approx.) to that midterm examination in which the candidate scores more marks and the remaining 3 marks (20% approx.) for other midterm examination in which the candidate scores less marks. Similarly a weightage of 10 marks (80% approx.) out of 12 marks earmarked for assignment tests shall be given for the assignment in which the candidate scores more marks and remaining 2 marks (20% approx.) shall be given for the assignment test in which the candidate scores less marks.

A maximum of five marks are allotted for attendance in the respective theory courses in a graded manner as indicated in ***clause 8.2.*** The remaining 5 marks out of the 40 marks earmarked for the sessional marks are awarded (quiz / online examination) by the concerned teacher in the respective theory courses.

6.3 The evaluation for Laboratory class work consists of a weightage of 25 marks for day to day laboratory work including record work and 15 marks for internal laboratory examination including Viva-voce examination.

In case of Project work, the sessional marks shall be awarded based on the day-to-day progress, the performance in two Seminars and the Project Report submitted at the end of the semester. The allotment of sessional marks for Seminars and day-to-day work shall be 15 and 25 respectively.

NOTE : A candidate who is absent for any Assignment / Mid Term Exam, for any reason whatsoever, shall be deemed to have scored zero marks in that Test / Exam and no make-up test / Exam shall be conducted.

6.4 A candidate who could not secure a minimum of 50% aggregate sessional marks is not eligible to appear for the Semester End Examination and shall have to repeat that Semester.

7 LABORATORY / PRACTICAL COURSES

In any semester, a minimum of 10 experiments / exercises specified in the syllabus for laboratory course shall be completed by the candidate and get the record certified by the concerned faculty and Head of the Department, to be eligible to face the Semester End Examination in that Practical course.

8 ATTENDANCE REGULATIONS

8.1 Regular course of study means a minimum average attendance of 75% in all the courses computed by totalling the number of hours / periods of lectures, design and / or drawing, practical's and project work as the case may be, held in every course as the denominator and the total number of hours / periods actually attended by the candidate in all the courses, as the numerator.

8.2 A weightage in sessional marks up to a maximum of 5 marks out of 40 marks in each theory course shall be given for those candidates who put in a minimum of 75% attendance in the respective theory in a graded manner as indicated below:

Attendance of 75% and above but less than 80%	- 2 mark
Attendance of 80% and above but less than 85%	- 3 marks
Attendance of 85% and above but less than 90%	- 4 marks
Attendance of 90% and above	- 5 marks

8.3 Condonation of shortage in attendance may be recommended on genuine medical grounds, up to a maximum of 10% provided the candidate puts in at least 65% attendance as calculated in ***clause 8.1***, provided the Principal is satisfied with the genuineness of the reasons and the conduct of the candidate. However, marks will not be awarded for condonation of shortage in attendance.

8.4 A candidate who could not satisfy the minimum attendance requirements in any semester as mentioned in ***clause 8.1***, is not eligible to appear for the Semester End Examinations and shall have to repeat the same Semester.

9 DETENTION

A candidate, who fails to satisfy either the minimum attendance requirements as stipulated in ***Clause-8***, or the requirement of minimum aggregate sessional marks as stipulated in ***Clause-6***, shall be detained. Such candidate shall have to repeat the same semester.

10 SEMESTER END EXAMINATION

10.1 For each theory course, there shall be a comprehensive Semester End Examination at the end of each Semester.

10.2 For each Practical course the Smester End Examination shall be conducted by one internal and one external examiner appointed by the Principal of the College, the duration being that approved in the detailed Schemes of Instruction & Examination.

10.3 Viva-voce Examination in Project Work shall be conducted by one internal examiner and one external examiner appointed by the Principal.

11 CONDITIONS FOR PASS

A candidate shall be declared to have passed in individual course if he / she secures a minimum of 35% marks in theory and 50% marks in Practical courses/drawing courses/Project Viva-voce in Semester End Examination and minimum of 40% marks in both Sessional & Semester End Examination put together.

12 AWARD OF CREDITS

12.1 Credits are awarded for each Theory Course / Practical Course and Project Work.

12.2 AWARD OF GRADES

S.No.	Range of Marks	Grade	Grade Points
1	≥ 90	O	10.0
2	≥ 80 - < 90	A^+	9.0
3	≥ 70 - < 80	A	8.0
4	≥ 60 - < 70	B^+	7.0
5	≥ 50 - < 60	B	6.0
6	≥ 40 - < 50	C	5.0
7	< 40	F	0.0
8	The grade 'W' represents withdrawal / absent	W	0.0

12.3 A candidate securing 'F' grade in any course there by securing zero grade points has to reappear and secure at least 'E' grade in the subsequent examinations for that course.

12.4 A candidate who has earned 'F' grade in any course can repeat the course and can improve the internal marks by re-registering a maximum of TWO Subjects per semester. However, a student, who is not on rolls due to detention (not promoted to the next semester), can register a maximum of SIX subjects comprising of all semesters, put together.

12.5 After each semester, Grade sheet will be issued which will contain the following details:

- The list of courses for each semester and corresponding credits and grades obtained
- The Semester Grade Point Average (SGPA) for each semester and
- The Cumulative Grade Point Average (CGPA) of all courses put together up to that semester.

SGPA is calculated based on the following formula: $\frac{\sum [\text{ No. of Credits X Grade Points }]}{\sum \text{ No. of Credits}}$

CGPA will be calculated in a similar manner, considering all the courses up to that semester.

12.6 A consolidated Grade Sheet shall be issued to the candidate, after completing all , indicating the CGPA of all the Four / Three years put together.

12.7 Conversion of CGPA into equivalent Percentage.: Percentage of Marks = 9.25 x CGPA

13 CONDITIONS FOR PROMOTION

13.1 A candidate shall be eligible for promotion to next semester, if he/she satisfies the minimum requirements of attendance and sessional marks as stipulated in ***Clauses 6 and 8***.

13.2 A candidate shall be eligible for promotion to Third Year, if he / she secures 26 credits (70% approx.) of the total number of credits (38) of First Year by the time the classwork commences for Third Year, in addition to satisfying the minimum requirements of attendance and sessional marks stipulated in ***Clauses 6 and 8*** in Semester IV [Second Year].

13.3 A candidate shall be eligible for promotion to Fourth Year, if he / she secures a minimum of 70% of the total number of credits of First & Second Years put together, by the time the classwork commences for Fourth Year, in addition to satisfying the minimum requirements of attendance and sessional marks stipulated in ***Clauses 6 and 8*** in Semester VI [Third Year].

S. No.	Branch	Total No. of Credits First & Second Years put together	Minimum No. of Credits required for promotion (70% approximately)
1	Computer Science & Business Systems	38+40 = 78	54
2	Chemical Engineering	38+40 = 78	54
3	Civil Engineering	38+46 = 84	58
4	Computer Science & Engineering	38+44 = 82	57
5	Electrical & Electronics Engineering	38+45 = 83	58
6	Electronics & Communication Engineering	38+45 = 83	58
7	Information Technology	38+44 = 82	57
8	Mechanical Engineering	38+44 = 82	57

13.4 A candidate (Diploma Holder) admitted under lateral entry into Second Year, shall be eligible for promotion to Fourth Year, if he/she secures a minimum of 70% of the total number of credits of Second Year by the time the classwork commences for Fourth Year, in addition to satisfying the minimum requirements of attendance and sessional marks stipulated in ***Clauses 6 and 8*** in Semester VI [Third Year]

S. No.	Branch	Total No. of Credits in Second Year	Minimum No. of Credits required for promotion (70% approximately)
1	Computer Science & Business Systems	40	28
2	Chemical Engineering	40	28
3	Civil Engineering	46	32
4	Computer Science & Engineering	44	30
5	Electrical & Electronics Engineering	45	31
6	Electronics & Communication Engineering	45	31
7	Information Technology	44	30
8	Mechanical Engineering	44	30

14 ELIGIBILITY FOR AWARD OF B.TECH. DEGREE

The B.Tech. Degree shall be conferred on a candidate who has satisfied the following requirements:

14.1 The candidate must have satisfied the conditions for pass in all the courses of all the years as stipulated in ***Clauses 11***.

14.2 **Maximum Time Limit for completion of B.Tech Degree**

A candidate, who fails to fulfil all the academic requirements for the award of the degree within eight academic years from the year of admission, shall forfeit his/her seat in B.Tech. course.

14.3 A candidate (Diploma Holder) admitted under lateral entry into Second Year B.Tech., who fails to fulfil all the academic requirements for the award of the degree within six academic years from the year of admission, shall forfeit his/her seat in B.Tech. course.

15 AWARD OF CLASS

A candidate who becomes eligible for the award of B.Tech. Degree as stipulated in ***Clause 12*** shall be placed in one of the following Classes.

S.No.	Class	CGPA
1	First Class With Distinction	8.0 or more
2	First Class	6.5 or more but less than 8.0
3	Second Class	5.5 or more but less than 6.5
4	Third Class	5.0 or more but less than 5.5

16 IMPROVEMENT OF CLASS

A candidate, after becoming eligible for the award of the Degree, may improve the CGPA by appearing for the Semester End Examination in any of the theory course as and when conducted. But this provision shall be within a period of two academic years after becoming eligible for the award of the Degree. However, this facility cannot be availed by a candidate who has taken the Original Degree Certificate.

17 AWARD OF RANK

The rank shall be awarded based on the following:

17.1 Ranks shall be awarded in each branch of study for the top five percent of the candidates appearing for the Regular Semester End Examinations or the top ten candidates whichever is minimum.

17.2 Only such candidates who pass the Final year examination at the end of the fourth/third academic year after admission as regular final year candidate along with others in their batch and become eligible for the award of the degree shall be eligible for the award of rank. The Rank will be awarded only to those candidates who complete their degree within four/three academic years.

17.3 For the purpose of awarding rank in each branch, only such candidates who passed all courses in the first attempt only shall be considered.

18 SUPPLEMENTARY EXAMINATIONS

18.1 In addition to the Regular semester end examinations held at the end of each semester, supplementary examinations will also be conducted during the academic year. Such candidates taking the Regular / Supplementary examinations as supplementary candidates may have to take more than one examination per day.

18.2 Instant examination will be conducted immediately after the declaration of Semester VIII [Fourth Year] results for those candidates who cleared all courses except one course in Semester VIII [Fourth Year].

19 TRANSITORY REGULATIONS

A Candidate, who is detained or discontinued in the semester, on readmission shall be required to do all the courses in the curriculum prescribed for such batch of candidates in which the candidates joins subsequently.

19.1 A candidate, studied under R-16 regulations of RVR & JCCE (Autonomous) curriculum, detained due to lack of academics/attendance at the end of the Semester II [First Year] or Semester III [Second Year], shall join in appropriate Semester of R-18 regulations. The candidate has to clear all the backlog subjects or equivalent subjects if any under R-18 curriculum by appearing the supplementary examinations, conducted by the college under R-18 curriculum. The class will be awarded based on the academic performance of the candidate as R-18 regulations.

19.2 A candidate, studied under R-16 regulations of RVR & JCCE (Autonomous) curriculum, detained due to lack of academics / attendance at the end of the Semester IV [Second Year] and also at the subsequent semesters will follow the same R-16 regulations/curriculum and he/she has to complete all the courses by appearing in the examination conducted by the college under R-16 curriculum. The class will be awarded based on the academic performance of the candidate as per R-16 regulations.

19.3 A candidate, transferred from other institutions / universities into Semester II [Second Year] and also at the subsequent semesters of B.Tech., shall join at appropriate semester of R-18 curriculum. Such candidate shall study all the courses prescribed for that batch, in which, the candidate joins. The candidate has to clear the backlog courses, if any, in the semesters which he/she has studied in the earlier institutions / universities by appearing the supplementary examinations conducted by the college in R-18 circulum courses / equivalent courses. The equivalent courses will be decided by concerned Board of Studies.

20 CONDUCT AND DISCIPLINE

20.1 Candidates shall conduct themselves within and outside the premises of the institute in a manner befitting the candidates of our institution.

20.2 As per the order of Honourable Supreme Court of India, ragging in any form is considered as a criminal offence and is banned. Any form of ragging will be severely dealt with.

20.3 The following acts of omission and / or commission shall constitute gross violation of the code of conduct and are liable to invoke disciplinary measures with regard to ragging.

a Lack of courtesy and decorum, indecent behaviour anywhere within or outside the campus.

b Wilful damage of college / individual property

c Possession, consumption or distribution of alcoholic drinks or any kind of narcotics or hallucinogenic drugs.

d Mutilation or unauthorized possession of library books.

e Noisy and unseemly behaviour, disturbing studies of fellow candidates.

f Hacking of computer systems (such as entering into other person's areas without prior permission, manipulation and / or damage of computer hardware and software or any other cyber-crime etc.)

g Usage of camera / cell phone in the campus

h Plagiarism of any nature

i Any other acts of gross indiscipline as decided by the academic council from time to time.

20.4 Commensurate with the gravity of offense, the punishment may be reprimand, fine, expulsion from the institute / hostel, debar from examination, disallowing the use of certain facilities of the institute, rustication for a specified period or even outright expulsion from the institute or even handing over the case to appropriate law enforcement or the judiciary, as required by the circumstances.

20.5 For an offence committed in (i) a hostel (ii) a department or in a class room and (iii) elsewhere, the chief warden, the head of the department and the principal respectively, shall have the authority to reprimand or impose fine.

20.6 Cases of adoption of unfair means and / or any malpractice in an examination shall be reported to the principal for taking appropriate action.

20.7 All cases of serious offence, possibly requiring punishment other than reprimand, shall be reported to the academic council.

20.8 The institute level standing disciplinary action committee constituted by the academic council shall be the authority to investigate the details of the offence, and recommend disciplinary action based on the nature and extent of the offence committed.

20.9 The principal shall deal with any academic problem, which is not covered under these rules and regulations, in consultation with the programmes committee in an appropriate manner, and subsequently such actions shall be placed before the academic council for ratification. Any emergency modification of regulation, approved by the appropriate authority, shall be reported to the academic council for ratification.

20.10 ''Grievance and Redressal Committee'' (General) constituted by the Principal shall deal with all grievances pertaining to the academic / administrative / disciplinary matters.

21 MALPRACTICES

21.1 The Principal shall refer the cases of malpractices in internal assessment tests and semester-end examinations to a malpractice enquiry committee constituted by him / her for the purpose. Such committee shall follow the approved scales of punishment. The principal shall take necessary action, against the erring candidates basing on the recommendations of the committee.

21.2 Any action on the part of a candidate during an examination trying to get undue advantage or trying to help another, or drive the same through unfair means is punishable according to the provisions contained hereunder. The involvement of the staff, who are in-charge of conducting examinations, valuing examination papers and preparing / keeping records of documents relating to the examinations in such acts (inclusive of providing incorrect or misleading information) that infringe upon the course of natural justice to one and all

concerned in the examination shall be viewed seriously and recommended for award of appropriate punishment after thorough enquiry.

22 AMENDMENTS TO REGULATIONS

The College may, from time to time, revise, amend, or change the Regulations, Schemes of Examinations, and / or Syllabus.

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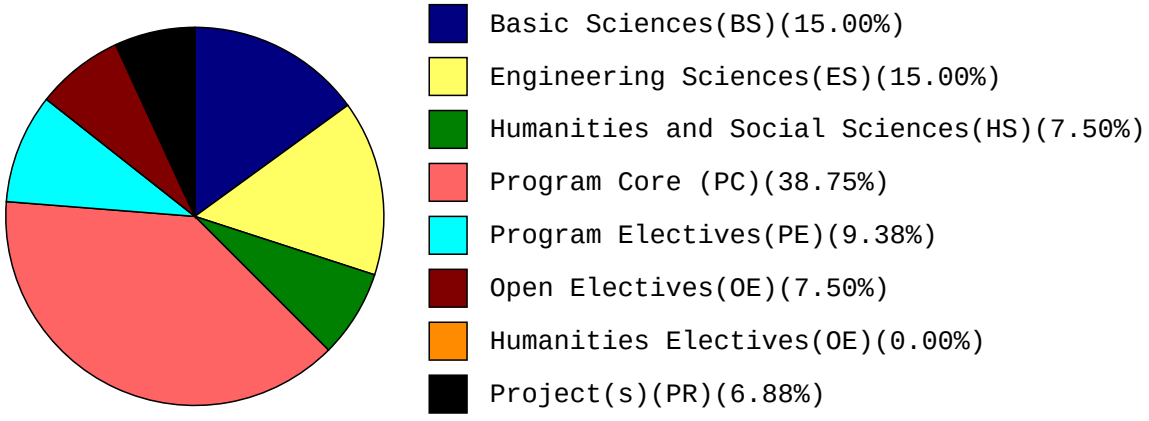
DEPARTMENT OF MECHANICAL ENGINEERING

B.TECH. MECHANICAL ENGINEERING

Program curriculum grouping based on course components

Course Component	Curriculum Content (% of total number of credits program)	Total number of contact hours	Total number of credits
Basic Sciences (BS)	15	27	24
Engineering Sciences (ES)	15	32	24
Humanities and Social Sciences (HS)	7.5	15	12
Professional Core (PC)	38.75	71	62
Professional Electives (PE)	9.38	12	15
Open Electives (OE)	7.5	9	12
Humanities Electives (HE)	0		0
Project(s) (PR)	6.88	16	11
Mandatory Course(s) (MC)	--	8	--
Total number of Credits			160



B.TECH. MECHANICAL ENGINEERING

(w.e.f. the batch of students admitted from the academic year 2018-2019)

Three Weeks Orientation Programme is Mandatory before starting Semester I [First Year]

Semester I [First Year] COURSE STRUCTURE

SNo.	Course Details		Scheme of Instruction			Scheme of Examination			Category Code
	Code No.	Subject Name	Periods per week			Maximum Marks		Credits	
			L	T	P	SES	EXT		
1	ME/CE/EC 111	Mathematics-I	3	1	-	40	60	4	BS
2	ME/EC/EE 112	Engineering Chemistry	3	1	-	40	60	4	BS
3	ME/CE/CH/EE 113	English for Communication Skills	2	-	-	40	60	2	HS
4	ME/EC/EE 151	Chemistry Lab	-	-	3	40	60	1.5	BS
5	ME/CE/CH/EE 152	English Language Communication Skills Lab	-	-	2	40	60	1	HS
6	ME/CE/EE 153	Workshop Practice Lab	1	-	4	40	60	3	ES
7	MC 002	Environmental Science	2	-	-	100	-	-	MC
		TOTAL	11	2	9	340	360	15.5	TPW-22

Semester II [First Year] COURSE STRUCTURE

SNo.	Course Details		Scheme of Instruction			Scheme of Examination			Category Code
	Code No.	Subject Name	Periods per week			Maximum Marks		Credits	
			L	T	P	SES	EXT		
1	ME/CE/EC 121	Mathematics-II	3	1	-	40	60	4	BS
2	ME 122	Engineering Physics	3	1	-	40	60	4	BS
3	ME/CE/CH/CS/ EE/EC/IT 123	Programing for Problem Solving	3	-	-	40	60	3	ES
4	ME/CH 124	Basic Electrical Engineering	3	1	-	40	60	4	ES
5	ME 161	Physics Lab	-	-	3	40	60	1.5	BS
6	ME/CE/CH/CS/ EE/EC/IT/ 162	Programing for Problem Solving Lab	-	-	4	40	60	2	ES
7	ME/CE/EE 163	Engineering Graphics & Design Lab	1	-	4	40	60	3	ES
8	ME/CH 164	Basic Electrical Engineering Lab	-	-	2	40	60	1	ES
9	MC 001	Constitution of India	2	-	-	100	-	-	MC
		TOTAL	15	3	13	420	480	22.5	TPW-31

Semester III [Second Year] COURSE STRUCTURE

SNo.	Course Details		Scheme of Instruction			Scheme of Examination			Category Code
	Code No.	Subject Name	Periods per week			Maximum Marks		Credits	
			L	T	P	SES	EXT		
1	ME 211	Engineering Mechanics	2	1	-	40	60	3	ES
2	ME 212	Life Science for Engineers	2	-	-	40	60	2	BS
3	ME 213	Manufacturing Processes	3	-	-	40	60	3	PC
4	ME 214	Basic Thermodynamics	2	1	-	40	60	3	PC
5	ME 215	Theory of Mechanisms & Machines	2	1	-	40	60	3	PC
6	ME 216	Fluid Mechanics & Hydraulic Machines	2	1	-	40	60	3	PC
7	ME 251	Machine Drawing Lab	1	-	2	40	60	2	PC
8	ME 252	Communicative English Lab	1	-	2	40	60	2	HS
9	ME 253	Basic Electronics Lab	1	-	2	40	60	2	ES
10	MC 003	Essence of Indian Traditional Knowledge	2	-	-	100	-	-	MC
		TOTAL	18	4	6	460	540	23	TPW-28

Semester IV [Second Year] COURSE STRUCTURE

SNo.	Course Details		Scheme of Instruction			Scheme of Examination			Category
	Code No.	Subject Name	Periods per week			Maximum Marks		Credits	Code
			L	T	P	SES	EXT		
1	ME 221	Mathematics - III (PDE, Probability & Statistics)	2	1	-	40	60	3	BS
2	ME 222	Strength of Materials	2	1	-	40	60	3	PC
3	ME 223	Manufacturing Technology	3	-	-	40	60	3	PC
4	ME 224	Applied Thermodynamics	2	1	-	40	60	3	PC
5	ME 225	Material Science and Metallurgy	3	-	-	40	60	3	PC
6	ME 226	Open Elective-I	3	-	-	40	60	3	OE
7	ME 261	Fluid Mechanics & Strength of Materials Lab	-	-	2	40	60	1	PC
8	ME 262	Manufacturing Lab - 1	-	-	2	40	60	1	PC
9	ME 263	Modelling Lab	-	-	2	40	60	1	PC
10	MC 004	Design Thinking and Product Innovation	2	-	-	100	-	-	MC
		TOTAL	17	3	6	460	540	21	TPW-26

Semester V (Third Year) COURSE STRUCTURE

SNo.	Course Details		Scheme of Instruction			Scheme of Examination			Category
	Code No.	Subject Name	Periods per week			Maximum Marks		Credits	Code
			L	T	P	SES	EXT		
1	ME 311	Design of Machine Elements	2	1	-	40	60	3	PC
2	ME 312	Advanced Strength of Materials	2	1	-	40	60	3	PC
3	ME 313	Machine Dynamics and Vibrations	3	-	-	40	60	3	PC
4	ME 314	Operations Research	2	1	-	40	60	3	ES
5	ME 315	Professional Elective-I	3	-	-	40	60	3	PE
6	ME 316	Humanities Elective-I	3	-	-	40	60	3	HS
7	ME 351	Thermal Engineering Laboratory	1	-	2	40	60	2	PC
8	ME 352	Professional Communication Skills Lab	-	-	2	40	60	1	HS
		TOTAL	16	3	4	320	480	21	TPW-23

Semester VI [Third Year] COURSE STRUCTURE

SNo.	Course Details		Scheme of Instruction			Scheme of Examination			Category
	Code No.	Subject Name	Periods per week			Maximum Marks		Credits	Code
			L	T	P	SES	EXT		
1	ME 321	Design of Transmission Elements	2	1	-	40	60	3	PC
2	ME 322	Finite Element Method	2	1	-	40	60	3	PC
3	ME 323	Heat Transfer	2	1	-	40	60	3	PC
4	ME 324	Professional Elective-II	3	-	-	40	60	3	PE
5	ME 325	Humanities Elective-II	3	-	-	40	60	3	HS
6	ME 326	Open Elective-II	3	-	-	40	60	3	OE
7	ME 361	Heat Transfer Laboratory	-	-	2	40	60	1	PC
8	ME 362	Analysis & Simulation Lab	-	-	2	40	60	1	PC
		TOTAL	15	3	4	320	480	20	TPW-22

Semester VII [Fourth Year] COURSE STRUCTURE

SNo.	Course Details		Scheme of Instruction			Scheme of Examination			Category Code
	Code No.	Subject Name	Periods per week			Maximum Marks		Credits	
			L	T	P	SES	EXT		
1	ME 411	Automation in Manufacturing	3	-	-	40	60	3	PC
2	ME 412	Fundamentals of Industrial Engineering	3	-	-	40	60	3	PC
3	ME 413	Metrology and Mechanical Measurements	3	-	-	40	60	3	PC
4	ME 414	Professional Elective-III	3	-	-	40	60	3	PE
5	ME 415	Professional Elective-IV	3	-	-	40	60	3	PE
6	ME 416	Open Elective-III	3	-	-	40	60	3	OE
7	ME 451	Manufacturing Lab II (CAM)	-	-	2	40	60	1	PC
8	ME 452	Design and Metrology Lab	-	-	2	40	60	1	PC
9	ME 453	Internship	-	-	-	100	-	2	PR
10	ME 454	Mini Project	-	-	2	100	00	2.0	PR
		TOTAL	18	0	6	520	480	24	TPW-24

Semester VIII [Fourth Year] COURSE STRUCTURE

SNo.	Course Details		Scheme of Instruction			Scheme of Examination			Category Code
	Code No.	Subject Name	Periods per week			Maximum Marks		Credits	
			L	T	P	SES	EXT		
1	ME 421	Professional Elective-V (MOOCs)	-	-	-	100	-	3	PE
2	ME 422	Open Elective-IV (MOOCs)	-	-	-	100	-	3	OE
3	ME 461	Project	-	-	14	40	60	7	PR
		TOTAL	0	0	14	240	60	13	TPW-14

Program Elective Courses

Code No.	Subject Name	Code No.	Subject Name
MEEL01	Computer Aided Design	MEEL02	Mechatronic System Design
MEEL03	Fluidics and control systems	MEEL04	Industrial Robotics
MEEL05	I C Engines	MEEL06	Gas Dynamics and JET Propulsion
MEEL07	Refrigeration and Air Conditioning	MEEL08	Automobile Engineering
MEEL09	Power Plant Engineering	MEEL10	Energy Conservation and Management
MEEL11	Product Lifecycle Management	MEEL12	Principles of Industrial Management
MEEL13	Process Planning and Cost Estimation	MEEL14	Total Quality Management
MEEL15	Composite Materials	MEEL16	Design Of Experiments
MEEL17	Farm Machinery and Equipment	MEEL18	Computional Fluid Dynamics
MEEL19	Elements of Aerospace Engineering	MEEL20	Production Planning and Control

Value Added Courses

Code No.	Subject Name	Code No.	Subject Name
ME V01	English Competency Development Programme	ME V02	AI Tools , Techniques & Applications
ME V03	Advanced Modelling Lab (DELMIA)	ME V04	Advanced Modelling Lab (SIMULIA)

Open Elective Courses

Code No.	Subject Name	Code No.	Subject Name
CEOL01	Building Materials and Construction	CEOL02	Solid waste Management
CEOL03	Remote Sensing and GIS	CHOL01	Energy Engineering
CHOL02	Biofuels	CHOL03	Environmental Engineering
CHOL04	Nanoscience and Nanotechnology	CSOL01	Programming with Java
CSOL02	Relational Database Management Systems	CSOL03	Introduction to Python Programming
CSOL04	Internet of Things	ECOL01	Applied Electronics
ECOL02	Basic Communication	ECOL03	Basic Electronics & Communication Engineering

ECOL04	Microprocessors & Interfacing	ECOL05	Digital Image Processing
EEOL01	Renewable Energy Sources	EEOL02	Utilization of Electrical Energy
EEOL03	Power Converters	EEOL04	Energy Conservation
EEOL05	Electric Vehicles	ITOL01	Data Structures & Algorithms
ITOL02	Operating Systems	ITOL03	Big Data Analytics
ITOL04	Web Technologies		

ME/CE/EC 111	MATHEMATICS-I	L	T	P	C	Int	Ext
	(Calculus & Matrix Theory)	3	1	-	4	40	60

Semester I [First Year]

COURSE OBJECTIVES:

1. To familiarize the prospective engineers with techniques in calculus, multivariate analysis and linear algebra.
2. To equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. evaluate certain improper integrals. Apart from some other applications they will have a basic understanding of Beta and Gamma functions.
2. know fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
3. understand Fourier series and deal with functions of several variables.
4. do problems on matrices and linear algebra in a comprehensive manner.

UNIT I [CO:1] **(15)**

Evolutes and Involutes, Evaluation of improper integrals: Integrals without infinite limits of integration, Beta function, Gamma function, Relation between beta and gamma functions (without proof), Applications of definite integrals to evaluate surface areas and volumes of revolutions.

UNIT II [CO:2] **(15)**

Rolle's theorem (without proof), Lagrange's mean value theorem (without proof), Taylor's and Maclaurin series (without proof), Sequences, Series, Series of positive terms, Convergence tests: Comparision test (limit form) D'Alembert's ratio test, Raabe's test for convergence.

UNIT III [CO:3] **(15)**

Fourier series: Half range sine and cosine series, Parseval's formula. Multivariable Calculus: Limit, continuity and partial derivatives, total derivative, Maxima, minima and saddle points of two variables, Method of Lagrange multipliers. Scalar and vector point functions , Gradient, directional derivative divergence and curl, del applied twice to point and product of point functions(without proofs).

UNIT IV [CO:4] **(15)**

Rank of a matrix, Normal form, Inverse by Gauss Jordan method, System of linear equations: non homogeneous, Homogeneous systems, Rank-nullity theorem (without proof), Eigenvalues and eigenvectors, Cayley-Hamilton Theorem (without proof), Diagonalization of matrices, reduction of quadratic form to canonical form.

LEARNING RESOURCES:

TEXT BOOK:

B.S.Grewal - Higher Engineering Mathematics, Khanna publishers, 42nd edition, 2017.

REFERENCE BOOK(s):

1. G.B. Thomas and R.L. Finney - Calculus and Analytic geometry, Pearson, 2002.
2. N.P. Bali and Manish Goyal - A text book of Engineering Mathematics, LaxmiPublications, Reprint, 2010.

3. Erwin Kreyszig - Advanced Engineering Mathematics, John Wiley & Sons, 2006.

WEB RESOURCES:

http://nptel.iitm.ac.in/courses/

ME/EC/EE 112	ENGINEERING CHEMISTRY	L	T	P	C	Int	Ext
		3	1	-	4	40	60

Semester I [First Year]

COURSE OBJECTIVES:

1. To imparts concepts involved in molecular structure and intermolecular forces.
2. To Understands the chemistry behind electrochemical energy systems.
3. To understand the chemical concepts involved in Water treatment and Corrosion.
4. To understand the about the major organic reactions and end products like conducting polymers.
5. To learn the analytical methods useful in characterization of compounds.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Student can identify stable complexes and suitable electrochemical energy systems for end usage.
2. apply his knowledge for effective water treatment and corrosion prevention.
3. identify chemical reactions that are used in the synthesis of molecules and polymers
4. distinguish the ranges of the electromagnetic spectrum and characterize a given compound using analytical techniques..

UNIT I [CO:1] **(15)**

Molecular structure, Intermolecular forces and Energy systems:

Crystal field theory-salient features, energy level diagrams-tetrahedral and octahedral complexes, crystal field stabilization energies and magnetic properties.

Ionic, dipolar, Vander Waal's interaction and Hydrogen bonding, critical phenomena-Andrew's isotherms of CO_2, derivation of critical constants from Vander Waal's equation.

Electrode potential, electrochemical series, Nernst equation and its applications. Batteries-Primary (Dry cell) and secondary (Lead acid), Lithium battery (Li-MnO_2)- advantages, Fuel cell (H_2 - O_2 cell).

UNIT II [CO:2] **(15)**

Water Chemistry and Corrosion :

Water Chemistry - WHO standards, Municipal water treatment-Removal of suspended impurities - Sedimentation, Co-agulation and Filtration-Disinfection of water by chlorine, Break point chlorination, Dechlorination, Purification by ion-exchange method and reverse osmosis.

Corrosion-Introduction, Electrochemical theory of corrosion, galvanic corrosion, differential aeration corrosion, Factors-temperature, pH, overvoltage. Cathodic protection by sacrificial anodic method and impressed current method. Electroplating (Cu), Electrolessplating (Ni).

UNIT III [CO:3] **(15)**

Organic reactions and Polymers :

Types of organic reactions-Substitution($SN^1$and SN^2), Elimination ($E^1$and E^2), Addition-Markownikoff's rule and anti-Markownikoff's rule, Cyclisation (Diel's Alder reaction), Synthesis of aspirin.

Polymers - Functionality, Degree of Polymerization, Tacticity-Addition and condensation polymerization, Relationship between Structure and Properties of polymers (Strength, Crystallinity, Elasticity, Plastic Deformation, Glass transition temperature (T_g)), Factors affecting T_g.

Conducting polymers: Introduction, Examples, General applications, Mechanism of conduction in polyacetylene.

UNIT IV [CO:4] **(15)**

Spectroscopic techniques and its applications :

Beer-Lambert's law, limitations, colorimetric determination of Fe(III) UV-VIS spectroscopy - electronic transitions, shifts-blue and red, Block diagram - brief introduction of components, Applications - purity and differentiation of conjugated and non-conjugated dienes.

IR Spectroscopy - condition to be IR active, vibrational modes of - AB_2, Block diagram-brief introduction of components, IR spectrum of CO_2 and H_2O molecules, General applications. Fluorescence and its applications in medicine.

LEARNING RESOURCES:

TEXT BOOK(s):

1. P.C.Jain and Monica Jain- Engineering chemistry, 16th edition, Dhanpat Rai Publishing Company.
2. Wiley Engineering chemistry, 2nd edition, Wiley India Private Limited.

REFERENCE BOOK(s):

1. Bruce H. Mahan, University Chemistry, 3rd edition, Narosa Publishing House..
2. Shashi Chawla - A text book of Engineering chemistry, 3rd edition, Dhanpat Rai Publishing Company..

WEB RESOURCES:

1. Engineering Chemistry (NPTEL Web Book by B.L. Tembe, Kamaluddin & M.S. Krishnan).
2. http://www.powerstream.com/BatteryFAQ.html#lec
3. http://freevideolectures.com/Course/3029/Modern-Instrumental-Methods-ofAnalysis.

ME/CE/CH/EE 113	ENGLISH FOR COMMUNICATION SKILLS	L	T	P	C	Int	Ext
		2	-	-	2	40	60

Semester I [First Year]

COURSE OBJECTIVES:

1. To enable students improve their lexical and communicative competence and to equip students with oral and written communication skills.
2. To help students understand and learn the correct usage and application of Grammar principles.
3. To get them acquainted with the features of successful professional communication.
4. To enable students acquire various specific features of effective written communication.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. use vocabulary contextually.
2. compose effectively the various forms of professional communication.
3. apply grammar rules efficiently in spoken and written forms.
4. improve clarity to locate and learn the required information.

UNIT I [CO:1] **(8)**

Vocabulary Building

1.1 - Root words from foreign languages and their use in English.

1.2 - Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives.

1.3 - Synonyms, antonyms, and standard abbreviations.

1.4 - One word substitutes.

UNIT II [CO:1,2,3] **(8)**

Writing Skills

2.1 - Proposal writing

2.2 - Letter-writing

2.3 - Techniques for writing precisely (precis writing)

2.4 - E-mail writing

UNIT III [CO:3] **(8)**

Identifying Common Errors in Writing

3.1 - Subject-verb agreement

3.2 - Noun-pronoun agreement

3.3 - Articles

3.4 - Prepositions

3.5 - Tenses

3.6 - Redundancies

UNIT IV [CO:1,2,3,4] **(8)**

Nature and Style of Sensible Writing

4.1 - Description & Narration (Paragraph Writing). [CO:1,2,3]

4.2 - Essay Writing (Expository Essay). [CO:1,2,3]

4.3 - Note-Making and Note-Taking. [CO:1,2,4]

4.4 - Methods of preparing notes. [CO:1,2,4]

LEARNING RESOURCES:

TEXT BOOK:

Communication Skills. Sanjay Kumar and Pushpa Lata.Oxford University Press.

REFERENCE BOOK(s):

1. Remedial English Grammar. F.T. Wood. macmillan.2007
2. On Writing Well. William Zinsser. Harper ResourceBook. 2001
3. Study Writing. Liz Hamp-Lyons and Ben Heasly.Cambridge University Press.2006.
4. Practical English Usage.Michael Swan. OUP. 1995Press

ME/EC/EE 151	CHEMISTRY LAB	L	T	P	C	Int	Ext
		-	-	3	1.5	40	60

Semester I [First Year]

COURSE OBJECTIVES:

1. To learn the concepts of equivalent weight, molecular weight, normality, molarity, weight percent, volume percent.
2. To know the methods of determining hardness and chloride ion content of water sample.
3. To learn the redox methods to determine Fe2+ ions present in solution.
4. To know principles and methods involved in using instruments like conductivity bridge and potentiometer
5. To know the molecular properties like surface tension, viscosity.
6. To know synthetic methods for preparation of drugs and polymer

COURSE OUTCOMES:

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

1. estimate the Fe(II) content of a given solution and chloride/hardness content of water.
2. measure molecular properties such as surface tension, viscosity.
3. measure conductance of solutions, redox potentials of a cell.
4. synthesize a small drug molecule and polymer.

List of Experiments:

1. Estimation of Mohr's salt using $KMnO_4$.
2. Estimation of Mohr's salt using $K_2Cr_2O_7$.
3. Determination of chloride ion content of water.
4. Determination of Hardness of water using EDTA method.
5. Determination of Fe(II) strength using $K_2Cr_2O_7$ potentiometrically.
6. Determination on strength of NaOH using HCl conductometrically.
7. Determination of surface tension.
8. Determination of Viscosity.
9. Determination of Saponification / acid value of oil.
10. Preparation of p-bromo acetanilide.
11. Preparation of Phenol Formaldehyde resin.
12. Determination of partition co-efficient of I2 in water.
13. Determination of Rf value using TLC.
14. Verification of Freundlich isotherm using adsorption of acetic acid on activated charcoal.

Note: A minimum of 10(Ten) experiments have to be performed and recorded by the candidate to attain eligibility for Semester End Practical Examination.

ME/CE/CH/EE 152	ENGLISH LANGUAGE COMMUNICATION SKILLS LAB	L	T	P	C	Int	Ext
		-	-	2	1	40	60

Semester I [First Year]

COURSE OBJECTIVES:

1. To Identify speaker's purpose and tone; make inferences and predictions about spoken discourse, discuss and respond to content of a lecture or listening passage orally and/or in writing.
2. To acquaint the students with the Standard English pronunciation, i.e., Receive Pronunciation (RP), with the knowledge of stress and intonation.
3. To develop production and process of language useful for social and professional life.
4. To develop in them communication and social graces necessary for functioning. Improve the dynamics of professional presentations.
5. To develop critical reading and comprehension skills at different levels.

COURSE OUTCOMES:

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

1. comprehend relationships between ideas and make inferences and predictions about spoken discourse.
2. speak English with a reasonable degree of accuracy in pronunciation.
3. develop appropriate speech dynamics in professional situations.
4. use effective strategies and social graces to enhance the value of communication.
5. develop effective communication and presentation skills and using language effectively to face interviews with success.

List of Exercises / Activities:

Oral Communication

(This unit involves interactive practice sessions in Language Lab).

1. Listening Comprehension.
2. Pronunciation, Intonation, Stress and Rhythm.
3. Common Everyday Situations: Conversations and Dialogues.
4. Interviews.
5. Formal Presentations.
6. Reading Comprehension.

REFERENCE BOOK(S) :

1. Communication Skills. Sanjay Kumar and Pushpa Lata. Oxford University Press.
2. Practical English Usage. Michael Swan. OUP. 1995 Press
3. Exercises in Spoken English. Parts.I- III. CIEFL, Hyderabad. Oxford University
4. Technical English .M. Sambaiah, Wiley Publications, New Delhi

ME/CE/EE 153	WORKSHOP PRACTICE LAB	L	T	P	C	Int	Ext
		1	-	4	3	40	60

Semester I [First Year]

COURSE OBJECTIVES:

Engineers, whatever be their line of activity, must be proficient with all aspects of manufacturing, however it should not be forgotten that practice without theory is blind and the theory without practice is lame.

1. Students involved in acquiring manufacturing skills must have balanced knowledge of theory as well as practice.
2. Imparts basic knowledge of various tools and their use in different sections of manufacture such as fitting, carpentry, tin smithy, moulding, casting, welding, electrical wiring, PCB work on electronic circuits and practice with machine shop tools & equipments.

COURSE OUTCOMES:

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

1. will gain knowledge of the different manufacturing processes which are commonly employed in the industry to fabricate components using different materials.

Lectures and Videos: [10 hours]

1. Manufacturing Methods: Introduction to various types of manufacturing methods - casting - forming - various machining operations such as turning, milling, shaping, drilling, slotting etc.,, - various joining methods such as welding, brazing, soldering etc.,- Advanced manufacturing methods (3 Lectures).
2. CNC machining and Additive manufacturing (1 Lecture).
3. Fitting operations and power tools (power hack saw, table mounted circular saw, wood turning lathe, bench grinder, concrete mixer, concrete vibrator etc.,) (1 Lecture).
4. Basic principles involved in electrical circuits and electronic PCB circuits(1 Lecture).
5. Carpentry (1 Lecture).
6. Welding(arc welding & gas welding) (1 Lecture).
7. Metal casting(1 Lecture).
8. Plastic moulding, glass cutting (1 Lecture).

Text book:

1. Hajra Choudhury S, K., Hajra Choudhury A.K and Nirjhar Roy S.K. - Elements of Workshop Technology, VolumeI and Volume II,2010, Media promoters and publishers private limited, Mumbai.

Reference books:.

1. Kalpakjian S and Steven S.Schmid. - Manufacturing Engineering and Technology, 4th edition, Pearson Education, India, 2002.
2. Rao P.N. - Manufacturing Technology, Volume I &II, Tata McGrawHill House, 2017.

Work shop Practice: (60 hours)

Objectives:

Students acquiring practical knowledge on various manufacturing techniques and will be able to fabricate components with their own hands.

Outcomes:

Up on completion of laboratory, students will be able to gain the manufacturing skills and get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.

List of Exercises - Trade wise Experiments:

1. Welding shop(both arc &gas welding)
   - Square butt joint
   - Lap joint
   - Single v butt joint
   - Gas welding & Cutting
2. Fitting Shop& Casting
   - Inclined fit
   - Half round fit
   - V fit
   - Moulding and casting of Hand wheel
3. Practice on electrical wiring and Electronic circuit boards
   - One bulb controlled by one switch &one bulb controlled by two switches
   - Two bulbs controlled by one switch (Stair case connection)
   - Tube light connection
   - Measurement of resistance, voltage and current with the help of a multi-meter & soldering on an electronic PCB circuit.
4. Machine Shop
   - Practice of machining operations on Lathe, Milling, Shaping, Drilling and Slotting Machines.
5. Carpentry
   - Lap joint
   - Cross lap joint
   - Dovetail joint
   - Turning on wood turning Lathe
6. Tin Smithy
   - Rectangular tray
   - Funnel
   - Pipe joint
   - Rectangular Scoop

Plastic moulding and glass cutting

Note: A minimum of 2 (Two) from each trade - Total 12 (Twelve) experiments - have to be Performed and recorded by the candidate to attain eligibility for Semester End Practical Examination.

ME/CE/EC 121	MATHEMATICS-II	L	T	P	C	Int	Ext
	(Calculus, Ordinary Differential Equations and Complex Variable)	3	1	-	4	40	60

Semester II [First Year]

COURSE OBJECTIVES:

The objective of this course is to familiarize the prospective engineers with techniques in Multivariate integration, ordinary and partial differential equations and complex variables. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. solve differential equations which model physical processes..
2. evaluate multiple integrals and their usage.
3. integrate vector functions.
4. understand differentiation and integration of functions of a complex variable and appy them in various engineeing problems.

UNIT I [CO:1] **(15)**

Differentials equations of first order-Linear equations, Bernoulli's equation, exact equations, equations reducible to exact equations.

Differentials equations of higher order - Second order linear differential equations with constant coefficients - Method of variation of parameters, Cauchy's homogeneous linear equation and Legendre's linear equation.

UNIT II [CO:2] **(15)**

Multiple Integrals - Double integrals (Cartesian and polar), Change of order of integration, Change of variables Cartesian to polar coordinates.

Area by double integrals, Triple integrals (Cartesian), Volume by triple integrals.

UNIT III [CO:3] **(15)**

Integration of vectors - Line integrals, surface integrals, Green's theorem in the plane (without proof), Stoke's theorem (without proof), Volume integrals, Gauss divergence theorem (without proof).

Complex variables - Differentiation, Cauchy Riemann equations (Cartesian and polar-without proof), analytic functions.

UNIT IV [CO:4] **(15)**

Harmonic functions, finding harmonic conjugate - Milne Thomson method.

Complex integration - Cauchy Integral Theorem (without proof), Cauchy Integral Formula (without proof).

LEARNING RESOURCES:

TEXT BOOK:

B.S.Grewal - Higher Engineering Mathematics, Khanna publishers, 42nd edition, 2017.

REFERENCE BOOK(s):

1. Erwin Kreyszig - Advanced Engineering Mathematics, John Wiley & Sons, 2006.
2. N.P. Bali and Manish Goyal - A text book of Engineering Mathematics, LaxmiPublications, Reprint, 2010.

WEB RESOURCES:

http://nptel.iitm.ac.in/courses/

ME 122	ENGINEERING PHYSICS	L	T	P	C	Int	Ext
	(Waves and Optics)	3	1	-	4	40	60

Semester II [First Year]

COURSE OBJECTIVES:

1. To impart knowledge and understanding the basic principles of oscillators.
2. To understand about basic phenomena of mechanical waves in the medium.
3. To understand the basic phenomena of light waves and interference.
4. To understand about diffraction phenomena and basic principles of lasers.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Identify and illustrate physical concepts and terminology used in oscillations.
2. Identify the basic phenomena of mechanical waves in medium.
3. Identify the propagation of light and interference phenomena.
4. Identify the basic concepts of diffraction phenomena and lasers.

UNIT I [CO:4] **(15)**

Simple harmonic motion, damped and forced simple harmonic oscillator:

Mechanical and electrical simple harmonic oscillators, complex number notation and phasor representation of simple harmonic motion, damped harmonic oscillator - heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor, forced mechanical and electrical oscillators, electrical and mechanical impedance.

UNIT II [CO:4] **(15)**

Non-dispersive transverse and longitudinal waves in one dimension and introduction to dispersion :

Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, impedance matching standing waves and their Eigen frequencies, longitudinal waves and the wave equation for them, acoustics waves and speed of sound, standing sound waves.

UNIT III [CO:4] **(15)**

The propagation of light :

Fermat's principle of stationary time and its applications e.g. in explaining mirage effect, laws of reflection and refraction, Light as an electromagnetic wave and Brewster's angle, total internal reflection.

Wave optics : Interference introduction, Stoke`s principle, interference in thin films by reflected light(cosine law),theory of air wedge , Newton's rings, Michelson interferometer and its applications.

UNIT IV [CO:4] **(15)**

Diffraction and Lasers :

Farunhofer diffraction from a single slit, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power.

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas laser (He-Ne), solid-state lasers(Neodymium), Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, applications of lasers in science, engineering and medicine.

LEARNING RESOURCES:

TEXT BOOK:

M.N. Avadhanulu, P.G. Kshirasagar - A Text book of Engineering Physics, S. Chand & Company Ltd., 2018.

REFERENCE BOOK(s):

1. Ian G. Main, Oscillations and waves inphysics.
2. H.J. Pain, The physics of vibrations and waves .
3. E. Hecht,Optics.
4. A. Ghatak,Optics.
5. O. Svelto, Principles ofLasers.

WEB RESOURCES:

Online course:

ME/CE/CH/CS/ EE/EC/IT 123	PROGRAMING FOR PROBLEM SOLVING	L	T	P	C	Int	Ext
		3	-	-	3	40	60

Semester II [First Year]

COURSE OBJECTIVES:

1. To understand the basic problem solving process using Flow Charts and algorithms.
2. To understand the basic concepts of control structures in C.
3. To learn concepts of arrays, functions, pointers and Dynamic memory allocation in C.
4. To use the concepts of structures, unions, files and command line arguments in C.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. develop algorithms and flow charts for simple problems.
2. use suitable control structures for developing code in C.
3. design modular programs using the concepts of functions and recursion.
4. Develop code for complex applications using structures, pointers and file handling features.

UNIT I [CO:1] **(12)**

Introduction to Programming: Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.)

Idea of Algorithm : Steps to solve logical and numerical problems, Representation of Algorithm: Flowchart / Pseudocode with examples,from algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code, Arithmetic expressions and precedence.

UNIT II [CO:2] **(11)**

Conditional Branching and Loops : Writing and evaluation of conditionals and consequent branching, Iteration and loops.

Arrays : Arrays (1-D, 2-D), Character arrays and Strings Basic Algorithms:Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations.

UNIT III [CO:3] **(11)**

Function : Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions : idea of call by reference

Recursion : Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series.

UNIT IV [CO:4] **(11)**

Structures: Structures, Defining structures and Array of Structures.

Pointers : Idea of pointers, Defining pointers, Use of Pointers in self referential structures.

File handling : Defining and opening a file, closing a file, input/output operations on files using file handling functions, random access to files.

LEARNING RESOURCES:

TEXT BOOK:

Byron Gottfried - Programming with C (Schaum's Outlines), Third Edition, Tata McGraw-Hill.

REFERENCE BOOK(s):

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India
2. Programming in C by Stephen G. Kochan, Fourth Edition, Pearson
3. C Complete Reference, Herbert Sheildt, TMH., 2000.
4. Programming with C by K R Venugopal & Sudeep R Prasad, TMH., 1997.

WEB RESOURCES:

1. http://cprogramminglanguage.net/
2. http://lectures-c.blogspot.com/
3. http://www.coronadoenterprises.com/tutorials/c/c_intro.htm
4. http://vfu.bg/en/e-Learning/Computer-Basics--computer_basics2.pdf

ME/CH 124	BASIC ELECTRICAL ENGINEERING	L	T	P	C	Int	Ext
		3	1	-	4	40	60

Semester II [First Year]

COURSE OBJECTIVES:

1. To introduce fundamental laws, basic electrical elements, sources and their characteristics.
2. To develop the ability to apply circuit analysis to AC circuits.
3. To provide students with fundamental concepts on the construction and operation of transformers and electrical machines.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. understand the basic electrical circuits and batteries.
2. gain the knowledge on the concept of AC circuits.
3. get the knowledge on the principle and operation of single phase transformer
4. understand the operation of electrical machines.

UNIT I [CO:1] **(15)**

Batteries : Lead-acid, Nickel-iron, Nickel-Cadmium batteries (Operation only). Elementary calculations for energy consumption.

DC Circuits : Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems.

UNIT II [CO:2] **(15)**

AC Circuits : Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), Three phase balanced circuits, voltage and current relations in star and delta connections.

UNIT III [CO:3] **(15)**

Transformers : Magnetic materials, BH characteristics, working principle of single phase transformer, ideal and practical transformer, equivalent circuit form O.C and S.C tests. Losses in transformers, regulation and efficiency. Auto-transformer - Working principle, comparison with two winding transformer.

UNIT IV [CO:4] **(15)**

Electrical Machines: Construction, working principle of DC generator and motor (Elementary treatment only), torque-speed characteristic of separately excited dc motor. Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency. Construction and working of synchronous generators.

LEARNING RESOURCES:

TEXT BOOK(s):

1. T.K.Nagasarkar and M.S.Sukhija - Principles of Basic Electrical Engineering, Oxford University Press, 2018.
2. D. P. Kothari and I. J. Nagrath - Basic Electrical Engineering, Tata McGraw Hill, 2010.

REFERENCE BOOK(s):

1. D. C. Kulshreshtha - Basic Electrical Engineering, McGraw Hill, 2009.
2. L. S. Bobrow - Fundamentals of Electrical Engineering, Oxford University Press, 2011.
3. E. Hughes - Electrical and Electronics Technology, Pearson, 2010.
4. V. D. Toro - Electrical Engineering Fundamentals, Prentice Hall India, 1989.
5. J.B Gupta - Basic Electrical Engineering, S.K.Kataria & Sons, 6th Edition 2015.

WEB RESOURCES:

1. http://www.egate.ws/
2. http://cosmolearning.org/courses/circuit-theory/
3. http://www.nptelvideos.in/2012/11/circuit-theory.html
4. http://elearning.vtu.ac.in/P9/notes/06ES34/Unit1-KCV.pdf
5. http://pbtstudies.blogspot.in/

ME 161	PHYSICS LAB	L	T	P	C	Int	Ext
		-	-	3	1.5	40	60

Semester II [First Year]

COURSE OBJECTIVES:

1. To give background in experimental techniques and to reinforce instructionin physical principles.
2. To find measurement, data, error, or graphical analysis in addition to illustrating a physical principle
3. To give skills that can transfer critical thinking into problem solving methods, how to identify what data is important, how to collect that data and then draw conclusions from it.

COURSE OUTCOMES:

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

1. use CRO, Function generator, Spectrometer for making measurements
2. test the optical instruments using principles of interference and diffraction
3. the concepts learned in the physics labtrained in carrying out precise measurements and handling sensitive equipment.
4. draw conclusions from data and develop skills in experimental design.

List of Experiments:

1. Some basic measuring instruments: Screw gauge, Vernier Callipers, Spherometer, Travelling Microscope etc., & General instructions.
2. To determine the acceleration due to gravity and radius of gyration using compound pendulum.
3. To determine the rigidity modulus of the given wire material using Torsional pendulum.
4. To determine the young modulus of the given material by non uniform bending.
5. To study the characteristic curves of a given Photocell and determine the Planck's constant.
6. To determine the radius of curvature of a given Plano-convex lens by Newton's Rings experiment.
7. To calculate the frequency & amplitude of sinusoidal waves and calibration of a given audio oscillator - Lissajous' Figures.
8. To determine the magnetic field along the axis of circular current carrying coil.
9. To measure the a.c. supply frequency using A.C. sonometer.
10. To determine the quality factor of a given series resonance LCR circuit.
11. To determine Fill factor of a given photovoltaic cell.
12. To determine the wavelengths of spectral lines of mercury light using diffraction grating.
13. To determine the wavelength of laser using diffraction grating.
14. To find the dispersive power and resolving power of a grating.
15. To determine the magnetic field in Helmoltz coil.
16. To determine the refractive index of the material of a prism.

REFERENCE BOOKS :

1. Students reference manual : Department of physics, RVR & JC College of Engg.

2. Engineering Physics Lab Manual; Dr. C.V.Madhusudhana Rao, V. Vasanth Kumar, 3rd edition, Scitech publications(India) Pvt. Ltd. Chennai.

3. Engineering Physics Practicals: Dr.B. Srinivasa Rao, V.K.V.Krishna, K.S.Rudramamba University Science Press, Daryaganj, NewDelhi.

Note: A minimum of 10(Ten) experiments have to be performed and recorded by the candidate to

attain eligibility for Semester End Practical Examination.

ME/CE/CH/CS/ EE/EC/IT/ 162	PROGRAMING FOR PROBLEM SOLVING LAB	L	T	P	C	Int	Ext
		-	-	4	2	40	60

Semester II [First Year]

COURSE OBJECTIVES:

1. To understand the basic problem solving process using Flow Charts and algorithms.
2. To understand the basic concepts of control structures in C.
3. To learn concepts of arrays, functions, pointers and Dynamic memory allocation in C.
4. To use the concepts of structures, unions, files and command line arguments in C.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. develop algorithms and flow charts for simple problems.
2. use suitable control structures for developing code in C.
3. design modular programs using the concepts of functions and recursion.
4. Develop code for complex applications using structures, pointers and file handling features.

List of Exercises / Activities:

[The laboratory should be preceded or followed by a tutorial to explain the approach or algorithm to be implemented for the problem given.]

Tutorial 1 : Problem solving using computers:

Lab1: Familiarization with programming environment.

Tutorial 2: Variable types and type conversions:

Lab 2: Simple computational problems using arithmetic expressions.

Tutorial 3: Branching and logical expressions:

Lab 3: Problems involving if-then-else structures.

Tutorial 4: Loops, while and for loops:

Lab 4: Iterative problems e.g., sum of series.

Tutorial 5: 1D Arrays: searching, sorting:

Lab 5: 1D Array manipulation.

Tutorial 6: 2D arrays and Strings:

Lab 6: Matrix problems, String operations.

Tutorial 7: Functions, call by value:

Lab 7: Simple functions.

Tutorial 8 & 9: Numerical methods (Root finding, numerical differentiation, numerical integration):

Lab 8 and 9: Programming for solving Numerical methods problems.

Tutorial 10: Recursion, structure of recursive calls:

Lab 10: Recursive functions.

Tutorial 11: Pointers, structures and dynamic memory allocation:

Lab 11: Pointers and structures.

Tutorial 12: File handling:

Lab 12: File operations.

Note: A minimum of 10(Ten) experiments have to be Performed and recorded by the candidate to attain eligibility for Semester End Practical Examination.

ME/CE/EE 163	ENGINEERING GRAPHICS & DESIGN LAB	L	T	P	C	Int	Ext
		1	-	4	3	40	60

Semester II [First Year]

COURSE OBJECTIVES:

1. Expose the students to standards and conventions followed in preparation of engineering drawings.
2. Make them understand the concepts of orthographic and isometric projections.
3. Develop the ability of conveying the engineering information through drawings.
4. Make them understand the relevance of engineering drawing to different engineering domains.
5. Develop the ability of producing engineering drawings using drawing instruments.
6. Enable them to use computer aided drafting packages for the generation of drawings.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Prepare engineering drawings as per BIS conventions mentioned in the relevant codes.
2. Produce computer generated drawings using CAD software..
3. Use the knowledge of orthographic projections to represent engineering information / concepts and present the same in the form of drawings.
4. Develop isometric drawings of simple objects reading the orthographic projections of those objects.
5. Convert pictorial and isometric views of simple objects to orthographic views.

(Units I to IV shall be taught in conventional drawing method and Unit V shall be taught with the aid of computer)

UNIT I

General : Principles of Engineering Graphics and their significance, usage of drawing instruments, lettering.

Conic sections : Construction of Ellipse, Parabola, Hyperbola and Rectangular Hyperbola. (General method only)

Curves : Cycloid, Epicycloid, Hypocycloid and Involute and Scales

UNIT II

Method of Projections : Principles of projection - First angle and third angle projection of points, Projection of straight lines inclined to both planes. Traces of lines.

Projections of planes : Projections of planes inclined to both the planes, projections on auxiliary planes.

UNIT III

Projections of Regular Solids : Projections of solids (Prism, Pyramid, Cylinder and Cone) with varying positions.

Sections of Solids : Sections of Prisms, Pyramids, cylinders and Cones. True shapes of sections. (Limited to the cutting plane perpendicular to one of the principal plane).

Development of surfaces : Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)

UNIT IV

Isometric Projections: Principles of Isometric projection-Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids

Orthographic Projections : Conversion of pictorial views into Orthographic views and Vice-versa. (Treatment is limited to simple castings).

Perspective Projections : Introduction to Perspective Projection

UNIT V

Over view of Computer Aided drafting (AutoCAD) : Introduction, starting and customizing AutoCAD screen, usage of different menus, toolbars(drawing, editing, dimension, text, object properties..etc), tabs (Object, snap, grid, polar, ortho, otrack..etc) and command prompt. Setting units, limits, layers and viewports (Isometric, Top, Front, back..etc). 2D drawings of various mechanical and structural components, electrical and electronic circuits. Orthographic and Isometric views of mechanical castings and simple structures.

LEARNING RESOURCES:

TEXT BOOK:

Bhatt N.D., Panchal V.M. & Ingle P.R. - Engineering Drawing, Charotar Publishing House, 2014.

REFERENCE BOOK(s):

1. Shah, M.B. & Rana B.C. - Engineering Drawing and Computer Graphics, Pearson Education, 2008.
2. Agrawal B. & Agrawal C. M. - Engineering Graphics, TMH Publication, 2012.
3. Narayana, K.L. & P Kannaiah - Text book on Engineering Drawing, Scitech Publishers, 2008.
4. (Corresponding set of) CAD Software Theory and User Manuals

ME/CH 164	BASIC ELECTRICAL ENGINEERING LAB	L	T	P	C	Int	Ext
		-	-	2	1	40	60

Semester II [First Year]

COURSE OBJECTIVES:

1. To conduct experiments on electrical circuits.
2. To design experimental setups for theorems.
3. To know the response of electrical circuits for different excitations.

COURSE OUTCOMES:

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

1. Get an exposure to common electrical components and their ratings.
2. Make electrical connections by wires of appropriate ratings.
3. Understand the usage of common electrical measuring instruments.
4. Understand the basic characteristics of resonance.
5. Verify the network theorems.

List of Exercises / Activities:

1. Familiarisation of Electrical Installations and Electrical Testing Equipment: Miniature circuit breakers (MCBs), Moulded Case Circuit Breakers (MCCBs), Earth-leakage circuit breakers (ELCBs), Fuses, Types of Wires, Wire Gauges, continuity test, megger, Cables and Earthing.
2. Basic safety precautions. Introduction and use of measuring instruments â€“ voltmeter,ammeter, wattmeter, multi-meter, oscilloscope, measurement of basic parameters.
3. Verification of KVL& KCL.
4. Verification of Superposition Theorem.
5. Verification of Thevenin's Theorem.
6. Verification of Norton's Theorem.
7. Transformers: Observation of the no-load current waveform on an oscilloscope (non sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics).
8. OC & SC tests on single phase transformer.
9. Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
10. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
11. Swinburne's test on dc motor.
12. Speed control of dc motor.
13. Experiments on three-phase induction motors. Direction reversal by change of phase-sequence connections, Torque-Slip Characteristics of an induction motor.
14. Synchronous Machine operating as a generator: stand-alone operation with a load, control of voltage through field excitation.
15. Determination of choke coil parameters.

Note: A minimum of 10(Ten) experiments have to be Performed and recorded by the candidate to attain eligibility for Semester End Practical Examination.

ME 211	ENGINEERING MECHANICS	L	T	P	C	Int	Ext
		2	1	-	3	40	60

Semester III [Second Year]

COURSE OBJECTIVES:

1. Learn and understand the basic principles of mechanics of rigid bodies, various types of force systems in plane and to analyze problems in a simple and logical manner.
2. Learn basic concepts of force systems in space and study centroids of various standard geometrical shapes as well as composite areas and centre of gravity of material bodies.
3. Study the concept of moment of inertia of areas & material bodies and learn computation deflections using virtual work.
4. Learn principles of dynamics and understand the kinematics and kinetics of rectilinear, curvilinear translation, rotation about fixed axis and general plane motion of rigid bodies.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Apply principles of mechanics, static equilibrium equations to various types of force systems in order to determine the resultant, unknown forces and moments.
2. Use vector analytical techniques for analysing forces and moments in spatial force systems and also determine the centroids and center of gravity of standard geometric shapes as well as composite areas.
3. Apply principle of virtual work to solve simple structures. Calculate the area moment of inertia and mass moment of inertia of standard shapes as well as composite sections.
4. Apply fundamental concepts of kinematics and kinetics of particles and rigid bodies to the analysis of simple and practical problems.

UNIT I [CO:1] **(12)**

Basic Concepts & Force systems in a plane: Principles of statics, composition and resolution of forces, equilibrium of concurrent forces in a plane, method of projections, Method of moments, Couple, equilibrium of parallel forces in a plane, resultant and equillibrum of general case of forces in a plane, plane trusses-method of joints. Friction: Concept of friction, laws of friction, simple contact friction, wedge friction.

UNIT II [CO:2] **(12)**

Force systems in a space (Using vector notation): Position vector, unit vector, force vector, resultant and equilibrium of concurrent forces in space, moment of a force about a point, moment of a force about an axis. Centroid and Centre of Gravity: Centroids of simple shapes from first principles, centroids of composite plane figures, centre of gravity of three dimensional bodies (Right circular cone and Hemi sphere).

UNIT III [CO:3] **(12)**

Virtual Work: Introduction, principle of virtual work, Equilibrium of Ideal systems.Moment of Inertia: Area moment of inertia - Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections, Mass moment inertia of circular plate, Cylinder, Cone and Sphere.

UNIT IV [CO:4] **(12)**

Kinematics: Rectilinear translation, Curvilinear translation, Rotation about fixed axis, General Plane motion of rigid bodies.Kinetics: Rectilinear translation, Work and energy, Impulse momentum, Collision of elastic bodies-direct central impact, Curvilinear translation, Rotation about fixed axis, General plane motion of rigid bodies.

LEARNING RESOURCES:

TEXT BOOK(s):

1. Engineering mechanics by S. Timoshenko, D. H. Young, J V Rao and Sukumar Pati - 5th edition, McGraw Hill Education (India) Private Limited, (For concepts).
2. Engineering mechanics-statics and dynamics by A. K. Tayal - 14th edition, Umesh publications (For numerical problems).
3. Engineering Mechanics by S.S. Bhavikatti, 5th edition, New Age International Pvt Ltd Publishers.

REFERENCE BOOK(s):

1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall.
2. J. L. Meriam and L. G. Kraige, Engineering Mechanics: Dynamics, Wiley, 2011.
3. Singers Engineering Mechanics: Statics and Dynamics, K.Vijaya Kumar Reddy and J Suresh Kumar, 3rd Edition SI Units - BSP Books Pvt. Ltd. Publications.
4. Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications.

WEB RESOURCES:

1. https://nptel.ac.in/courses/122104015/
2. https://nptel.ac.in/courses/112103109/

ME 212	LIFE SCIENCE FOR ENGINEERS	L	T	P	C	Int	Ext
		2	-	-	2	40	60

Semester III [Second Year]

COURSE OBJECTIVES:

1. To recall the basics of biology viz. cellular organization, function and classification.
2. To provide an understanding of the basic structure and functions of major biomolecules
3. To describe the transfer of genetic information and Introduce the techniques used for modification of living organisms
4. To describe the applications of rDNA technology and biomaterials

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Understand and appreciate the cellular organization and its diversity
2. Recognize and understand the molecular basis of different forms of life and their applications
3. Identify the complementarity in the structure and functions of biomolecules
4. Differentiate the genetic phenomena and demonstrate the genetic engineering of organisms

UNIT I *Text Book - 1,2* [CO:1] **(6)**

Living Organisms:

Comparison of biological organisms with manmade systems, Classification of living organisms, Cellular basis of life.

Differences between prokaryotes and eukaryotes, classification on the basis of carbon and energy sources, molecular taxonomy.

UNIT II *Text Book - 1,2* [CO:2] **(6)**

Proteins and Enzymes

Water, Biomolecules- carbohydrates, proteins and lipids, structure and functions of proteins and nucleic acids, hemoglobin, antibodies.

Enzymes: Basic Structure and Classification of Enzymes; Enzymes in Fermentation and industrial applications

UNIT III *Text Book - 2,4* [CO:3] **(6)**

Cell Physiology

Bioenergetics, Respiration: Glycolysis and TCA cycle, Electron transport chain and oxidative phosphorylation.

Mechanism of photosynthesis; Neurons, synaptic and neuromuscular junctions

UNIT IV *Text Book - 2,3* [CO:4] **(10)**

Genes and genetic material (DNA and RNA)

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

Recombinant DNA Technology: recombinant vaccines, transgenic microbes, animalcloning, biosensors, biochips.

LEARNING RESOURCES:

TEXT BOOK(s):

1. Wiley Editorial - "Biology for Engineers", Wiley India, First Edition 2018, ISBN: 9788126576340
2. U. Satyanarayana and U. Chakrapani - "Biochemistry", 3rd Edition, Uppala - publisher interlinks, 2007
3. AVSS Sambamurty - Genetics, 2nd Edition, Narosa publishing House, 2006
4. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A global approach", Pearson Education Ltd, 2018.

REFERENCE BOOK(s):

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

ME 213	MANUFACTURING PROCESSES	L	T	P	C	Int	Ext
		3	-	-	3	40	60

Semester III [Second Year]

COURSE OBJECTIVES:

1. To motivate and challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. understand the Fundamentals of casting process
2. understand the fundamentals of bulk and sheet deformation process
3. understand the varieties of fabrication methods used in manufacturing
4. understand Unconventional manufacturing methods employed for making different products.

UNIT I [CO:1] **(12)**

Conventional Manufacturing processes:Casting and moulding: Introduction to Casting, terminology, Pattern-types, materials and allowances, moulding sand properties.Metal casting processes: Sand casting, Investment Casting, Centrifugal and Die Casting with related equipment, Elements of gating system for castings, Riser design- caine's method, modulus method-Problems. Casting defects and Remedies.

UNIT II [CO:2] **(12)**

Introduction to bulk and sheet metal forming Fundamentals of hot and cold working processes, : Plastic deformation and yield criteria; Rolling-types of roll mills and passes, load estimation for rolling, forging, extrusion and sheet forming (shearing, Punching, bending).

UNIT III [CO:3] **(12)**

Joining/fastening processes:, Welding: Gas welding, TIG and MIG welding, submerged arc welding and resistance welding process-Simple problems. Solid-liquid state joining processes: Brazing, soldering and adhesive bonding. Additive manufacturing: Introduction to Rapid prototyping-types-Selective Laser Sintering (SLS) Stereo lithography (SLA), Laminated Object Manufacturing (LOM), Fused Deposition Modelling (FDM) and Applications.

UNIT IV [CO:4] **(12)**

Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters Electrical Discharge Machining, principle and processes parameters, MRR, surface finish, tool wear, dielectric, wire EDM; Electro-chemical machining (ECM), etchant & maskant, process parameters, MRR and surface finish. Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining.

LEARNING RESOURCES:

TEXT BOOK(s):

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)-Pearson India, 2014.
2. Workshop Technology by Hazra Chaudhary vol I & vol II , Media Publishers & Promoters,India
3. Production Technology Vol 1 and 2 by R.K. Jain , Khanna Publishers , Edn. 19 , Delhi

REFERENCE BOOK(s):

1. Degarmo, Black &Kohser, Materials and Processes in Manufacturing.
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems.

WEB RESOURCES:

1. https://nptel.ac.in/courses/112104195/1
2. https://nptel.ac.in/courses/112107144/13

ME 214	BASIC THERMODYNAMICS	L	T	P	C	Int	Ext
		2	1	-	3	40	60

Semester III [Second Year]

COURSE OBJECTIVES:

1. To learn about Thermodynamic system types and examples, work and heat interactions, and balance of energy between system and its surroundings.
2. To learn about I law of thermodynamics applied to closed and open systems and application to various engineering devices.
3. To understand the concepts of heat engine, refrigerator and heat pump and know the rate of conversion of heat into work and calculate Thermal Efficiency and COP.
4. To learn about II law of thermodynamics and Entropy concepts and to understand how much amount of energy can be Available for conversion into useful work and the concepts of Irreversibility and know about the concept of air standard efficiency and working of different important air standard cycles.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Apply energy balance to systems and control volumes, and able to calculate heat and work transfers.
2. Apply I law of thermodynamics to systems and engineering devices and can evaluate heat, work, internal energy and enthalpy.
3. Evaluate the performance of energy conversion devices like heat engine, refrigerator and heat pump and also able to evaluate entropy changes for various systems.
4. Differentiate between high grade and low grade energies and able to evaluate exergy and irreversibility for different systems and also evaluate air standard thermal efficiency, mean effective pressure of air standard cycles.

UNIT I [CO:1] **(12)**

FUNDAMENTALS: System & Control volume; Property, State & Process; Exact & Inexact differentials; Temperature, Definition of thermodynamic equilibrium and Zeroth law; Temperature scales; Various Thermometers-Temperature measurement.WORK & HEAT - Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, gravitational, spring and shaft work-- Definition of heat; examples of heat/work interaction in systems.

UNIT II [CO:2] **(12)**

FIRST LAW OF THERMODYNAMICS FOR NON FLOW PROCESSES; First law applied to a cycle and to a process, Concept of total energy E; Demonstration that E is a property; Various modes of energy, Internal energy and EnthalpyFIRST LAW FOR FLOW PROCESSES - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; I law applications for system and control volume.

UNIT III [CO:3] **(12)**

SECOND LAW OF THERMODYNAMICS: Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale.ENTROPY: Clausius inequality; Definition of entropy S ; Demonstration that entropy S is a property; Evaluation of S for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Determination of entropy change for different non flow processes- Principle of increase of entropy; Illustration of processes in T-s coordinates.

UNIT IV [CO:4] **(12)**

AIR STANDARD CYCLES: Otto, Diesel and Dual cycles- Analysis for thermal efficiency and mean effective pressure, comparison between Otto, Diesel and Dual cycles.AVAILABILITY AND IRREVERSIBILITY:- Available and Unavailable energies, Irreversibility and Availability, Availability function for systems and Control volumes, Lost work.

LEARNING RESOURCES:

TEXT BOOK(s):

1. Engineering Thermodynamics- Nag, P.K, 2005, Tata McGraw-Hill Publishing Co. Ltd.
2. Thermal Engineering- M.M. Rathore, McGrawHill , 2010.

REFERENCE BOOK(s):

1. Thermal Engineering- Er. R.K. Rajput, Lakshmi Publications,2010.
2. Treatise on Heat Engineering , V.P.Vasandhani and D.S. Kumar, 4th Edition Metropolitan Book Co. Pvt Ltd,.

WEB RESOURCES:

1. https://nptel.ac.in/courses/112105123/
2. https://www.coursera.org/learn/thermodynamics-intro
3. http://web.mit.edu/16.unified/www/FALL/thermodynamics/thermo.pdf

ME 215	THEORY OF MECHANISMS & MACHINES	L	T	P	C	Int	Ext
		2	1	-	3	40	60

Semester III [Second Year]

COURSE OBJECTIVES:

1. To provide basic concepts on mechanisms, machines and analyze the velocities of various links in mechanisms.
2. To introduce the instantaneous centre concepts for analysis.
3. Brief study on synthesis and concepts of Type, Number and Dimensional synthesis
4. To introduce the CAMs and their design regards to synthesis and To introduce various concepts on gears, classification and types

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. understand various mechanisms and terminology used in kinematics
2. analyze the mechanisms and machines regarding velocities and accelerations
3. understand the concepts of synthesis in respect of CAM systems
4. understand the Gear terminology and able to analyze gear trains

UNIT I [CO:1] **(12)**

Introduction : Mechanisms and machines, Rigid and resistant bodies, Link, Kinematic pair, Degrees of Freedom, Classifications of Kinematic pairs, kinematic-chain, Linkage, Mechanism, and structure, Classification of mechanisms, Equivalent Mechanisms, Four - Link (bar) Mechanism, Inversions of Slider - Crank Chain, Double - Slider Chain.Straight Line Mechanisms: Hart Mechanism, Scott Russel Mechanism, Grass Hoper Mechansim.Velocity Analysis: Introduction, Absolute and Relative Motion, Addition and subtraction of Vectors, Motion of a Link, Four Link Mechanism, Angular Velocity of Links, Velocity of Rubbing, Slider – Crank Mechanism, Crank and Slotted Lever Mechanism.

UNIT II [CO:2] **(12)**

Instantaneous centre: Notation, Number of I - Centers, Arnold Kennedy's theorem, Locating I - Centres, Angular velocity by I - Centre Method.Acceleration Analysis: Acceleration, Four-Link Mechanism, Angular acceleration of Links, Acceleration of Intermediate and offset points, slider- Crank Mechanism, Coriolis component acceleration, Crank and slotted lever Mechanism.

UNIT III [CO:3] **(12)**

Kinematic Synthesis: Stages of synthesis-Concepts of type, Number and dimensional synthesis - Tasks of dimensional synthesis, Concepts of function generation, Rigid body guidance and path generation, Freudenstein’s equation for function generation using three precision points.Cams: Introduction, Types of cams, Types of Followers, Definitions, Graphical synthesis of cam profile. (Knife Edge, Roller and Flat faced Followers).

UNIT IV [CO:4] **(12)**

Gears: Introduction, Classification gear terminology, Law of Gearing, Velocity of Sliding, Forms of Teeth, Cycloidal Profile Teeth, Involute Profile Teeth, Path of contact, Arc of contact, Number of pairs of Teeth in contact, Interference in Involute Gears, Minimum number of Teeth, Interference between Rack and Pinion, Undercutting, Comparison of Cycloidal and Involute tooth forms. Gear Trains: Introduction, simple Gear Train, Compound Gear Train, Reverted Gear train, Planetary or Epicyclic Gear Train, Analysis of Epicyclic Gear Train, Torques in Epicyclic Trains: Tabular Methods.

LEARNING RESOURCES:

TEXT BOOK(s):

1. Theory of Machines of by S.S.Rattan. TMH, second re print , 2009.
2. Theory of Mechanisms and Machines by Ghosh and Mallik , East West Press, New Delhi,Re print 2000.

REFERENCE BOOK(s):

1. Theory of Mechanisms and Machines by C.S.Sharma, Kamlesh Purohit, PHI , 2006.
2. Theory of Mechanism and Machine by J.E. Shigley, MGH , 2nd Edition.

WEB RESOURCES:

1. http://nptel.iitk.ac.in
2. http://ptumech.loremate.com/tom1/node/1
3. http://www.youtube.com/watch?v=6coD3oOuhr8

ME 216	FLUID MECHANICS & HYDRAULIC MACHINES	L	T	P	C	Int	Ext
		2	1	-	3	40	60

Semester III [Second Year]

COURSE OBJECTIVES:

1. To learn about the application of mass and momentum conservation laws for fluid flows
2. To understand the importance of dimensional analysis
3. To obtain the knowledge to draw velocity triangles in various types of rotodynamic machines and analyze the flow in water turbines
4. To analyze the flow in water pumps.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. to mathematically analyze simple flow situations.
2. gain experience with boundary layer concepts
3. evaluate the performance of turbines
4. evaluate the performance of Pumps

UNIT I [CO:1] **(12)**

Definition of fluid, Newton law of viscosity, Units and dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension - Simple numerical problems Control volume- application of continuity equation, Incompressible flow, Eulers equation, Bernoullis equation and Numerical problems. Applications on Bernoulli Principle (working principle and derivations on Pitot tube, venturimeter and orifice meter only).

UNIT II [CO:2] **(12)**

Fluid flow Types, Reynolds experiment, laws of fluid friction, Darcy-Wiesbach equation, Laminar flow through a circular conduits, Hagen-Poiseulle law, concept of boundary layer, measures of boundary layer thickness. Need for dimensional analysis ,methods of dimension analysis , Buckingham Pi theorem, Similitude , types of similitude, dimensionless parameters , application of dimensionless parameters , Model analysis.

UNIT III [CO:3] **(12)**

Theory of Rotodynamic machines , Classification of water turbines, heads and efficiencies, working principle , Pelton wheel, Francis turbine and Kaplan turbines. Velocity components at entry and exit of the rotor, velocity triangles:Axial, radial and mixed flow turbines, work done by the rotor, performance characteristic curves.

UNIT IV [CO:4] **(12)**

Reciprocating Pumps: Types, Working principle, Power required by a Reciprocating pump, Coefficient of discharge, Slip and negative slip, Effect of Acceleration of piston on velocity and pressure in suction and delivery pipes, Indicator diagram, Air vessels. Centrifugal Pumps: Types, Working principle, Reciprocating vs. Centrifugal pump, Work done by impeller, Head of a pump, losses and efficiencies, Minimum starting speed, Specific speed, Multistage pumps, Pumps in parallel, Performance characteristic curves, limitation of suction lift, NPSH.

LEARNING RESOURCES:

TEXT BOOK(s):

1. Hydraulics and Fluid Mechanics --P.N.Modi & S.M. Seth, Standard Book House, New Delhi, 1977.

2. Hydraulic Machines - Jagadish Lal, MPP, 1994.

REFERENCE BOOK(s):

1. Fluid Mechanics & Fluid Power Engineering - D.S.Kumar, SK Kataria &sons, New Delhi, 2012 Re Print
2. Fluid Mechanics & Hydraulic Machines - R.K.Bansal , Laxmi Publications, 2005.

WEB RESOURCES:

1. www.hydraulicspneumatics.com
2. http://www.efluids.com/
3. http://fluid.power.net/
4. www.pumps.org/

ME 251	MACHINE DRAWING LAB	L	T	P	C	Int	Ext
		1	-	2	2	40	60

Semester III [Second Year]

COURSE OBJECTIVES:

1. To make the students understand the concepts of sectioning & method of representing full & half sectional views of various symmetrical & asymmetrical components.
2. To make the students understand the nomenclature associated with screw threaded fasteners, methods to represent and drawing of internal as well as external screw threads.
3. To make the students understand the uses of keys, cotters & pins temporary joints possible between two shafts or shaft & hub.
4. To make the students understand and draw assemblies of machine parts and to draw their sectional views

COURSE OUTCOMES:

After the successful completion of the course,students are able to

1. Student can identify and apply sectional views for different drawings
2. Student can identify different types of threaded fasteners and their applications.
3. Students can apply their knowledge on keys and joints in practical situations
4. Students can able to assemble parts of different machines and produce their drawings

EXPERIMENTS:

1. Sectional views: Introduction, full & half section
2. Screwed fasteners: Screw thread nomenclature - types & classification of screw threads, Square & Hexagonal headed bolted joints.
3. Keys, Cotters and Pin joints: Saddle & Sunk Keys, Cotter Joint with sleeve , Knuckle Joint
4. Assembly Drawings : Stuffing Box , Screw Jack , Eccentric , Pipe - Vice

Note:**

LEARNING RESOURCES:

TEXT BOOK:

Machine Drawing by K.L.Narayana, P.Kannaiah & K.Venkata Reddy, New Age International , 3rd Edition

REFERENCE BOOK(s):

1. Machine Drawing by K.R.Gopala Krishnan, Subhas Publications, 20th Edition, 2007.
2. A Text book on Machine Drawing by R.K.Dhawan, S. Chand & Company Pvt. Ltd. 2014 edition

WEB RESOURCES:

https://nptel.ac.in/courses/112106075/

ME 252	COMMUNICATIVE ENGLISH LAB	L	T	P	C	Int	Ext
		1	-	2	2	40	60

Semester III [Second Year]

COURSE OBJECTIVES:

1. To build confidence and enable students speak better English.
2. To motivate students to use English in different situations and contexts.
3. To enable students understand the importance of preparation and practice in presentations.
4. To enable them to understand the basic nuances for efeective language communication.
5. Practice comprehensible pronunciation of English.

COURSE OUTCOMES:

Upon completion of the course students shall.

1. Recognise the need of good comunication skills for professional courses.
2. Understand the basic tenets of communication.
3. Articulating syllables clearly, speaking fluently with correct pronunciation.
4. Develop their self awareness.
5. Understand the importance of group dynamics.

UNIT I [CO:4] **(7)**

Basics of Presentations

Ice breaking session

Student Presentation-I

Learning about Presentations

> - Presentation structure

> - Managing nerves in a presentation

> - Mini Presentations

> - Feedback on presentations

UNIT II [CO:4] **(7)**

Professional and Personal Grooming

Functional English

Non Verbal Communication

Stage Manners

Undersatnding and preparing a Presentation

Team presentations

UNIT III [CO:4] **(7)**

Speech Nuances

Pronunciation

MTI-Mother Tongue Influence

Stress in English

Tempo of Speech

Indianisms and Often Made Mistakes

Idioms & Phrasal verbs

UNIT IV [CO:4] **(7)**

Free Talk

Dilemma Questions

Paraphrasing an article or a video in student's own words(Team task)

Impromptu speeches

Introducing TED TALKS

Movie based Learning-Karate Kid Movie-Understanding Life Skills

LEARNING RESOURCES:

REFERENCE BOOK(s):

1. Making Successful Presentations :A Self-Teaching Guide-Terry C. Smith,19846
2. Professional Presentations -Malcom Goodale
3. Giving Presentations -Jo Billingham
4. APA ART Speak Well I
5. HANDOUTS

ME 253	BASIC ELECTRONICS LAB	L	T	P	C	Int	Ext
		1	-	2	2	40	60

Semester III [Second Year]

COURSE OBJECTIVES:

1. To Understand the characteristics of basic electronics devices like P-N junction diode,zener diode,BJT characteristics in various configurations,JFET.
2. To Understand the effect of filter on operation of Half-wave,Full-wave rectifiers
3. To Design combinational logic circuits such as adder,subtractor,code converters
4. To Understand the operational amplifier applications

COURSE OUTCOMES:

After the successful completion of the course,students are able to

1. Obtain the characteristics of devices like P-N junction diode,zener diode,BJT in CE,CB configurations,JFET,etc
2. Design the half-wave and full-wave rectifiers
3. Design combinational logic circuits such as adders ,subtractors and code converters
4. Design Adder,subtractor,differentiator,integrator using IC 741.

EXPERIMENTS:

1. Characteristics of Silicon and Germanium Diodes
2. Characteristics of Zener diode
3. Half-Wave Rectifiers
4. Full-Wave Rectifiers
5. Characteristics of CE configurations
6. Characteristics of JFET
7. Realization of Gates using Discrete components
8. Realization of Gates using Universal building block(NAND only)
9. Design of combinational logic circuit like Half-adder,half-subtractor
10. Design of code converters
11. Conversion of Flip-Flops
12. Applications of op-amp,(Adder,Subtractor) using IC 741
13. Applications of integrator and differentiator using IC 741
14. Astable multivibrator using IC 555

Note:**

A minimum of 10(Ten) experiments have to be performed and recorded by the candidate to attend eligibility for universal practical examination

LEARNING RESOURCES:

TEXT BOOK(s):

1. Millimans,Electronic Devices and Circuits,Jacob milliman christos C.Halkias satyabrata jit,MC Graw Hill,4th Edition.
2. R.P.Jain,Mosdern Digital Electronics,Tata Mc Graw Hill,3rd Edition,2007.

REFERENCE BOOK(s):

1. Floyd,Electronics Devices Pearson Education 9th Edition,2012.
2. Frenzel,Communication Electronics:Principles and Applications,Tata Mc Graw Hill,3rd Edition,2001

ME 221	MATHEMATICS - III	L	T	P	C	Int	Ext
	(PDE, PROBABILITY & STATISTICS)	2	1	-	3	40	60

Semester IV [Second Year]

COURSE OBJECTIVES:

Course Objectives:

1. 1. To provide knowledge on partial differential equations and its applications in engineering.
2. 2. To provide knowledge on numerical methods including solving systems of linear equations and interpolation.
3. 3. To provide knowledge on numerical integration, numerical solution of ordinary and partial differential equations.
4. 4. To provide knowledge on probability distributions and testing of hypothesis.

COURSE OUTCOMES:

Course Outcomes: After successful completion of the course, the students are able to

1. 1. Solve first and second order partial differential equations in engineering applications.
2. 2. Solve system of equations and evaluate derivatives using numerical techniques.
3. 3. Solve integrals, ordinary and partial differential equations using numerical techniques.
4. 4. Apply knowledge of distribution theory and testing of hypothesis for engineering problems.

UNIT I *Text Book - 1* [CO:1] **(12)**

Unit-I: Partial Differential Equations and Applications:Definition, Linear equation of the first order, classification of second order linear equation and its solution by method of separation of variables, Solution of one dimensional wave equation.Solution of one dimensional heat equation, Solution of two dimensional heat equation in steady state (Cartesian only).

UNIT II *Text Book - 1* [CO:2] **(12)**

Unit-II: Numerical Solution of Equations, Interpolation and Numerical differentiation:Newton-Raphson method, Gauss Seidel iteration method, forward and backward differences, differences of a polynomial, Newton's Forward and Backward Interpolation formulae (without proof).Lagrange's Interpolation formula (without proof), Inverse interpolation. Newton's forward and backward differences formula to compute first and second order derivatives.

UNIT III *Text Book - 1* [CO:3] **(12)**

Unit-III: Numerical Integration, Numerical Solution of Ordinary and Partial Differential Equations: Trapezoidal rule, Simpson's one-third rule and three-eight rules (without proof)Euler's method, Runge-Kutta method of fourth order, Laplace's equation and Poisson's equation.

UNIT IV *Text Book - 2* [CO:4] **(12)**

Unit-IV: Probability Distributions & Testing of Hypothesis:Binomial distribution, Poisson distribution, Normal distribution and their applications.Test for single mean (t-test), test for two means (t-test), Test for ratio of variances (F-test), Chi-square test for goodness of fit for Binomial and Poisson distributions and independence of attributes.

LEARNING RESOURCES:

TEXT BOOK(s):

1. (i) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43nd edition, 2015.
2. (ii) Richard A. Johnson., Miller & Freund's, Probability and Statistics for Engineers, PHI, 6th Edition.

REFERENCE BOOK(s):

1. (i) Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. (ii) N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, 2010.
3. (iii) S.S. Sastry, Introductory Methods of Numerical Analysis, PHI Learning Private Limited, 5th edition, 2012.
4. (iv) S. Ross, A First Course in Probability, 6th Edition, Pearson Education India, 2002.

WEB RESOURCES:

http://nptel.iitm.ac.in/courses/

ME 222	STRENGTH OF MATERIALS	L	T	P	C	Int	Ext
		2	1	-	3	40	60

Semester IV [Second Year]

COURSE OBJECTIVES:

1. Introduce various properties of engineering materials like elasticity, plasticity, various types of stresses and strains including thermal stresses and strains, elastic constants and relations among them.
2. Understand and apply concepts like plane stress and strain to determine principal stresses and strains for plane stress and strain problems using analytical and Mohr s circle methods.
3. Induce the concepts of drawing shear force and bending moment diagrams and to make them determine deflections and stresses induced in beams like simply supported, cantilever and over hanging
4. Derive the general equation of torsion for circular members and its application to stepped bars. Also, to determine stresses in constrained bars subjected to Torsion.
5. Analyze various stresses induced thin and thick cylindrical pressure vessels and spherical shells subjected to internal fluid pressure

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Derive various relations among the elastic constants and apply them to determine normal, shear stresses, strains, thermal stresses, strains and displacements
2. Compute Principal stresses and strains for plane stress and strain problems using analytical and Mohr s circle methods
3. Draw the shear force and bending moment diagrams for various simply supported and cantilever beams, Estimate deflections, normal and shear stresses in various types of simply supported, cantilever and over hanging beams
4. Derive the general equation of torsion and apply the same to determine stresses in constrained bars, stepped bars and other circular members,Determine circumferential, longitudinal and radial stresses, strains in thin and thick pressure vessels subjected to internal fluid pressure

UNIT I [CO:1] **(12)**

Introduction : Properties of engineering materials, Linear Elasticity and Hooke's Law, Tension, Compression and Shear, deformation, Normal Stress and Strain, shear stress and strain, thermal stresses and strains, Stress - Strain Diagrams, Poisson’s ratio, Bulk Modulus, shear modulus, Young’s modulus, Relation between elastic constants, factor of safety and allowable stresses.

UNIT II [CO:2] **(12)**

Plane stress and plane strain: principal stresses, principal strains and principal planes for a two dimensional state of stress and strain and their significance. Determination of principal stresses, principal strains, orientation principal planes and maximum shear planes using analytical method and Mohr’s circle (graphical) method.

UNIT III [CO:3] **(12)**

Shear force and bending Moment diagrams: Relations between loads, shear force and bending moment. Shear force and bending moment diagrams for simply supported, cantilever and over hanging beams. Beam deflections: Determination of slopes and deflections of cantilever, simply supported and overhanging beams by double integration method, Castigliano’s strain energy method. Stresses in beams: Normal and shear stresses in beams having I-Section, T-Section, rectangular and Circular sections.

UNIT IV [CO:4] **(12)**

Torsion: General equation of torsion for circular members, torsion in solid circular, hollow, and stepped bars. Torsion in bars fixed at both the ends, stresses. Pressure vessels: Analysis of thin and thick

cylindrical and spherical pressure vessels subjected to uniform internal fluid pressure.

LEARNING RESOURCES:

TEXT BOOK(s):

1. Mechanics of Materials by James M. Gere and Barry J. Goodner, Published by Cengage Learning, 8th edition.
2. Strength of materials by Sadhu Singh, Khanna Publishers, 11th Edition

REFERENCE BOOK(s):

1. Engineering Mechanics of Solids by E.P.Popov, PHI, 2nd Edition.
2. Strength of Materials by S. Ramamrutham, DhanpatRai Publishing Company (P) Ltd, 18th Edition
3. Introduction to Solid Mechanics by I.H. Shames, PHI, 3rd Edition.
4. Strength of Materials by R.K.Bansal, LaxmiPublications, 6th Edition.

WEB RESOURCES:

1. http://nptel.iitm.ac.in/
2. www.learnerstv.com/Free-Engineering-video-lecture-courses.html

ME 223	MANUFACTURING TECHNOLOGY	L	T	P	C	Int	Ext
		3	-	-	3	40	60

Semester IV [Second Year]

COURSE OBJECTIVES:

1. To provide the fundamental knowledge regarding the working principle, specifications, parts and various operations performed various tools.
2. To develop knowledge in design considerations, principles and related devices used in Jigs and Fixtures
3. To provide knowledge of various types of press working tools and related calculations
4. To provide basic information regarding the way of formation of chips, deformation of work piece, generation of temperature and cutting forces.
5. To provide information regarding the cutting tool materials and their application to different metals in metal cutting.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Gain the knowledge of operating the machines and their mechanisms.
2. Ability to identify the functions of location, clamping devices and applications of JIGS & FIXTURES
3. Able to understand PRESS WORKING TOOLS major components, types of drawing dies, bending dies and related calculations
4. Able to understand types of drawing dies, drawing die and bending dies and related calculations
5. To get familiar with the nomenclature of tool and the parameters in the selection of tools and learn the various forces acting on tooling

UNIT I [CO:1] **(12)**

Lathe: Constructional details, specifications, classification of lathes. Lathe accessories - various work holding devices, Lathe operations including taper turning and thread cutting. Drilling Machines: Types and specifications, spindle feed mechanism, drilling operations.

UNIT II [CO:2] **(12)**

Grinding Machines: Working principle of cylindrical,center less and surface grinding machines.Grinding operations:Glazing,loading,Truing and dressing.Surface Finishing.Operations:Honing and lapping operationsMilling machines: Working Principle,size and specification,up and Down Milling, Types of milling machines,Milling Operations,Milling cutters

UNIT III [CO:3] **(12)**

Jigs & Fixtures: Introduction, design considerations in jigs& fixtures.The principle of six point location,locating pins,Clamping and clamping devices Press working tools:Types of dies - compound die, combination die, progressive die and design of drawing die:limited to simple problems Bending die: Bending methods, spring back, bending allowance, bending force.

UNIT IV [CO:4] **(12)**

Theory of Metal Cutting: Introduction, Nomenclature of single point cutting tool,Tool Geometry,Mechanics of chip formation,types of chips.Determination of shear angle and chip thickness ratio,stress and strain in the chip,velocity relations, Merchant's theory of orthogonal cutting forces,related simple problems.Tool wear, tool life and tool life criteria,cutting fluids-types and required characteristics.Cutting Tool Materials.Requirements of tool materials and types

LEARNING RESOURCES:

TEXT BOOK(s):

1. Elements of Workshop Technology Vol. II by Hazra Chowdary , Media Promoters & Publishers, 1983
2. Production Engineering by P.C. Sharma, S.Chand &Co , 2007.

REFERENCE BOOK(s):

1. Manufacturing Engineering & Technology by Kalpak Jain, PHI , 5th Edition , 2005.
2. Materials and Processes in Manufacturing by E.Paul De Garmo, J.T.Black and Ronald A.Kohser , John Wiley & Sons, 2003.
3. Manufacturing Science by A. Ghosh & A.K.Mallik , Affiliated East-West Press (P) Ltd., New Delhi ,Re Print 1998

WEB RESOURCES:

1. www.mini-lathe.com/links.htm,machinedesign.com/.../designer-sguidetometalcutting-machinery-0608 -
2. www.metalwebnews.com/wc.html
3. www.americanmachinist.com
4. www6.conestogac.on.ca/~ffulkerson/J&F%20Notes.pdf

ME 224	APPLIED THERMODYNAMICS	L	T	P	C	Int	Ext
		2	1	-	3	40	60

Semester IV [Second Year]

COURSE OBJECTIVES:

1. To make the student understand what is a pure substance what are its properties and know the working of different high pressure boilers, mountings and accessories & steam power plant and methods of improving efficiency of plant
2. To know the working of various nozzles and calculate the exit velocity and areas of nozzle and the working principles of steam turbine both impulse and reaction.
3. To make the student under the basic principles of refrigeration and air conditioning systems and to understand the various Psychrometric processes and summer air conditioning system
4. To know the working principles of gas turbines and methods of improving the performance of gas power plant.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. The student will be able to have clear idea about the properties of steam, the use of steam tables, use of Mollier chart and evaluate steam properties and able to understand the working of boilers, mountings and accessories. Able to understand the Ranking cycle, Reheat and Regeneration cycles applic
2. Able to understand the working of steam nozzles &Able to understand the working principles of impulse and reaction steam turbines and evaluate their efficiencies.
3. Able to evaluate thermal efficiency of simple gas turbine, gas turbine with Intercooling, reheating and regeneration.
4. Able to grasp thorough knowledge of refrigeration and Air Conditioning .principles and systems& Able to understand about Psychrometric properties, processes and Psychrometric chart and Summer air Conditioning system working.

UNIT I [CO:1] **(12)**

Pure Substance: Definition, process of steam generation, P-v, T-s and h-s diagrams, properties of Wet, Dry Saturated and Superheated steam, Use of Steam Tables, Mollier chart.Steam Boilers: Function, classification, working of Benson &La Mont boilers, Mountings & Accessories (Functionality only).

UNIT II [CO:2] **(12)**

Vapor Power Cycles: Simple steam power cycle, Rankine cycle analysis –Representation on T-s and h-s diagrams, Actual power cycle – processes, Comparison of Rankine and Carnot cycle, Effect of pressure and temperature on the Rankine cycle performance. Methods of Improving Performance: Mean temperature of heat addition, Reheat cycle, Ideal regenerative cycle, Regenerative cycle – Analysis.

UNIT III [CO:3] **(12)**

Steam Nozzles: Types of nozzles, isentropic flow through nozzles, Effect of friction, Nozzle efficiency, Critical pressure ratio and maximum discharge, calculation of throat and exit areas using Mollier diagram. Steam Turbines: Impulse Turbines: Types of steam turbines, Impulse turbines, pressure and velocity compounding, velocity diagrams, work output, power, blade efficiency and stage efficiency. Reaction turbines: Working of reaction turbine, velocity diagrams, degree of reaction, work output, power, blade efficiency and stage efficiency, Governing of turbines, Overall efficiency and reheat factor.

UNIT IV [CO:4] **(12)**

Gas Turbines: Classification- Brayton cycles- Effect of reheat, regeneration and Intercooling concepts for improving the performance.Refrigeration: Need for Refrigeration, Definitions, Methods of refrigeration, Working of Refrigerator and Heat pump, Bell-Coleman cycle, Refrigerating effect, COP, Vapour compression refrigeration system-Dry and Wet compressions. Psychrometry and Air

conditioning: Introduction, Psychrometric properties, Psychrometric chart, Psychrometric processes-Summer air conditioning systems.

LEARNING RESOURCES:

TEXT BOOK(s):

1. Thermodynamics An Engineering Approach Y. A. Cengel & M. A. Boles, TMH, 6th Edition, New Delhi,2010.
2. Thermal Engineering- M.M. Rathore, TMH, New Delhi,2010

REFERENCE BOOK(s):

1. Treatise on Heat Engineering-V.P.Vasandani and D.S.Kumar, Metropolitan Book co, New Delhi, 4th Edition
2. Thermal Engineering ---Rajput, LaxmiPubl, New Delhi , 2012
3. Refrigeration and Air Conditioning- R. S. Khurmi and Gupta

WEB RESOURCES:

1. http://www.iscid.org/encyclopedia/Tthermodynamics
2. http://www.transtutors.com/

ME 225 **MATERIAL SCIENCE AND METALLURGY** **L T P C Int Ext**
3 - - 3 40 60

Semester IV [Second Year]

COURSE OBJECTIVES:

COURSE OBJECTIVES:

1. To Understand of the correlation between the internal structure of materials, their mechanical properties and various methods to quantify their mechanical integrity and failure criteria.
2. To provide a detailed interpretation of equilibrium phase diagrams
3. To Learn about heat treatment methods to tailor the properties of Fe-C alloys.
4. To Introduce various materials related to properties and applications

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Gain the knowledge about various crystal structures and their importance in Mechanical Properties and Testing
2. Differentiate various phase diagrams in a binary systems.
3. Recognize the purpose of heat treatment and various heat treatment processes.
4. Familiar with various materials in terms of its properties and applications.

UNIT I *Text Book - 1,2* [CO:1] **(12)**

Crystal structure Unit cells, Crystal structures, Atomic Packing Factors, Coordination Numbers , Imperfection in solids: Point, line, interficial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.Testing and evaluation of properties Mechanical Properties of materials. Tensile Testing, Compression Testing , Hardness Testing , Impact Testing and an introduction to Non Destructive Testing (NDT)

UNIT II *Text Book - 1,2* [CO:2] **(12)**

Constitution of Alloys and Phase diagramsNecessity of Alloying, Types of Solid Solutions ,Gibbs Phase Rule , Hume-Rothery's Rules, Lever rule, Phase Diagrams - Isomorphous, Eutectic, Eutectoid , Partial eutectic , peritectic and Monotectic systemsIron –carbon system Iron transformations in the solid state – allotropy and Iron-Iron Carbide Phase Diagram and related phases,

UNIT III *Text Book - 1,2* [CO:3] **(12)**

Heat Treatment of Steels: TTT diagrams for eutectoid, hypo and hyper eutectoid steels, martensite and bainitic transformation. Heat Treatment methods: Introduction and purpose of heat treatment, Annealing, Normalizing, Hardening, Tempering, Austempering , Martempering, Age hardening and Surface Hardening of Steels.

UNIT IV *Text Book - 1,2* [CO:4] **(12)**

Materials and PropertiesClassification of materials and their usage in various fields Ferrous Alloys : Types , Properties, applications of Steels & Cast irons. Non-ferrous alloys: Properties and applications of Copper, Aluminium and its alloys. Ceramic materials : Classification of Ceramics , Properties and applications of glasses, cermets, abrasive materials Plastics: Types , Properties, applications of Plastics , Blow and Injection MouldingComposite Materials : Classification of Composite Materials , Properties, applications of composites

LEARNING RESOURCES:

TEXT BOOK(s):

1. Material Science and Metallurgy - Dr.V.D.Kodgire, Everest Publishers , 2008.

2. Introduction to Physical Metallurgy - Avner, McGrawHill , 2nd Edition ,1997
3. Material Science and Metallurgy - V. Raghavan, Pearson Education / PHI, 5th Edition , 2004.

REFERENCE BOOK(s):

1. Material Science and Metallurgy - R.B.Choudary - Khanna Pub , 1st Edition.
2. A Text Book of Material Science and Metallurgy , O.P. Khanna , Dhanapat Rai Publiacations, 2012.

WEB RESOURCES:

1. http://nptel.ac.in/courses/113106032/
2. http://freevideolectures.com/Subject/Metallurgy-and-Material-Science
3. https://www.freedu.in/courses/sub/47/

ME 226	OPEN ELECTIVE-I	L	T	P	C	Int	Ext
		3	-	-	3	40	60

Semester IV [Second Year]

Open Elective Courses

Code No.	Subject Name	Code No.	Subject Name
CEOL01	Building Materials and Construction	CEOL02	Solid waste Management
CEOL03	Remote Sensing and GIS	CHOL01	Energy Engineering
CHOL02	Biofuels	CHOL03	Environmental Engineering
CHOL04	Nanoscience and Nanotechnology	CSOL01	Programming with Java
CSOL02	Relational Database Management Systems	CSOL03	Introduction to Python Programming
CSOL04	Internet of Things	ECOL01	Applied Electronics
ECOL02	Basic Communication	ECOL03	Basic Electronics & Communication Engineering
ECOL04	Microprocessors & Interfacing	ECOL05	Digital Image Processing
EEOL01	Renewable Energy Sources	EEOL02	Utilization of Electrical Energy
EEOL03	Power Converters	EEOL04	Energy Conservation
EEOL05	Electric Vehicles	ITOL01	Data Structures & Algorithms
ITOL02	Operating Systems	ITOL03	Big Data Analytics
ITOL04	Web Technologies		

ME 261	FLUID MECHANICS & STRENGTH OF MATERIALS LAB	L	T	P	C	Int	Ext
		-	-	2	1	40	60

Semester IV [Second Year]

COURSE OBJECTIVES:

1. Apply fundamental principles of fluid mechanics for the solution of practical Mechanical engineering problems of water conveyance in pipes, pipe networks, and open channels.
2. Describe the operating characteristics of hydraulic machinery (pumps and turbines), and the factors affecting their operation and specifications, as well as their operation in a system.
3. Understanding the basic strength of materials principles by conducting experiments
4. Learn to analyze and synthesize test results, write individual and group reports incorporating experimental data, graphs, assessment of results, and conclusions 3. To give more understand in basic of structural field

COURSE OUTCOMES:

After the successful completion of the course,students are able to

1. Apply fundamental knowledge of fluid mechanics in solving problems and making design of pressure-pipe in mechanical engineering
2. Understand the basics of hydraulic machinery and their operation design in water systems.
3. Conduct experiments in flow measurement, hydraulic machinery and interpreting data from experiments, as well as documenting them in engineering reports
4. Ability to design and conduct experiments, acquire data, analyze and interpret data
5. Physical insight into the behavior materials and structural elements, including distribution of stresses and strains, deformations and failure modes

EXPERIMENTS:

1. Orifice - Determination of coefficient of discharge
2. Venturi meter - Determination of coefficient of discharge
3. Pipe friction - Determination of friction factor and size of roughness of a given pipe
4. Single - stage centrifugal pump - To draw the operating characteristics of the pump and to determine the designed discharge and designed head from it.
5. Single - acting reciprocating pump - To draw the operating characteristic curves at constant speed and determination of efficiency.
6. Gear pump - To draw the operating characteristic curves and determination of overall efficiency of a pump
7. Pelton turbine - To draw the performance characteristic curves and determination of overall efficiency
8. Francis turbine - To draw the performance characteristic curves and determination of overall efficiency.
9. Kaplan turbine - To draw the performance characteristic curves and determination of overall efficiency
10. (a) Rockwell Hardness test - Determination of Hardness Number for different metal specimens such as mildsteel, cast iron, Brass, Aluminum .
    (b) Brinnell's Hardness Test - Determination of Hardness Number for different metal specimens such as mildsteel, cast iron, Brass, Aluminum
11. Impact Test - (a) Charpy and (b) Izod: Determination of impact strength of mild steel and cast iron specimens
12. Tension Test on UTM - Determination of mechanical properties of mild steel and cast iron specimens
13. Tests on helical spring - Determination of stiffness of helical springs
14. To find the modulus of rigidity by conducting torsion test on solid circular shaft

Note:**

ME 262	MANUFACTURING LAB - 1	L	T	P	C	Int	Ext
		-	-	2	1	40	60

Semester IV [Second Year]

COURSE OBJECTIVES:

Course Objectives

1. To provide an understanding of advanced manufacturing methods
2. To get an idea of the dimensional & form accuracy of products

COURSE OUTCOMES:

Course outcomes: After the successful completion of the course,students are able to

1. Gain knowledge of various machine tools and its operations.
2. Familiarize with the selection of suitable production process for the desired component

EXPERIMENTS:

1. 1. Taper turning and external thread cutting using lathe
2. 2. Internal Taper turning and internal thread cutting using lathe
3. 3. Contour milling using vertical milling machine
4. 4. Spur gear cutting in milling machine
5. 5. Measurement of cutting forces in Milling/ Turning process
6. 6. Drilling of a small hole using wire EDM
7. 7. Grinding single point cutting tool on Tool and Cutter Grinder
8. 8. Machining Key way on Shaping Machine
9. 9. Machining a spline on Slotting Machine

Note:**

ME 263	MODELLING LAB	L	T	P	C	Int	Ext
		-	-	2	1	40	60

Semester IV [Second Year]

COURSE OBJECTIVES:

1. To provide the students with the knowledge and techniques of the research and application of CAD/CAM.
2. To create 3D part geometry using the design module of the modeling
3. To develop the skills in CAD operations to visualize and create three dimensional part models of mechanical components and assemblies.
4. Student will be able to produce CAD drawings which communicate the appropriate manufacturing details, standards, and specifications.

COURSE OUTCOMES:

After the successful completion of the course,students are able to

1. The students will be able to model the given 2D and 3D components, Assemblies etc
2. Has ability to layout an efficient production area and industrial facility using Computer-Aided Design (CAD) software.
3. Has ability to plan the process and utilization of equipment

EXPERIMENTS:

1. Sketcher: Creation of sketch profile with constraints, Transformations, Project 3DElements, Sketch Analysis, Practice of different sketches
2. Part Modeling: Creating Sketch Based features, Creating Dress-up based features, Draft & Draft Analysis
3. Assembly Modeling: Assembly Constraints, Engineering Connections, Insert new product or part , BI Essentials, Interference Analysis
4. Generative Shape Design: Creation of 3DElements, Creation of offset, Creation technique of Multi section, Sweep and Blend. Split and Trim operations, Join, Extract.
5. Process Planning: Creating Systems & operations, Apply flow between Operations. Plant Equipment allocation: Creating Manufacturing Cells and Stations, Insert storage Transpiration and industrial resources

Note:**

3D modeling using any of the modeling packages like 3D Experience/CATIA, Pro/ ENGINEER, Uni- Graphics, Solid Works, Ideas, Auto Desk Inventor etc.

Parts and Assemblies can be chosen from Textbook

LEARNING RESOURCES:

TEXT BOOK:

"Machine Drawing" by K. L. Narayana, P. Kannaiah, K. Venkata Reddy , New Age International , 2007.

ME 311	DESIGN OF MACHINE ELEMENTS	L	T	P	C	Int	Ext
		2	1	-	3	40	60

Semester V [Third Year]

COURSE OBJECTIVES:

COURSE OBJECTIVES

1. To teach students how to apply the concepts of stress analysis, theories of failure and material science to analyze.
2. To illustrate to students the variety of mechanical components available and emphasize the need to continue learning.
3. To teach students how to apply mechanical engineering design theory to identify and quantify machine elements in the design of commonly used mechanical systems.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. demonstrate the ability to apply the fundamentals of stress analysis, theories of failure and material science in the design of machine components.
2. Analyze and Design of power screws and threaded joints.
3. Design and Analyze of breaks and clutches.
4. Design and analyze springs and permanent joints such as Riveted joints and Welded joints under loading conditions.

UNIT I [CO:1] **(12)**

Basics: Introduction, basic procedure of machine design.Design for Static Strength: Simple Stresses, Combined stresses, torsion and bending stresses, various theories of failure, Factor of safety and its importance in design, stress concentration factors, reduction of stress concentration.Design for Fatigue Strength: Fluctuating stresses, fatigue failure, endurance limit, low cycle and high cycle fatigue, notch sensitivity, endurance approximate estimation, reversed stresses design for infinite life, cumulative damage in fatigue, Soderberg and Goodman lines, modified Goodman diagrams, Gerber equation, fatigue design under combined stresses.

UNIT II [CO:2] **(12)**

Power Screws: Types- Mechanics of power screws, efficiency, Design of Screw Jack.Threaded Joints: Basic types, bolt of uniform strength, materials and manufacture, eccentrically loaded bolted joints in shear, eccentric load perpendicular to axis of bolt, eccentric load on circular base.

UNIT III [CO:3] **(12)**

Riveted and Welded joints: Boiler Joints & Lozenge Joint, Design of joints under eccentric loading and eccentrically loaded welded joints.SPRINGS: Introduction, Materials, Types of springs, Design of helical springs under axial load and fatigue loading.

UNIT IV [CO:4] **(12)**

Shafts: Design of solid and hollow shafts for strength - For Bending, Torsion, Combined bending and torsion and combined bending, torsion and axial loads.Bearings: Types of Bearings, Bearing materials, Journal bearing design (using Mckee's equation and Raymond and Boyd charts & tables) Ball and Roller Bearings: Static load, Dynamic load, Equivalent radial load, selection of ball and roller bearings.

LEARNING RESOURCES:

TEXT BOOK(s):

1. Design of Machine Elements by V.B. Bhandari, Tata McGraw Hill, 3rd Edition, 2017.

2. Machine Design by P.C. Sharma & D.K. Agarwal., S.K. Kataria & Sons , 2003.
3. Design of Machine Elements by C.S. Sharma & K. Purohit ,PHI Ltd,2005
4. Machine Design by R.S. Khurmi & J.K. Guptha , S. Chand , 2012

REFERENCE BOOK(s):

1. Shigley, J.E. and Mischke, C.R., Mechanical Engineering Design, Fifth Edition, McGraw-Hill International; 1989.
2. Deutschman, D., Michels, W.J. and Wilson, C.E., Machine Design Theory and Practice, Macmillan, 1992
3. Juvinal, R.C., Fundamentals of Machine Component Design, John Wiley, 1994.
4. Spottes, M.F., Design of Machine elements, Prentice-Hall India, 1994.
5. R. L. Norton, Mechanical Design – An Integrated Approach, Prentice Hall, 1998

WEB RESOURCES:

1. https://nptel.ac.in/courses/112106137/pdf/1_1.pdf
2. https://www.thomasnet.com/articles/hardware/coupling-types
3. http://www.springhouston.com/spring-information/
4. https://nptel.ac.in/courses/112105125/18

ME 312	ADVANCED STRENGTH OF MATERIALS	L	T	P	C	Int	Ext
		2	1	-	3	40	60

Semester V [Third Year]

COURSE OBJECTIVES:

1. Introduce state of stress and strain at a point and its representation in three dimensional Cartesian coordinates. Vector representation of displacement at a point and calculation of displacements, stresses and strains at a point
2. Determine principal stresses and directional cosines in three dimensions using Cauchy's stress equilibrium equations.
3. Analyze indeterminate beams using Macaulay's method, Clapeyron's three moment method and to estimate stresses in various axially and eccentrically loaded columns following Rankine, Euler and secant approaches
4. Determine contact stresses in cylinders and spheres in contact with flat surfaces, cylinders and spheres using Hertz theory.
5. Induce concept of stress concentration, its significance and to determine stress intensity factors and fracture toughness for plates subjected to in plane loads.
6. Estimate shear Centre for various beam sections, calculate stresses induced in rotating members like rings and discs.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Calculate stresses, strains and displacements at a point using Cartesian three dimensional stress, strain relations and displacement vectors.Determine principal stresses and directional cosines for a three dimensional state of stress expressed in Cartesian coordinates.
2. Analyze indeterminate beams and columns using theories like Macaulay's method, Clapeyron's three moment method, Euler method, Rankine method. Etc.
3. Determine contact stresses induced in cylinders and spheres using Hertz theory.Understand, analyze members subjected to stress concentrations and estimate stress intensity factors.
4. Estimate shear centre for various beam sections like T, I, rectangular…etc.Calculate stresses induced in rotating rings and discs.

UNIT I [CO:1] **(12)**

Introduction: Body force, surface force, stress vector, state of stress at a point. State of stress at a point in Cartesian coordinates. State of strain at point. Deformations in the neighborhood of a point. Derivation of Cauchy's equilibrium relations, principal stresses and directions of principal planes in three dimensions.

UNIT II [CO:2] **(12)**

Analysis of Indeterminate beams: Introduction and analysis of fixed-fixed beams by Macaulay's method. Analysis of continuous beams by Clapeyron's three moment method. Analysis of columns: Introduction and analysis of axially loaded columns by Euler and Rankine relations, analysis of eccentrically loaded columns by secant formula

UNIT III [CO:3] **(12)**

Contact stresses: Hertz contact stresses: - Determination of maximum contact pressure and stresses when two spheres are in contact, two cylinders are in contact, cylinder in contact with flat surface and sphere in contact with flat surface.Stress concentration: Introduction, factors affecting stress concentration, theoretical stress concentration factor, determination of stress concentration or stress intensity factors, critical stress intensity factor or fracture toughness for plates subjected to in plane axial and transverse loads.

UNIT IV [CO:4] **(12)**

Shear Centre: Bending Axis and Shear Centre, Position of Shear Centre, Shear flow, Shear Centre of Channel section, Angle section, T- section and I- section. Rotating rings and discs: Stresses in thin rotating rings and thick discs

LEARNING RESOURCES:

TEXT BOOK(s):

1. Advanced mechanics of solids, L.S. Srinath, Tata-Mc-Graw hill publishers
2. Mechanics of Materials, James M. Gere and Barry J. Goodner, Published by Cengage Learning, 8th edition.
3. Strength of materials by Sadhu Singh, KhannaPublishers, 11th Edition

REFERENCE BOOK(s):

1. Engineering Mechanics of Solids by E.P.Popov, PHI, 2nd Edition
2. Strength of Materials by S. Ramamrutham, DhanpatRai Publishing Company (P)Ltd, 18th Edition.
3. Introduction to Solid Mechanics by I.H. Shames, PHI, 3rd Edition.
4. Strength of Materials by R.K.Bansal, LaxmiPublications, 6th Edition.

WEB RESOURCES:

1. http://nptel.iitm.ac.in/
2. www.learnerstv.com/Free-Engineering-video-lecture-courses.htm
3. http://en.wikibooks.org/wiki/Strength_of_Materials

ME 313	MACHINE DYNAMICS AND VIBRATIONS	L	T	P	C	Int	Ext
		3	-	-	3	40	60

Semester V [Third Year]

COURSE OBJECTIVES:

1. Students will be able to understand basic concepts of forces involved in mechanism and estimate the inertia forces and torques. To learn about the various types of governors and estimate the equilibrium speeds
2. The student is able to learn about the balancing of rotating masses located in the same and different planes.To learn about the gyroscopic effects on rotating shaft, ships and stability of two wheelers when negotiating curved path
3. The student is able to learn undamped and damped free and forced vibrations and how to determine the natural frequency of the single degree of freedom system
4. The student is able to learn about the two degrees of freedom systems and how to draw the mode shapes of the system

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Estimation of Inertia forces in a crank-slider mechanism
2. State of balance of typical multi-cylinder engines, Unbalance in rotating machinery
3. Sources, effects, types of vibration and elimination.
4. Principal modes of vibration and mode shapes.

UNIT I [CO:1] **(12)**

Dynamic Force Analysis : Introduction, D'Alembert's Principle, Equivalent Offset Inertia Force, Dynamic Analysis of Slider - Crank mechanism (Using Analytical method) Velocity and Acceleration of piston, Angular velocity and Angular Acceleration of Connecting Rod, Piston Effort (Effective Driving Force), Crank Effort. Turning Moment on Crankshaft,Inertia of connecting Rod.Governors:Introduction, Types of Governors, Watt Governor, Porter Governor, Hartnell Governor, Sensitiveness of a Governor, Hunting, Isochronism, Stability, Controlling force, Power of a Governor

UNIT II [CO:2] **(12)**

Balancing :Introduction, Static balancing, Dynamic balancing, Transferring of a Force from one plane to another, Balancing of Several Masses in Different planes, Primary & Secondary Balancing of Reciprocating Mass , Balancing of In line Engines and V Engines Gyroscopes :Angular Velocity, Angular Acceleration, Gyroscopic Torque, Gyroscopic Effect on Naval Ships, Stability of a two wheel vehicle.

UNIT III [CO:3] **(12)**

Fundamentals of Vibration:Introduction, Definitions, Vector method of representing Harmonic Motions, Addition of two simple Harmonic motion of the same frequencyUndamped Free Vibrations of Single Degree of Freedom SystemsIntroduction, Derivations of differential equations, solution of differential equation, Torsional vibrations, Equivalent stiffness of spring combinations, Energy method. Damped Free Vibrations of Single Degree of Freedom SystemsIntroduction, Different types of damping, Free vibrations with viscous damping, Logarithmic Decrement, Viscous dampers, Coulomb damping,

UNIT IV [CO:4] **(12)**

Forced Vibrations of Single Degree of Freedom Systems:Introduction, Forced vibrations with constant Harmonic excitation, Forced vibration with rotating and reciprocating unbalance, forced vibrations due to excitation of the support, Critical speed of a light shaft having a single disc without damping, critical speed of a light shaft having a single disc with damping, Vibration, isolation and transmissibility, vibration measuring instruments. Two Degrees of Freedom Systems:Introduction, Principal modes of vibration, undamped dynamic vibration absorber.

LEARNING RESOURCES:

TEXT BOOK(s):

1. Theory of Machines by S.S. Rattan , TMH , 3rd Edition , 2009.
2. Mechanical Vibrations - G.K.Groover , Nem Chand Bros , 7th Edition , 2003.
3. Mechanical Vibrations - Rao V.Dukkipati, J.Srinivas, PHI , 2004.

REFERENCE BOOK(s):

1. Theory of Machines by T. Bevan , Cbs Publishers , 2004.
2. Theory of Mechanisms and Machines by A. Ghosh and A.K. Mallik, Affiliated East-West Press (P) Ltd., New Delhi , 3rd Edition ,Re Print 2000
3. Mechanical Vibration - S.S.Rao , Addison & Wesley , 1995.

WEB RESOURCES:

1. Machine Dynamics by Prof. Amitabha Ghosh, IITK, Kanpur , http://nptel.iitm.ac.in/video.php?subjectId=112104114
2. Machine Dynamics by Prof. C. Amarnath, Prof. K. Kurien Issac, Prof. P.Seshu of IITB, Mumbai http://www.cdeep.iitb.ac.in/nptel/Mechanical/Dynamics%20of%20Machines/TOC.html

ME 314	OPERATIONS RESEARCH	L	T	P	C	Int	Ext
		2	1	-	3	40	60

Semester V [Third Year]

COURSE OBJECTIVES:

1. Grasp the methodology of OR problem solving and formulate linear programming problem.
2. Develop formulation skills in transportation models and assignment problems and finding solutions
3. Understand the basics in the field of dynamic programming and theory of games
4. Basic understanding of inventory and simulation

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Recognize the importance and value of Operations Research. Formulate a given simplified description of a suitable real-world problem as a linear programming model and use the simplex method to solve small linear programming models.
2. Solve & interpret transportation models' and assignment problems.
3. formulate and solve basic game theory and dynamic programming problems.
4. Gain knowledge in fundamental concepts in inventory and simulation

UNIT I [CO:1] **(12)**

Linear Programming : Definition and Scope of Operations Research, Mathematical formulation of the problem, graphical method, Simplex method, artificial basis technique, duality, dual Simplex method. Degeneracy, alternative optima, unbounded solution, infeasible solution.

UNIT II [CO:2] **(12)**

Transportation Problem: Introduction to the problem, LP formulation of a transportation problem. Basic feasible solution by north-west corner method, Vogel's approximation method, least cost method. Finding optimal solution by MODI method, degeneracy, unbalanced transportation matrix and Maximization in transportation model. Assignment Problem: One-to-one assignment problem, optimal solution, unbalanced assignment matrix. Traveling salesman problem. Maximization in assignment problem.

UNIT III [CO:3] **(12)**

Theory of games: Introduction, Rectangular two person zero person games, solution of rectangular games in terms of mixed strategies, solution of 2x2 games without saddle points, concept of dominance to reduce the given matrix, graphical method for 2xn and nx2 games.Dynamic programming: Introduction, Characteristics of D.P. model, the recursive equation approach, solution of an L.P. by D.P.

UNIT IV [CO:4] **(12)**

Inventory: Introduction, Basic EOQ, Deterministic continuous review models, Economic production quantity model, Basic EOQ model with shortages, Quantity discounts, Re-order point, buffer stock, reserve stock and safety stockSimulation: Introduction, definition and applications. Monte Carlo simulation. Application problems in queuing and inventory.

LEARNING RESOURCES:

TEXT BOOK(s):

1. Introduction to Operations Research - Phillips, Ravindran, James Soldberg Wiley 1976.
2. Operations Research - H.A. Taha , Pearson , 7th Edition, June 2002.

3. Operations Research - Gupta and Hira , S. Chand , 2008.

ME 315 **PROFESSIONAL ELECTIVE-I**

L	T	P	C	Int	Ext
3	-	-	3	40	60

Semester V [Third Year]

Professional Elective Courses

Code No.	Subject Name	Code No.	Subject Name
MEEL01	Computer Aided Design	MEEL02	Mechatronic System Design
MEEL03	Fluidics and control systems	MEEL04	Industrial Robotics
MEEL05	I C Engines	MEEL06	Gas Dynamics and JET Propulsion
MEEL07	Refrigeration and Air Conditioning	MEEL08	Automobile Engineering
MEEL09	Power Plant Engineering	MEEL10	Energy Conservation and Management
MEEL11	Product Lifecycle Management	MEEL12	Principles of Industrial Management
MEEL13	Process Planning and Cost Estimation	MEEL14	Total Quality Management
MEEL15	Composite Materials	MEEL16	Design Of Experiments
MEEL17	Farm Machinery and Equipment	MEEL18	Computional Fluid Dynamics
MEEL19	Elements of Aerospace Engineering	MEEL20	Production Planning and Control

ME 316	HUMANITIES ELECTIVE-I	L	T	P	C	Int	Ext
		3	-	-	3	40	60

Semester V [Third Year]

Humanities Elective Courses

Code No.	Subject Name	Code No.	Subject Name
HSEL01	Industrial Management & Entrepreneurship	HSEL02	Economics for Engineers
HSEL03	Introduction to Industrial Management	HSEL04	Project Management & Entrepreneurship
HSEL05	Human Resources & Organisational Behaviour	HSEL06	Ethics & Human Values

ME 351	THERMAL ENGINEERING LABORATORY	L	T	P	C	Int	Ext
		1	-	2	2	40	60

Semester V [Third Year]

COURSE OBJECTIVES:

1. To understand the measurement of properties of oils like Viscosity and its variation with temperature
2. To understand the measurement of Flash, Fire points and Calorific value of given fuels
3. To estimate the performance of I.C. Engines by various tests
4. To estimate the performance of Reciprocating compressor and Rotary(Centrifugal) ompressor(Blower)

COURSE OUTCOMES:

After the successful completion of the course,students are able to

1. Able to measure the viscosity of given oils by different viscometers
2. Able to measure the flash, fire points and calorific value of given fuels
3. Able to calculate various performance parameters of I.C. Engine by conducting load test, heat balance test etc.,
4. Able to calculate Isothermal and Volumetric efficiencies of Reciprocating compressor & Overall efficiency of blower

EXPERIMENTS:

1. To determine the viscosity of given oil using Redwood Viscometer I
2. To determine the Flash and Fire points of given fuel using Cleaveland's apparatus
3. To determine the lower calorific value of given Gaseous fuel(LPG)
4. To determine the Flash point of given fuel using Able's and Pensky Martin's apparatus
5. To determine isothermal and volumetric efficiencies of a two stage reciprocating compressor
6. To determine the overall efficiency of the Blower test rig(Centrifugal compressor)
7. To draw VTD and PTD on the given engine models
8. To conduct load test on single cylinder diesel engine test rig using electrical dynamometer with bulb loading
9. To conduct Load and Morse test on multi cylinder petrol engine test rig using Hydraulic dynamometer
10. To conduct load and heat balance test on Twin cylinder diesel engine test rig.
11. To conduct a load and heat test on Variable compression ratio test rig on single cylinder diesel engine.
12. Calibrate the given pressure gauge.

Note:**

Tests on any Ten of the above are to be conducted

ME 352 PROFESSIONAL COMMUNICATION SKILLS LAB

L	T	P	C	Int	Ext
-	-	2	1	40	60

Semester V [Third Year]

COURSE OBJECTIVES:

1. Raise awareness of and to develop key employability skills.
2. Produce a resume that describes their education, skills, experiences and measurable achievements with proper grammar, format and brevity and demonstrate an ability to target the resume to the presenting purpose.
3. Develop confidence in relationship to their interviewing skills.
4. Expose students to basic written texts, new vocabulary, and introduce the concepts of Extensive reading.
5. To demonstrate their team working abilities; and also that they can emerge as leaders while still maintaining the group objectives

COURSE OUTCOMES:

After the successful completion of the course,students are able to

1. Develop their skills, knowledge and understanding of key employability skills.
2. Students can produce a resume that describes their education, skills, experiences and measurable achievements with proper grammar, format and brevity and demonstrate an ability to target the resume to the presenting purpose.
3. Identify appropriate verbal and non-verbal communication skills/techniques for an interview including preparedness, professional attire.
4. To develop extensive reading skill and comprehension for pleasure and profit.
5. Understand the key skills and behaviours required to facilitate a group discussion

EXPERIMENTS:

1. Career Planning and Goal Setting

   • Employability Skills – Pre Requisites for Employment
   • Self-Grooming
   • Goal Setting
   • SWOT Analysis
2. Resume Workshop

   • Effective Resume Writing: Structure and Presentation - Planning and Defining the Career Objective -Strengths and Skills set - Format - Cover Letter.
   • Email -Etiquette
   • Free Writing
3. Interview Skills
   • Facing Interviews: Interview Process - Understanding Employer Expectations - Pre-Interview Planning
   • Opening Strategies - Answering Strategies
   • Frequently Asked Questions (FAQs)
4. Extensive Reading

   • Wings of Fire -Abdul Kalam
   • “How I Taught my Grandmother” (or)“Wise and Otherwise” by Mrs.Sudha Murthy
   • The Monk Who Sold His Ferrari - Robin Sharma
5. Group Discussion (GD Lab)

   • Do s and Don’ts in GD
   • Types of GDs
   • How to face GD
   • Practice Sessions

Note:**

LEARNING RESOURCES:

TEXT BOOK(s):

1. Business Communication, II Ed, OUP, by Meenakshi Raman & Prakash Singh, 2012.
2. Technical Communication - Principles and Practice, II Ed, OUP by Meenakshi Raman & Sangeetha Sharma, 2015.

REFERENCE BOOK(s):

1. Strategies for Engineering Communication – Susan Stevenson and Steve Whitmore, 2002
2. Group Discussion: Theory& Technique – Harnack, Fest and Jones

WEB RESOURCES:

1. www.esl-lab.com
2. www.eslgold.com

ME 321	DESIGN OF TRANSMISSION ELEMENTS	L	T	P	C	Int	Ext
		2	1	-	3	40	60

Semester VI [Third Year]

COURSE OBJECTIVES:

1. Flexible drives like Flat & V- belts and chain drives, types, construction and selection
2. Gears like Spur, Helical, Bevel and Worm etc. materials used, force analysis, design and Gear Forces
3. Understand the theory and its limitations and to design the machine element to perform a specified duty
4. Apply the systematic engineering design process including, problem definition, information collection, concept generation & selection, and design configuration to design of mechanical systems and elements.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Know how to select and design proper belt or chain drive for the application
2. Knows about various Gears, their profiles and materials, types of failures, and is capable to design and specify the Spur, helix, Bevel and Worm Gears
3. Design or select from standard tables and catalogues machine elements, components and materials given appropriate performance requirements.
4. To master the fundamental processes of design and manufacturing and to gain an in-depth understanding of analytical and experimental methods of determination of stresses and strength of machine elements under various loading conditions

UNIT I [CO:1] **(12)**

Design of Belt and Chain DrivesBelt Drives : Flat and V-belts, Belt constructions, Geometrical relationships, Analysis of belt tensions, condition for maximum power, Selection of V-belts - Selection of Pulleys. Chain Drives: Introduction, Chain drives, Advantages of chain drives over belt drives, Polygonal effect, Selection of roller chains.

UNIT II [CO:2] **(12)**

Design of GearsSpur Gears : Classification of gears, Terminology of spur gear, standard systems of Gear Tooth, Force analysis, Gear tooth failures, Selection of material, Beam Strength of gear teeth, lubrication, Lewis EquationHelical Gears: Terminology of helical gears, virtual number of teeth, Tooth proportions, force analysis, Beam Strength of helical gears, effective load on gear tooth, wear strength of helical gears. Lewis Equation. Bevel Gears: Terminology, force analysis, Beam Strength of bevel gears, wear strength. Lewis Equation, Effective load on gear tooth Worm Gears: Terminology, Force analysis, Strength rating of worm gears, Wear rating of worm gears, Thermal Considerations.

UNIT III [CO:3] **(12)**

Design of Brakes and Clutches:Brakes: Introduction to Brakes, Types, Analysis and design of block brakes, band brakes, block and band brakes; Internal shoe brakes, pivoted shoe brakes, Temperature rise, Friction materials.Clutches: Analysis and design of simple and multiple disc clutches, cone clutches and centrifugal clutches.

UNIT IV [CO:4] **(12)**

Flywheel: Introduction, construction, Torque analysis, solid flywheel, Rimmed flywheel, stresses in rimmed flywheel by Timoshenko expressions.Pistion and Connecting rod: Introduction, Design of trunk type piston and connecting rod.Reliability and life expectances: Introduction, Method of achieving

reliability, Series, Parallel and series and parallel reliability, Analysis System design: Introduction, Human aspects of design, Standardization, Practical tips for problems encountered in design with examples.

LEARNING RESOURCES:

TEXT BOOK(s):

1. Design of Machine Elements by V.B. Bhandari, Tata McGraw Hill, 3rd Edition, 2017
2. Machine Design by P.C. Sharma & D.K. Agarwal., S.K. Kataria & Sons , 2003.
3. Design of Machine Elements by C.S. Sharma & K. Purohit ,PHI Ltd,2005.
4. Machine Design by R.S. Khurmi & J.K. Guptha , S. Chand , 2012.

REFERENCE BOOK(s):

1. Shigley J., Mischke C., Budynas R. and Nisbett K., Mechanical Engineering Design, 8th ed., Tata McGraw Hill, 2010.
2. Jindal U.C., Machine Design: Design of Transmission System, Dorling Kindersley, 2010.
3. Maitra G. and Prasad L., Handbook of Mechanical Design, 2nd ed., Tata McGraw Hill, 2001.

WEB RESOURCES:

1. https://www.machinedesign.com/basics-design/flat-belts
2. http://qtcgears.com/spotlight/plasticgears.php
3. https://www.machinedesign.com/news/selecting-and-applying-clutches-and-brakes
4. https://www.machinedesign.com/basics-design/internal-combustion-engines

ME 322	FINITE ELEMENT METHOD	L	T	P	C	Int	Ext
		2	1	-	3	40	60

Semester VI [Third Year]

COURSE OBJECTIVES:

1. To furnish information on advanced strength of materials and to introduce the basic concepts, background and methodology of FEM
2. To select suitable elements for Finite element modeling, deriving the necessaryelemental matrices and for applying the principles to various mechanicalsystems
3. To learn the application of FEM to various structural problems Incorporatingtemperature and boundary conditions.
4. To derive the element mass matrices which help to predict dynamic behavior of the structure.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Create new solutions for the existing problems using FEA approaches and apply FEA to projects
2. Derive element stiffness and mass matrix equations for various structural systems.
3. To know the usage of different elements for different structures.
4. Determine engineering design quantities (deformation, force, strain, stress) for bar, truss, beam and 2-D structures and under different loading conditions.

UNIT I [CO:1] **(12)**

Introduction: Objectives and Methods of Engineering Analysis,FDM VsFEM, Rayleigh – Ritz Method, Weighted Residual Methods. FEM Advantages, Disadvantages, FEM Applications, FEM ProcedureOne Dimensional Elements: Finite Element Modeling, coordinates and shape functions, Potential Energy approach - Assembly of Global stiffness matrix and load vector. Finite element equations, Treatment of boundary conditions, Temperature Effects, Problems related to simple Axially loaded members.

UNIT II [CO:2] **(12)**

Analysis of Trusses: Element stiffness matrix, Stress Calculations, Problems limited to truss with three members only.Analysis of Beams: Derivation of Element stiffness matrix for two node, two degrees of freedom per node, Beam element and Simple Problems.

UNIT III [CO:3] **(12)**

Heat transfer problems: Formulation, and solution procedure, 1D – Straight uniform fin analysis, Tapered fin analysis.Two Dimensional Elements: Finite element modeling of two dimensional stress analysis with constant strain triangles (CST) and treatment of boundary conditions. Stiffness and Force Matrices for Two dimensional four noded Quadrilateral elements

UNIT IV [CO:4] **(12)**

Natural coordinate systems, isoparametric elements and shape functions, concepts of Iso parametric, super parametric and Sub parametric Elements, and numerical Integration by using Gaussian Quadrature. Dynamic Analysis: Formulation of finite element model, element matrices for one dimensional element, evaluation of Eigen values and Eigen vectors for a stepped bar by Characteristic Polynomial Technique.

LEARNING RESOURCES:

TEXT BOOK(s):

1. Introduction to Finite Elements in Engineering, Chandraputla, Ashok and Belegundu, PHI, 3rd edition, 2003.

2. The Finite Element Methods in Engineering, SS Rao, Pergamon, 5th Edition, 2011.

REFERENCE BOOK(s):

1. An Introduction to Finite Element Method, JN Reddy / Me Graw Hill, 2nd Edition, 1993.
2. Finite Element Analysis, G. Lakshmi Narasiah, BS Publications, 2008.

WEB RESOURCES:

Nptel.ac.in/courses/112104116
www.colorado.edu/MCEN/MCEN4173

ME 323	HEAT TRANSFER	L	T	P	C	Int	Ext
		2	1	-	3	40	60

Semester VI [Third Year]

COURSE OBJECTIVES:

Course Objectives

1. To enable the student to distinguish among the three modes.
2. To enable the student to prepare mathematical model of the problem with appropriate boundary conditions.
3. To enable the student to learn the basics of convective heat transfer.
4. To enable the student to design thermal equipment.
5. To enable the student to utilize analogies to solve heat transfer Problems.
6. To enable the students to estimate the radiation heat transfer between the bodies.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Analyze and design various methods of heat transfer for the bodies undergoing heat exchange using fundamental concepts of Conduction, Convection and Radiation.
2. Estimation of conduction heat transfer and Apply correlations to compute heat loss due to convection for practical applications.
3. Design heat transfer equipment to prevent failures of components due to poor heat dissipation.
4. Estimation of radiation heat transfer between bodies

UNIT I [CO:1] **(12)**

Introduction: Basic Modes and Laws of Heat transfer, thermal conductivity, Steady state Heat Conduction, General conduction equation in Cartesian and Cylindrical coordinates.One-Dimensional Steady State Heat Conduction: Heat flow through plane wall and cylinder withconstant thermal conductivity, Heat flow through composite slab and Cylinders, Thermalresistance, Electrical analogy, Thermal contact resistance, problems on variable thermalconductivity, critical insulation thickness, uniform heat generation in slabs.Extended Surfaces: Types, Applications, Fin materials, Heat transfer from fins with uniformcross section, Fin efficiency and Effectiveness.

UNIT II [CO:2] **(12)**

Transient Heat Conduction: (One dimensional only) - Lumped heat capacity systems.Forced Convection: Introduction, Principles of convection, Mass, Momentum and Energyequations for boundary layer, Hydrodynamic and thermal boundary layers and their thicknesses,concept of turbulence. Correlations for heat transfer in Laminar and Turbulent flows over a flat plate, and in pipes, relation between fluid friction and heat transfer in laminar & turbulent flows -Reynolds-Colburn

UNIT III [CO:3] **(12)**

Natural Convection: Approximate analysis for laminar film on a vertical plate, Correlations for vertical plates, horizontal plates, vertical and horizontal cylinders, inclined surfaces. Heat Exchangers: Classification, types of heat exchangers, Flow arrangement, Temperaturedistribution, Overall heat transfer coefficient, Fouling factor, LMTD and NTU methods of Heatexchanger analysis, correction for LMTD for use with multi pass and cross flow HeatExchangers, Effectiveness.

UNIT IV [CO:4] **(12)**

Radiation: Fundamentals of Radiation: Basic Concepts and definitions, Absorptivity,Reflectivity, Transmissivity, concept of Black body, Laws of Radiation, Kirchhoff's law,Planck's law, Wein's law, Stefan Boltzmann's law.Radiant Heat Transfer: Heat Exchange by radiation between two finite parallel surfaces,Electrical analogy, solid angle and Radiation intensity, radiant heat transfer between two finite

black and gray surfaces, shape factor, Radiation shields.

LEARNING RESOURCES:

TEXT BOOK(s):

1. Heat Transfer - Cengel and Boles, TMH, New Delhi , 2008.
2. Heat and Mass Transfer - Sachdeva, New Age India, New Delhi, 2009.
3. Heat Transfer-Rajput, Laxmi Publ, New Delhi,2011.

REFERENCE BOOK(s):

1. Heat transfer - J.P.Holman, MGH, New York , 6th Edition.
2. Heat transfer - S.P.Sukhatme, TMH ,2009.

ME 324 **PROFESSIONAL ELECTIVE-II**

L	T	P	C	Int	Ext
3	-	-	3	40	60

Semester VI [Third Year]

Professional Elective Courses

Code No.	Subject Name	Code No.	Subject Name
MEEL01	Computer Aided Design	MEEL02	Mechatronic System Design
MEEL03	Fluidics and control systems	MEEL04	Industrial Robotics
MEEL05	I C Engines	MEEL06	Gas Dynamics and JET Propulsion
MEEL07	Refrigeration and Air Conditioning	MEEL08	Automobile Engineering
MEEL09	Power Plant Engineering	MEEL10	Energy Conservation and Management
MEEL11	Product Lifecycle Management	MEEL12	Principles of Industrial Management
MEEL13	Process Planning and Cost Estimation	MEEL14	Total Quality Management
MEEL15	Composite Materials	MEEL16	Design Of Experiments
MEEL17	Farm Machinery and Equipment	MEEL18	Computional Fluid Dynamics
MEEL19	Elements of Aerospace Engineering	MEEL20	Production Planning and Control

ME 325 **HUMANITIES ELECTIVE-II**

L	T	P	C	Int	Ext
3	-	-	3	40	60

Semester VI [Third Year]

Humanities Elective Courses

Code No.	Subject Name	Code No.	Subject Name
HSEL01	Industrial Management & Entrepreneurship	HSEL02	Economics for Engineers
HSEL03	Introduction to Industrial Management	HSEL04	Project Management & Entrepreneurship
HSEL05	Human Resources & Organisational Behaviour	HSEL06	Ethics & Human Values

ME 326 **OPEN ELECTIVE-II**

L	T	P	C	Int	Ext
3	-	-	3	40	60

Semester VI [Third Year]

Open Elective Courses

Code No.	Subject Name	Code No.	Subject Name
CEOL01	Building Materials and Construction	CEOL02	Solid waste Management
CEOL03	Remote Sensing and GIS	CHOL01	Energy Engineering
CHOL02	Biofuels	CHOL03	Environmental Engineering
CHOL04	Nanoscience and Nanotechnology	CSOL01	Programming with Java
CSOL02	Relational Database Management Systems	CSOL03	Introduction to Python Programming
CSOL04	Internet of Things	ECOL01	Applied Electronics
ECOL02	Basic Communication	ECOL03	Basic Electronics & Communication Engineering
ECOL04	Microprocessors & Interfacing	ECOL05	Digital Image Processing
EEOL01	Renewable Energy Sources	EEOL02	Utilization of Electrical Energy
EEOL03	Power Converters	EEOL04	Energy Conservation
EEOL05	Electric Vehicles	ITOL01	Data Structures & Algorithms
ITOL02	Operating Systems	ITOL03	Big Data Analytics
ITOL04	Web Technologies		

ME 361	HEAT TRANSFER LABORATORY	L	T	P	C	Int	Ext
		-	-	2	1	40	60

Semester VI [Third Year]

COURSE OBJECTIVES:

COURSE OBJECTIVES

1. To understand the measurement of performance of refrigeration tutor and air conditioning tutor
2. To understand the estimation of heat transfer rate in conduction mode of heat transfer
3. To understand the effectiveness of heat transfer rate through heat exchanger in a different flow conditions
4. To understand the estimation of heat transfer rate in convection & radiation mode of heat transfer

COURSE OUTCOMES:

After the successful completion of the course,students are able to

1. Able to calculate the COP and Capacity of the refrigeration and air conditioning plant
2. Able to estimate the heat transfer rate in conduction mode of heat transfer in Pin Fin and Metallic bar
3. Able to estimate overall heat transfer coefficient & effectiveness of heat exchanger in parallel flow and counter flow conditions.
4. Able to estimate heat transfer rate in natural convection mode and also by radiation mode

EXPERIMENTS:

1. Refrigeration Test Rig.
2. Air-Conditioning Test Rig.
3. Heat Exchanger Parallel & Counter flows.
4. Emissivity apparatus.
5. Pin Fin-Natural convection and Forced convection
6. Natural convection on Vertical cylinder.
7. Stefan-Boltzman ‘s apparatus
8. Axial conduction on metal bar.
9. Lagged pipe apparatus.
10. Automobile chassis- steering and transmission system.
11. Composite slab

Note:**

Tests on any Ten of the above are to be conducted

ME 362	ANALYSIS & SIMULATION LAB	L	T	P	C	Int	Ext
		-	-	2	1	40	60

Semester VI [Third Year]

COURSE OBJECTIVES:

COURSE OBJECTIVES:

1. To acquire basic understanding of Simulation and Analysis software.
2. To understand the different kinds of analysis and apply the basic principles to find out the stress , temperatures and other related parameters under different loading conditions.
3. Techniques to model and to simulate various systems;
4. The ability to analyze a system and to make use of the information to improve the performance.

COURSE OUTCOMES:

After the successful completion of the course,students are able to

1. Understand the basics of ANSYS capabilities, terminology and the GUI.
2. Know how to perform a complete ANSYS analysis step-by-step.
3. Acquire the knowledge in building solid models & meshing, apply loads, solving & reviewing results
4. Simulate the operation of a system and make improvement according to the simulation results.

EXPERIMENTS:

1. STATIC ANALYSIS:
   Truss and Beam Structures
   a. 2-D truss
   b. Beam analysis
2. STATIC ANALYSIS:
   Two Dimensional Problems
   a. 2-D structures with different materials
   b. Plate with hole
3. DYNAMIC ANALYSIS:
   Modal and Transient Analyses
   a. Modal analysis of Solid Structure
   b. Transient Response (spring-mass system)
4. NON-STRUCTURAL PROBLEMS
   a. Steady State heat transfer
   b. Transient heat transfer
5. Introduction to MATLAB & Simulink
6. Position Analysis of Slider-Crank (R-RRT) Mechanism and determination of point on a link.
7. Simulation of spring mass damper System using MATLAB.
8. Frequency Response Analysis (Draw the Phase Margin and Gain Margin, Bode Plots) of given system using MATLAB.

Note:**

LEARNING RESOURCES:

REFERENCE BOOK:

Finite Element Simulations Using ANSYS By Esam M. Alawadhi, CRCPress, 2n edition, 2016.

WEB RESOURCES:

1. www.mece.ualberta.ca.
2. Ansys, " Multiphysics User's Manual"

ME 411	AUTOMATION IN MANUFACTURING	L	T	P	C	Int	Ext
		3	-	-	3	40	60

Semester VII [Fourth Year]

COURSE OBJECTIVES:

COURSE OBJECTIVES

1. To understand the importance of automation in the of field machine tool based manufacturing
2. To get the knowledge of various elements of manufacturing automation
3. To understand the basics of CAPP and FMS and the role of manufacturing automation
4. To educate students to understand different advances in manufacturing system like: GT, CAPP and FMS
5. To educate students by covering robotics and different material handling system required in manufacturing shop floor.
6. To educate students by covering different Integrated production management system.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. get a comprehensive picture of computer based automation of manufacturing operations. Able to understand the function of robots in industrial application
2. understand the working of NC,CNC and adaptive control machining
3. to write manual and computer assisted part programmes.
4. understand the concepts of GT , CAPP and FMS

UNIT I [CO:1] **(12)**

Automation : Automation in production systems – automated manufacturing systems, computerized manufacturing support systems, reasons for automating, merits and demerits, automation principles and strategies, manufacturing industries and products, manufacturing operations – processing and assembly operations, other factory operationsIndustrial Robotics : Introduction, robot anatomy, joints and links, common robot and configurations, joint drive systems, robot control systems, end effectors, sensors in robotics, applications of robots – material handling, processing, assembly and inspection

UNIT II [CO:2] **(12)**

Numerical Control : Introduction, basic components of an NC system, classifications of NC systems, nomenclature of NC machine axes, interpolation methods, features of CNC, the machine control unit for CNC, CNC software. direct numerical control, distributed numerical control, applications of NC, advantages and disadvantages of NC, adaptive control machining.

UNIT III [CO:3] **(12)**

NC Part Programming : NC coding systems, manual part programming, simple examples on drilling, milling and turning operations computer assisted part programming, part programming with APT language, simple examples in drilling and milling operations.

UNIT IV [CO:4] **(12)**

Group Technology & Cellular Manufacturing : Introduction, part families, parts classification and coding, features of parts classification of coding system, OPITZ , MICLASS, Product Flow Analysis, composite part concept, machine cell design, applicationsComputer Aided Process Planning : Introduction, retrieval CAPP system, generative CAPP systems, benefits of CAPP.Flexible Manufacturing Systems : Introduction, types of FMS, components, FMS layout configurations, computer control system, human resources, applications and benefits. Introduction to Computer Integrated Manufacturing.

LEARNING RESOURCES:

TEXT BOOK(s):

1. Automation, Production systems and Computer Integrated Manufacturing by M.P.Groover, Pearson Education / PHI.
2. SeropeKalpakjian and Steven R. Schmid, Manufacturing – Engineering and Technology,7th edition,Pearson
3. YoramKoren, Computer control of manufacturing system, 1st edition

REFERENCE BOOK(s):

1. CAD/CAM by M.P.Groover and E.W.Zimmers, Pearson Education / PHI.
2. CAD/CAM by P.N.Rao, TMH

WEB RESOURCES:

1. http//ocw.mit.ac.in//
2. http//nptel.iitm.ac.in//

ME 412	FUNDAMENTALS OF INDUSTRIAL ENGINEERING	L	T	P	C	Int	Ext
		3	-	-	3	40	60

Semester VII [Fourth Year]

COURSE OBJECTIVES:

1. To provide the students with an understanding in the basics of productivity, work study& method study
2. To know the Techniques and their application which are used in work measurement
3. To expose to forecasting and its methods , plant location and facility layout
4. Understand the basics in the field of material handling ,line balancing and its algorithms

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Able to define and understand concepts of productivity and method study.
2. Able to state techniques and their methodology in work measurement
3. Appreciate and distinguish the importance of forecasting, plant location and facilities layout
4. Understand the concept of material handling and line balancing with its algorithms

UNIT I [CO:1] **(12)**

Productivity: Definition, methods to measure productivity, measures to improve productivity. Work Study: Introduction, Management techniques to reduce work content and ineffective time. Method Study: Procedure, Tools for recording information: charts and diagrams, use of fundamental hand motions (Therbligs), principles of motion economy, SIMO chart, cycle graph and chrono-cycle graph.

UNIT II [CO:2] **(12)**

Work Measurement : Objectives and techniques, time study methods and rating systems. Allowances , Standard and allowed time. Work Sampling : Activity sampling, confidence levels, number of observations, use of random number tables, procedure for making a work sampling study. Pre-determined fundamental motion time standards – Standard data

UNIT III [CO:3] **(12)**

Forecasting: Forecasting variables, forecasting procedure, methods of forecasting: moving average, least squares, simple exponential smoothing, linear regression, correlation coefficient, problems Plant Location and Facilities layout: Necessary factors governing plant location, principles of plant layout, types of layouts, Urban v/s Rural Location Computerized Layout Planning, CORELAP, CRAFT, ALDEP

UNIT IV [CO:4] **(12)**

Material Handling - Material Handling Function, Principles of Material Handling, MH Equipment – Conveyors, MH Equipment – Cranes, MH Equipment – TrucksMass Production Management (Line Balancing): Basic idea of assembly line balancing,Optimization of number of stations with given production rate, Minimization of cycle time with fixed number of stations.Line Balancing Algorithms: Kilbridge and Wester, Rank Positional Weight method, COMSOAL Moodie and Young method

LEARNING RESOURCES:

TEXT BOOK(s):

1. Introduction to work study – ILO
2. Barnes, Raeph.M., “Motion and Time Study – Design and Measurement of Work “, John Wiley &sons, New York, 1990.

3. Operations Management – Joseph G.Monks, Tata McGraw Hill
4. Production and Operations Management by Stevenson

REFERENCE BOOK(s):

1. Plant Layout and Design, Moore, J.M.Macmillan Company, New York, 1970.
2. Plant Layout and Material Handling, Apple, J.M., John Wiley and Sons, New York.
3. Facilities Planning, Tompkins and White John Wiley and Sons, New York.
4. Improving Productivity and Effectiveness, Mundel, Marvin, E., Prentice Hall, 1983.

ME 413 **METROLOGY AND MECHANICAL MEASUREMENTS** **L T P C Int Ext**
3 - - 3 40 60

Semester VII [Fourth Year]

Professional Elective Courses

Code No.	Subject Name	Code No.	Subject Name
MEEL01	Computer Aided Design	MEEL02	Mechatronic System Design
MEEL03	Fluidics and control systems	MEEL04	Industrial Robotics
MEEL05	I C Engines	MEEL06	Gas Dynamics and JET Propulsion
MEEL07	Refrigeration and Air Conditioning	MEEL08	Automobile Engineering
MEEL09	Power Plant Engineering	MEEL10	Energy Conservation and Management
MEEL11	Product Lifecycle Management	MEEL12	Principles of Industrial Management
MEEL13	Process Planning and Cost Estimation	MEEL14	Total Quality Management
MEEL15	Composite Materials	MEEL16	Design Of Experiments
MEEL17	Farm Machinery and Equipment	MEEL18	Computional Fluid Dynamics
MEEL19	Elements of Aerospace Engineering	MEEL20	Production Planning and Control

ME 414 **PROFESSIONAL ELECTIVE-III**

L	T	P	C	Int	Ext
3	-	-	3	40	60

Semester VII [Fourth Year]

Professional Elective Courses

Code No.	Subject Name	Code No.	Subject Name
MEEL01	Computer Aided Design	MEEL02	Mechatronic System Design
MEEL03	Fluidics and control systems	MEEL04	Industrial Robotics
MEEL05	I C Engines	MEEL06	Gas Dynamics and JET Propulsion
MEEL07	Refrigeration and Air Conditioning	MEEL08	Automobile Engineering
MEEL09	Power Plant Engineering	MEEL10	Energy Conservation and Management
MEEL11	Product Lifecycle Management	MEEL12	Principles of Industrial Management
MEEL13	Process Planning and Cost Estimation	MEEL14	Total Quality Management
MEEL15	Composite Materials	MEEL16	Design Of Experiments
MEEL17	Farm Machinery and Equipment	MEEL18	Computional Fluid Dynamics
MEEL19	Elements of Aerospace Engineering	MEEL20	Production Planning and Control

ME 415 **PROFESSIONAL ELECTIVE-IV**

L	T	P	C	Int	Ext
3	-	-	3	40	60

Semester VII [Fourth Year]

Professional Elective Courses

Code No.	Subject Name	Code No.	Subject Name
MEEL01	Computer Aided Design	MEEL02	Mechatronic System Design
MEEL03	Fluidics and control systems	MEEL04	Industrial Robotics
MEEL05	I C Engines	MEEL06	Gas Dynamics and JET Propulsion
MEEL07	Refrigeration and Air Conditioning	MEEL08	Automobile Engineering
MEEL09	Power Plant Engineering	MEEL10	Energy Conservation and Management
MEEL11	Product Lifecycle Management	MEEL12	Principles of Industrial Management
MEEL13	Process Planning and Cost Estimation	MEEL14	Total Quality Management
MEEL15	Composite Materials	MEEL16	Design Of Experiments
MEEL17	Farm Machinery and Equipment	MEEL18	Computional Fluid Dynamics
MEEL19	Elements of Aerospace Engineering	MEEL20	Production Planning and Control

ME 416 **OPEN ELECTIVE-III**

L	T	P	C	Int	Ext
3	-	-	3	40	60

Semester VII [Fourth Year]

Open Elective Courses

Code No.	Subject Name	Code No.	Subject Name
CEOL01	Building Materials and Construction	CEOL02	Solid waste Management
CEOL03	Remote Sensing and GIS	CHOL01	Energy Engineering
CHOL02	Biofuels	CHOL03	Environmental Engineering
CHOL04	Nanoscience and Nanotechnology	CSOL01	Programming with Java
CSOL02	Relational Database Management Systems	CSOL03	Introduction to Python Programming
CSOL04	Internet of Things	ECOL01	Applied Electronics
ECOL02	Basic Communication	ECOL03	Basic Electronics & Communication Engineering
ECOL04	Microprocessors & Interfacing	ECOL05	Digital Image Processing
EEOL01	Renewable Energy Sources	EEOL02	Utilization of Electrical Energy
EEOL03	Power Converters	EEOL04	Energy Conservation
EEOL05	Electric Vehicles	ITOL01	Data Structures & Algorithms
ITOL02	Operating Systems	ITOL03	Big Data Analytics
ITOL04	Web Technologies		

ME 451	MANUFACTURING LAB II (CAM)	L	T	P	C	Int	Ext
		-	-	2	1	40	60

Semester VII [Fourth Year]

COURSE OBJECTIVES:

1. Learn the programming of computer numerical control (CNC) machines with CAD/CAM systems.
2. Learn CNC Manual part programming for different contours using Lathe module of the CNC Lathe software.
3. Learn CNC Manual part programming for different contours using Mill module of the CNC Mill software.
4. Demonstrate and make the students to create the model using Mastercam software to convert the modeled part geometry into a cutter tool path for use on a numerically controlled lathe and milling machines
5. Gain experience and safely operate the CNC lathe and milling machines, and programming and machining complex engineering parts.

COURSE OUTCOMES:

After the successful completion of the course,students are able to

1. The students are able to write a CNC program for the profile to be generated.This is done with the help of CAM software.
2. The students are able to know and perform various operations on CNC Lathe and milling machines effectively and safely.
3. The students are able to create models for different contours and will be in a position to convert the part geometry into a NC code which is used for machining on CNC Lathe and milling machines

EXPERIMENTS:

1. Manual Part Programming examples in plain turning, step turning, taper turning, contour turning, thread cutting, drilling, boring, taper boring, counter boring, parting off with and without using Canned Cycles and sub programs on CNC Lathe
2. Manual Part Programming examples in drilling, pocket milling and profile milling with and without using Canned Cycles and sub programs on CNC Milling Machine.
3. Modelling, part program generation and tool path simulation using any one of the CAM software packages like Master CAM, Edge CAM, Ideas, Pro - E, CATIA etc.,

Note:**

ME 452	DESIGN AND METROLOGY LAB	L	T	P	C	Int	Ext
		-	-	2	1	40	60

Semester VII [Fourth Year]

COURSE OBJECTIVES:

1. To impart the knowledge regarding importance of accuracy & precision while taking the measurements
2. Students are exposed to measuring the dimensions of mechanical components.
3. Students are provided the basic knowledge about alignment of machine tools.
4. Students are exposed to measure the cutting forces with the help of dynamometers.
5. Students are exposed to know the importance of surface finish

COURSE OUTCOMES:

After the successful completion of the course,students are able to

1. Identify the importance alignment of machine tools
2. Gain the knowledge about various design principles practically
3. Acquire the working/ operation of various types of dynamometers.

EXPERIMENTS:

1. Angle and taper measurement by Bevel Protractor & Sine Bar.
2. Internal and External taper measurement using Ball & Rollers
3. Measuring effective dia. of thread using 2 wire, 3 wire method
4. Measuring gear tooth thickness using gear tooth vernier.
5. Measuring internal dia. using bore dial gauge.
6. Measurement of Circularity , Cylindricity, Flatness and straightness using CMM.
7. Alignment test on Lathe , Drilling , Milling machines
8. Measuring external diameters using Micrometer & Plot X & R Charts
9. Measurement of surface finish using surf tester
10. Measuring different parameters of a thread / gear using tooth profile projector
11. Vibration measurements
12. Gyroscope
13. Balancing
14. Whirling of shafts

Note:**

ME 454	MINI PROJECT	L	T	P	C	Int	Ext
		-	-	2	2.0	100	00

Semester VII [Fourth Year]

COURSE OBJECTIVES:

1. To make the graduate become an affective communicator.
2. To prepare graduates to express the knowledge they have gained in the areas related to Mechanical Engineering.

COURSE OUTCOMES:

After the successful completion of the course,students are able to

1. The graduate shall be able to express problem to be solved, the method to solve the problem and the analysis done on the problem.

2. The student will be able to know the latest tools available to get the solution of a given problem.

EXPERIMENTS:

1.

Note:**

Internal marks will be awarded based on the SEMINAR presentations on their Project Aim.
The students of the IV Year first semester are assigned mini-projects.
The students have to study industry related or theoretical topics, which enable them to know about the real time problems.

ME 421 **PROFESSIONAL ELECTIVE-V (MOOCS)** **L T P C Int Ext**

- - - 3 100 -

Semester VIII [Fourth Year]

Professional Elective Courses

Code No.	Subject Name	Code No.	Subject Name
MEEL01	Computer Aided Design	MEEL02	Mechatronic System Design
MEEL03	Fluidics and control systems	MEEL04	Industrial Robotics
MEEL05	I C Engines	MEEL06	Gas Dynamics and JET Propulsion
MEEL07	Refrigeration and Air Conditioning	MEEL08	Automobile Engineering
MEEL09	Power Plant Engineering	MEEL10	Energy Conservation and Management
MEEL11	Product Lifecycle Management	MEEL12	Principles of Industrial Management
MEEL13	Process Planning and Cost Estimation	MEEL14	Total Quality Management
MEEL15	Composite Materials	MEEL16	Design Of Experiments
MEEL17	Farm Machinery and Equipment	MEEL18	Computional Fluid Dynamics
MEEL19	Elements of Aerospace Engineering	MEEL20	Production Planning and Control

ME 422 **OPEN ELECTIVE-IV (MOOCS)**

L	T	P	C	Int	Ext
-	-	-	3	100	-

Semester VIII [Fourth Year]

Open Elective Courses

Code No.	Subject Name	Code No.	Subject Name
CEOL01	Building Materials and Construction	CEOL02	Solid waste Management
CEOL03	Remote Sensing and GIS	CHOL01	Energy Engineering
CHOL02	Biofuels	CHOL03	Environmental Engineering
CHOL04	Nanoscience and Nanotechnology	CSOL01	Programming with Java
CSOL02	Relational Database Management Systems	CSOL03	Introduction to Python Programming
CSOL04	Internet of Things	ECOL01	Applied Electronics
ECOL02	Basic Communication	ECOL03	Basic Electronics & Communication Engineering
ECOL04	Microprocessors & Interfacing	ECOL05	Digital Image Processing
EEOL01	Renewable Energy Sources	EEOL02	Utilization of Electrical Energy
EEOL03	Power Converters	EEOL04	Energy Conservation
EEOL05	Electric Vehicles	ITOL01	Data Structures & Algorithms
ITOL02	Operating Systems	ITOL03	Big Data Analytics
ITOL04	Web Technologies		

ME 461	PROJECT	L	T	P	C	Int	Ext
		-	-	14	7	40	60

Semester VIII [Fourth Year]

COURSE OBJECTIVES:

COURSE OUTCOMES:

EXPERIMENTS:

MEEL01 COMPUTER AIDED DESIGN L T P C Int Ext

COURSE OBJECTIVES:

1. To provide adequate information about the product life cycle, concepts of CAD software and its applications.
2. Be able to comprehend how CAD technology can be leveraged in the design process.
3. Students will learn theory and practice related to Geometric modeling, and free form surface modeling.
4. Develop CAD models for downstream Engineering activities such as manufacturing and finite element analysis

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Design a part or assembly of parts using computer aided design software.
2. Implement parametric modelling techniques to reflect engineering requirements.
3. Familiarize with top-down design principles to model a product.
4. Gain knowledge in the use of motion and interference checking to ensure that parts will not interfere throughout their complete range of motion

UNIT I [CO:1] **(12)**

Fundamentals of Computer Graphics: Product cycle, sequential and concurrent engineering Fundamentals of CAD, Applications of computer for design, Benefits of CAD, CAD system architecture, Input devices.CAD standards:Graphical Kernel System (GKS), Data exchange standards- IGES, STEP, CALS etc., and Communication standards

UNIT II [CO:2] **(12)**

Geometric Transformations: Coordinate systems, Transformation Principles, Translation, Scaling, Rotation, Matrix Representations and Homogeneous Coordinates, Composite transformations, Viewing Transformation.

UNIT III [CO:3] **(12)**

Geometric Modeling: Representation of curves, Hermite curves, Bezier curves, B-spline curves, Surface modeling and entities, surface patch, Coons and bi-cubic patches, Bezier and B-spline surfacesSolid Modeling:Solid entities, Solid representation, Sweep representation, Constructive solid geometry and Boundary representation, Solid modeling based applications.

UNIT IV [CO:4] **(12)**

Visual realism:Hidden line-surface-solid removal algorithms, shading, coloring, computer animation Assembly of parts:Assembly modelling, interferences of positions and orientation, tolerance analysis, interference checking

LEARNING RESOURCES:

TEXT BOOK(s):

1. CAD/CAM by Mikel P.Groover and Emory W.Zimmers,Prentice Hall of India , Delhi
2. CAD/CAM by P.N.Rao, Tata McGrawhill , Delhi
3. CAD/CAM by Ibrahim Zeid, Tata McGrawhill,Delhi.
4. Principles of Interactive Computer Graphics by Newman and Sproull, McGrawhill.

MEEL02 MECHATRONIC SYSTEM DESIGN L T P C Int Ext

COURSE OBJECTIVES:

1. Explain mechatronics and its relevance in engineering design.
2. Study of means of measuring various physical variables and to understand the concepts of signal conditioning
3. Study of different types of actuators and to study pneumatics & hydraulic system and its components
4. To study PLC system and its applications.
5. To design mechatronics systems and study basics of MEMS.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Be able to model and analyze electrical and mechanical systems
2. Have complete understanding of data acquisition and PLC programming.
3. Understand different types of sensors and actuators and their implementation.
4. Will have a basic knowledge about MEMS and gain knowledge of designing mechatronics

UNIT I [CO:1] **(12)**

Introduction: Integrated Design issues in Mechatronics, Mechatronics Design process, Mechatronics Key Elements, Applications in Mechatronics.Modelling and simulation of physical systems: Electrical systems, Mechanical systems translational & rotational systems, fluid systems.

UNIT II [CO:2] **(12)**

Sensors and Transducers: Introduction, sensor for motion and position measurement, force, torque and tactile sensors, sensor for flow measurement, temperature sensing devices. Actuating Devices: DC Motors, Stepper motors, fluid power Actuation, fluid power design elements: Input devices, Modulation Devices, Output Devices, graphical representation of hydraulic and pneumatic elements and equipments

UNIT III [CO:3] **(12)**

Signal Conditioning and Real Time Interfacing: Signal conditioning process, Elements of a Data Acquisition, transducers and signal conditioning, Data Conversion Process: Analog to Digital Conversion and types. PLC: Programmable Logic Controllers, Architecture, Ladder programing

UNIT IV [CO:4] **(12)**

CASE STUDIES: Pick and place robot, Car park barriers, car engine management

LEARNING RESOURCES:

TEXT BOOK(s):

1. Devdasshetty, Richard A.Kolk, “Mechatronics System Design”, PWS Publishing Company, 1997.
2. “Mems & Microsystems Design & Manufacture”, Tai –Ran Hsu, Tata Mc Graw-Hill publications, 2002

REFERENCE BOOK(s):

1. HMT, “Mechatronics”, Tata Mcgraw,Hill Publishing Company, Newdelhi,1998
2. A Textbook of Mechatronics ,R.K.Rajput, S. Chand & Company Private Limited
3. Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, William Bolton, Prentice Hall

WEB RESOURCES:

http://nptel.ac.in/syllabus/syllabus.php?subjectid=112103174

MEEL03 FLUIDICS AND CONTROL SYSTEMS L T P C Int Ext

COURSE OBJECTIVES:

1. To identify the elements of hydraulic systems.To Explain the working of various pumps and actuators
2. To understand various control elements of hydraulic systems
3. To know the variety of industrial circuits
4. To understand the common methods of designing logic circuits

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. To recognize various elements of hydraulic systems.To have good knowledge on working principles of various pumps and actuators
2. To use various control elements of hydraulic systems.
3. To design various logic circuits
4. To adapt proper industrial circuits for given application.

UNIT I [CO:1] **(12)**

Hydraulic Pumps & Pressure Regulation: Pressure regulation, pump types: Gear Pump, VanePump, Piston Pump, Combination Pumps. Selection and specification of pumps pumpcharacteristics.Hydraulic & Pneumatic Actuators: Linear and Rotary Actuators-Selection, Specification andCharacteristics, Hydraulic and pneumatic accessories

UNIT II [CO:2] **(12)**

Control and Regulation elements: Pressure-direction and flow control valves, relief valves,non-return valves and safety valves. Actuation systems. Application circuits.

UNIT III [CO:3] **(12)**

Hydraulic Circuits: Reciprocation, quick return, sequencing synchronizing circuits-accumulatorcircuits, industrial circuits-press circuits.

UNIT IV [CO:4] **(12)**

Pneumatic Systems and Circuits Pneumatic fundamentals, Control elements, Sequential circuits,Cascade methods, Mapping Methods, Step counter method, Compound circuit design,Combination circuit design.

LEARNING RESOURCES:

TEXT BOOK:

Andrew Parr, "Hydraulics and Pneumatics", (HB), Jaico Publishing House, 1999.

REFERENCE BOOK(s):

1. Antony Espossito, "Fluid power with Applications", Prentice Hall, 1980
2. Dudleyt A.Pease and John J.Pippenger, "Basic Fluid Power", Prentice Hall, 1987.

WEB RESOURCES:

1. http://nptel.ac.in/courses/112105046/m7L27.pdf
2. http://teacher.buet.ac.bd/mmrazzaque/Fluidics/Fluidic%20control.pdf

MEEL04 INDUSTRIAL ROBOTICS L T P C Int Ext

COURSE OBJECTIVES:

COURSE OBJECTIVES

1. To provide an introduction to Robotics and Automation including robot classification, design and selection, analysis and applications in industry.
2. To provide information on various types of end effectors, their design, interfacing and selection.
3. To provide the details of operations for a variety of sensory devices that are used on robot , the meaning of sensing, classification of sensor, that measure position, velocity & acceleration of robot joint.
4. The goal of the course is to familiarize the students with the basic concepts of transformations performed by robot.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Students will be familiarized in basic components of robotics, classification of robots and their applications.
2. They will have knowledge on types of robot grippers, their usage and design considerations.
3. They attain knowledge on various types of sensory devices their working and applications.
4. Students will apply basic transformations related to the movement of manipulator and able to design a robot mechanism to meet kinematics requirements.

UNIT I [CO:1] **(12)**

Introduction to Robotics, major component of a robot, robotic like devices, classification of robots - Classification by coordinate system and by control method, Specifications of robots, fixed versus flexible automation, economic analysis and overview of robot application in industry.

UNIT II [CO:2] **(12)**

Robot End Effectors: Introduction, end effectors, interfacing, types of end effectors, grippers and tools, considerations in the selection and design of remote centered devices, Requirements of End effectors. Robot Actuators: Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives

UNIT III [CO:3] **(12)**

Robotic Sensory Devices: Objective, Non-optical position sensors - potentiometers, synchros, inductosyn, optical position sensors – opto interrupters, optical encoders (absolute & incremental) Proximity Sensors: Contact type, non-contact type – inductive, capacitive proximity sensor, fibre optic proximity sensor, laser scanning proximity sensor, and reflected light sensor.Touch & Slip Sensors: Touch sensors - proximity rod & photo detector sensors, slip sensors - Forced oscillation slip sensor, interrupted type slip sensors.

UNIT IV [CO:4] **(12)**

Transformations and Kinematics: Objectives, homogenous coordinates, basic transformation operations, homogeneous transformation, Forward solution – Denavit Hartenberg procedure. Problems involving 2 and 3 DOF manipulators and SCARA manipulator. Inverse or backward solution - Closed form solution, problems involved articulated manipulators and SCARA manipulator.

LEARNING RESOURCES:

TEXT BOOK(s):

1. Robotic Engineering by Richard D.Klafter, Prentice-Hall of India Pvt Ltd, 2010.
2. Industrial Robotics by Mikell P. Groover, Tata McGraw-Hill Int. Edition 2, 2012.
3. Robotics and Control, R.K. Mittal and I.J. Nagarath, TMH, 2005.

REFERENCE BOOK(s):

1. Introduction To Robotics: Mechanics And Control, John J. Craig 3rd edition, pearson ,2008
2. Robotics: Control, Sensing, Vision, and Intelligence, K. S. Fu, R. C. Gonzales, and C. S. G. Lee, Tata McGraw-Hill, NY, 2008.
3. Introduction to Robotics: Analysis, Systems, Applications, Saeed B. Niku, Prentice Hall, NJ, 2010.

WEB RESOURCES:

1. http://nptel.iitm.ac.in/courses.php?branch=Mechanical
2. http://academicearth.org/courses/introduction-to-roboticsVideo references:
3. http://nptel.iitm.ac.in/video.php?courseId=1052

MEEL05 **I C ENGINES** **L T P C Int Ext**

COURSE OBJECTIVES:

1. To familiarize with the terminology associated with IC engines and understand the Basics of IC Engines.
2. To understand combustion and various parameters and variables affecting it in Various types of IC engines.
3. The students acquires sufficient knowledge about Cooling Methods, Lubrication Methods, Ignition systems.
4. The students acquires sufficient knowledge about emissions and its control and also Latest trends in IC engines.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. The students are expected to understand the various components, principle of operation, working of different types of I.C engines.
2. Able to know the variables affecting the performance of IC engines and methods to improve the performance.
3. Able to understand the Cooling Methods, Lubrication Methods, Ignition systems
4. The students are expected to understand the emissions and its control and also the Latest trends in IC engines.

UNIT I [CO:1] **(12)**

I.C.Engines: Introduction, Engine nomenclature, Classification of I.C.engines, Working principles of S.I. and C.I. Engines (both 4 stroke and 2-stroke)-Valve Timing and Port timing diagrams - Differences between S.I. & C. I. and 2 Stroke & 4 stroke engines.Fuel Supply Systems: S.I. Engines- Chemically correct air-fuel ratio, Air fuel Mixturerequirements, Carburetion, Simple float type carburetor, Fuel injection System for SIengines, MPFI.C.I.Engines- Air- fuel requirements, fuel injection systems, Electronic injectionsystem, CRDI.

UNIT II [CO:2] **(12)**

Combustion Processes:S.I.Engines-Normal combustion and flame front propagation, abnormal combustion, variables affecting detonation, Knock rating and Octane number,types of combustion chambers for petrol engines.C.I.Engines- Ignition delay, combustion knock in the C.I. engines,variables affecting ignition delay, Knock rating and Cetane number,types of combustion chambers for diesel engines.Engine performance curves, Variables affecting engine performance for both S.I. & C.I. Engines.

UNIT III [CO:3] **(12)**

Cooling Systems: Need for cooling system, Air and water cooling. Lubricating Systems: Objects of lubrication, Requirements of lubricants, various lubricating systems for I.C. Engines.Ignition System: Battery Ignition system, Ignition advance, ignition advance methods, Spark plugs, Magneto ignition system, Electronic Ignition system..

UNIT IV [CO:4] **(12)**

Testing of I.C.Engines:: Indicator diagram, evaluation of Indicated Power, Brake power, Fuel consumption, SFC, Mechanical & Thermal efficiencies, Mean Effective Pressure, air-fuel ratio, Heat balance sheet, Morse test.Engine emissions and control: S.I Engine emissions and methods to control, Diesel engine emissions, Diesel smoke and control.Options of prime movers: Electric Vehicle, Hybrid vehicle, Fuel cell vehicle.

LEARNING RESOURCES:

TEXT BOOK(s):

1. I.C. Engines - V.Ganesan - T.M.H., New Delhi, 3rd Edition
2. Treatise on Heat Engineering-V.P.Vasandani and D.S.Kumar, Metropolitan Bookco, New Delhi, 4th Edition.
3. A Course in I.C. Engines - M.L.Mathur &R.P.Sharma - Dhanpat Rai & Sons- New Delhi, 2010.
4. Fundamentals of I.C.Engines - H.N. Gupta, PHI, New Delhi,

REFERENCE BOOK(s):

1. 2009Thermal Science and Engineering- D.S.kumar, S.K.Kataria Publ, New Delhi 2010.
2. Thermal Engineering -Rajput, Laxmi Publ, New Delhi, 2012.

MEEL06 GAS DYNAMICS AND JET PROPULSION L T P C Int Ext

COURSE OBJECTIVES:

1. Able to understand the behavior of compressible fluid & Governing equations.
2. Able to understand the Non-isentropic flow behavior.
3. Able to understand the principle of Jet Propulsion and Working Principles of various jet engines.
4. Able to understand the working principle of rocket engine and its propellants.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Students can able to analyse the isentropic compressible flow systems.
2. Students can able to analyse the non-isentropic compressible flow.
3. Students can able to estimate the Thrust, Power and various efficiencies of Jet Propulsion units.
4. Students can able to analyse the rocket engines.

UNIT I [CO:1] **(12)**

Compressible flow, definition, Mach waves and Mach cone, stagnation states, Mass,momentum and energy equations of one-dimensional flow, Isentropic flow through variablearea ducts, nozzle s and diffusers, subsonic and supersonic flow I variable area ducts, chokedflow, Area-Mach number relations for isentropic flow

UNIT II [CO:2] **(12)**

Non-isentropic flow in constant area ducts, Rayleigh and Fanno flows, Normal shockrelations, oblique shock relations, isentropic and shock tables

UNIT III [CO:3] **(12)**

Theory of jet propulsion, thrust equation, thrust power and propulsive efficiency, Operatingprinciple and cycle analysis of ramjet, turbojet, turbofan and turboprop engines

UNIT IV [CO:4] **(12)**

Types of rocket engines, propellants & feeding systems, ignition and combustion, theory ofrocket propulsion, performance study, staging, terminal and characteristic velocity, spaceflights

LEARNING RESOURCES:

TEXT BOOK(s):

1. Gas Dynamics and Jet Propulsion --- P.L. Somasundaram
2. Gas Dynamics - E. Radhakrishnan
3. Gas Dynamics - John James
4. Fundamentals of Gas Dynamics - Chen, Recey Hung

MEEL07 REFRIGERATION AND AIR CONDITIONING L T P C Int Ext

COURSE OBJECTIVES:

1. To know the various methods of refrigeration and to introduce vapor compression Refrigeration cycle, analysis and methods for improving performance.
2. To know the operation of vapor absorption system.
3. To know the various components of refrigeration system and their working principles.
4. To design air conditioning systems by cooling load calculations. To know the various applications of refrigeration and air conditioning systems.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. The students will get the knowledge about the principle of refrigeration, different Methods of refrigeration.
2. Able to know the various components of refrigeration system and their working Principles.
3. Able to understand what is meant by air conditioning and various psychrometric Properties and processes and know the usage of Psychrometric chart.
4. Know how to provide required environment to suit various needs of day to day Requirements like comfort air conditioning, water cooling, and storage of perishable Food etc., and enable them to do simple design calculations and analysis of these Systems

UNIT I [CO:1] **(12)**

Introduction to Refrigeration: Necessity and applications, unit of refrigeration and C.O.P, Mechanical refrigeration-types, Reversed Carnot cycle of refrigeration.Air Refrigeration: Bell Coleman cycle, Open and Dense air systems, Actual refrigeration system, Necessity of aircraft refrigeration, Aircraft refrigeration systems- Types

UNIT II [CO:2] **(12)**

Vapour Compression Refrigeration: Working principle, essential components of plant, simple vapor compression refrigeration cycle, modifications, Use of P - h charts, Refrigerants - Classification, desirable properties, commonly used refrigerants, nomenclature and Alternate refrigerants. System Components: Compressors-types, Condensers - classification, working, Evaporators - classification, working, Expansion devices - types, working.

UNIT III [CO:3] **(12)**

Vapour Absorption System: Calculation of max COP, description and working of NH3 - water system, Li - Br- H2 O system, principle of operation of three fluid absorption system and salient features.Steam Jet Refrigeration: Principle of working, applications, merits and demerits. Non-Conventional Refrigeration Methods: Principle and operation of thermoelectric refrigerator and Vortex tube or Hilsch tube.

UNIT IV [CO:4] **(12)**

Psychrometry: Introduction, Psychrometric properties and relations, Psychrometric chart, Psychrometric processes, Sensible, Latent and Total heat, Sensible Heat Factor (SHF), Bypass factor. Introduction to Air Conditioning: Need for ventilation, infiltration, concepts of RSHF, GSHF, ERSHF & ADP, concept of human comfort and effective temperature, comfort air conditioning, industrial air conditioning requirements, air conditioning load calculations.Air Conditioning Systems: Introduction, components of Air conditioning system, Classification of Air conditioning systems, Central and Unitary, summer, winter and Year round systems.

LEARNING RESOURCES:

TEXT BOOK(s):

1. Refrigeration and air conditioning - C.P.Arora, TMH, 2007.
2. Refrigeration and Air conditioning - Manohar Prasad, New Age India, New Delhi,2006.
3. . A course in refrigeration and air conditioning - S.C.Arora & Domkundwar, Dhanpat Rai & sons, New Delhi, 2008.

REFERENCE BOOK(s):

1. Principles of Refrigeration - Dossat, John Wiley, 5th Edition, 2001.
2. Refrigeration and air conditioning - Stoecker, 2nd Edition, 1983.

MEEL08 AUTOMOBILE ENGINEERING L T P C Int Ext

COURSE OBJECTIVES:

Course Objectives

1. The students acquires sufficient knowledge to classify Engines, Chassis, Fuel Supply Systems, , Ignition Systems, , Suspension Systems and braking methods, Emission norms, Injection systems and Turbo charges
2. The students get the working knowledge of assembly of various components of layout and also alternative energy sources.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Identify the components of an automobile and analyze the working of each of the components.
2. Understand the emissions and its control and also the Latest trends in IC engines.
3. Repair and maintain of some of the components.
4. Predict the possible breakdowns. Modernize the components for the performance improvement.

UNIT I [CO:1] **(12)**

Introduction: Classification of vehicles, arrangements of drive. Chassis: Introduction to Chassis, Types, Construction Details.Engine: Classifications based on number of strokes, cylinders, types of, valves, valve arrangements and operating Mechanisms, Piston types, Piston rings, Firing order, Crankshafts, Flywheel. Assorted Equipment: Fuel supply pumps-A.C. Mechanical and S.U.Electrical type diaphragm pumps, Air and Fuel Filters, super chargers and Turbo chargers, Mufflers.

UNIT II [CO:2] **(12)**

Exhaust emissions: pollutants and Emission norms, Pollutants from SI engine and its control methods-3-way catalytic converter, Crankcase emission control, Evaporative emission control, EGR and Total emission control packages. Diesel engine emissions control-EGR, DPF, DOC and SCR.Alternative energy sources: Natural gas, LPG, biodiesel and hydrogen in automobiles and modification needed. Options of prime movers: Electric Vehicle, Hybrid vehicle, Fuel cell vehicle

UNIT III [CO:3] **(12)**

Electrical System: Alternator, cutout, Current and voltage regulators, charging circuit, starting motors. Clutch Systems - Single-plate and Multi-plate clutches, Centrifugal clutches, wet and dry type, actuating mechanisms. Power Train: Gear Box - Theory, Four speed and Five Speed Sliding Mesh, Constant mesh & synchromesh type, selector mechanism, overdrive, propeller shaft, differential - principle of working.

UNIT IV [CO:4] **(12)**

Suspension Systems: Need for suspension systems, springs, shock absorbers, axles - front and rear, different methods of floating rear axle, front axle and wheel alignment. (6)Vehicle Control: steering Geometry and types of steering gear box and power steering, types of brakes and brake actuation mechanisms (air and hydraulic),antilock braking system(ABS).

LEARNING RESOURCES:

TEXT BOOK(s):

1. Automobile Engineering - G.B.S.Narang, Khanna Publishers,7th Reprint ,2011.
2. Automobile Engineering -R.B.Gupta, SatyaPrakasan, 2009

3. Automobile Engineering -Vol I & II - Kirpal Singh, Standard Publishers,2011

REFERENCE BOOK(s):

1. Automotive Mechanics - Van Nostr and Company, Joseph Heitner, 2007
2. Automobile Engineering - S.Srinivasan, 2007, TMH.
3. Automobile Engineering - K. Ramakrishna, PHI, New Delhi, 2012.

WEB RESOURCES:

1. www.sciencedirect.com
2. www.2.accessengineeringlibrary.com.
3. www.asmedl.aip.org
4. www.ieee.org/ieeexplore

MEEL09 POWER PLANT ENGINEERING L T P C Int Ext

COURSE OBJECTIVES:

1. To provide an overview of Coal based thermal power plants and the associated energy conversion systems
2. To provide an overview of Brayton and combined cycles power plants.
3. List the principal components and types of nuclear reactors.
4. Explain the major types of hydro-power.
5. To provide an overview of a conventional or alternate power plants.
6. Define terms and factors associated with power plant economics and estimate the cost of producing power per kW.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. The students can understand the principles and operations of coal based thermal power plants.
2. The students can understand the principles and operations of advanced power cycles.
3. The students can understand the principles and operations of Nuclear power plants and Nuclear Waste and its disposal.
4. The students can understand the principles and operations of Hydroelectric power plants and different renewable energy based power generation systems and economic analysis of power plants.

UNIT I [CO:1] **(12)**

Coal based thermal power plants, basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, cooling towers and cooling ponds, fuel and ash handling, draught system, binary cycles and cogeneration systems.

UNIT II [CO:2] **(12)**

Gas turbine and combined cycle power plants, Brayton cycle analysis, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems.

UNIT III [CO:3] **(12)**

Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, Nuclear Waste and its disposal.

UNIT IV [CO:4] **(12)**

Hydroelectric power plants, classification, typical layout and components, principles of wind, OTEC, solar PV and solar thermal, geothermal, biogas and fuel cell, MHD power systems Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants

LEARNING RESOURCES:

TEXT BOOK(s):

1. . Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.
2. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.

3. Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998

MEEL10 ENERGY CONSERVATION AND MANAGEMENT L T P C Int Ext

COURSE OBJECTIVES:

1. Able to understand the methods of managing auditing energy.
2. Able to understand the methods of supply of electrical energy and methods of conservation of energy.
3. Able to understand the working principle of Thermal Systems and Thermal Energy Conservation measures.
4. Able to understand the conservation of energy in major utilities and Energy Economics.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Students can able to assess the national energy scenario and environmental aspects associated with energy utilization
2. Students can able to analyse the conservation methods in power transmission and utilization.
3. Students can able to analyse the thermal systems efficiency computation and energy conservation measures.
4. Students can able to analyse the conservation of energy in major utilities.

UNIT I [CO:1] **(12)**

Introduction to energy & power scenario of world, National Energy consumption data, and environmental aspects associated with energy utilization; Energy Auditing- need, types, methodology and barriers, role of energy managers, instruments of energy auditing.

UNIT II [CO:2] **(12)**

Components of EB billing, HT and LT supply, transformers, cable sizing; Concept of capacitors, power factor improvement, harmonics; Electric motors- motor efficiency computation, energy efficient motors; Illumination- Lux, Lumens, types of lighting, efficacy, LED lighting and scope of energy conservation in lighting

UNIT III [CO:3] **(12)**

Thermal systems, Boilers, Furnaces and Thermic Fluid heaters- efficiency computation and energy conservation measures; Steam distribution and usage, steam traps, condensate recovery, flash steam utilization; Insulation & Refractories.

UNIT IV [CO:4] **(12)**

Energy conservation in major utilities; pumps, fans, blowers, compressed air systems, Refrigeration& Air Conditioning systems, Cooling Towers, DG sets.Energy Economics- discount period, payback period, internal rate of return, net present value; Life Cycle costing- ESCO concept.

LEARNING RESOURCES:

TEXT BOOK(s):

1. Witte L.C. , Schmidt P.S. and Brown D.R., Industrial Energy Management and Utilization, Hemisphere Publ., Washington, 1988..
2. Callaghn P.W., Design and Management for Energy Conservation, Pergamon Press, Oxford, 1981.
3. Murphy W.R. and McKay G., Energy Management, Butterworths, London, 1987.
4. Energy Manager Training Manual , Bureau of Energy Efficiency (BEE) under Ministry of Power, GOI, 2004 (available at www.energymanager training.com).

MEEL11 PRODUCT LIFECYCLE MANAGEMENT L T P C Int Ext

COURSE OBJECTIVES:

1. To know the fundamental concepts of PLM
2. To study the importance of Product Data Management and Tools of communication.
3. To gain the knowledge on optimization of design products
4. To create an awareness on digital manufacturing

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. identify the need, opportunities and benefits of PLM
2. utilize various tools for collaborative work and apply product data management in work flow and product development
3. relate optimization theories for the design of products.
4. implement PLM strategy in manufacturing environment

UNIT I [CO:1] **(12)**

INTRODUCTION TO PRODUCT LIFE CYCLE MANAGEMENT (PLM) Definition, PLM Lifecycle model, Threads of PLM, Need for PLM, Opportunities and benefits of PLM, Views, Components and Phases of PLM, PLM feasibility study, PLM visioning –PLM Concepts, Processes and Workflow: Characteristics of PLM, Environment driving PLM,PLM Elements, Drivers of PLM, Conceptualization, Design, Development, Validation, Production, Support of PLM

UNIT II [CO:2] **(12)**

PRODUCT DATA MANAGEMENT (PDM) PROCESS AND WORKFLOW PDM systems and importance, reason for implementing a PDM system, financial justification of PDM implementation. Versioning, check-in and checkout, views, Metadata, Lifecycle, and workflow. Applied problems and solution on PDM processes and workflowCollaborative Product Development: Engineering vaulting, product reuse, smart parts, engineering change management, Bill of materials and process consistency, Digital mock-up and prototype development, design for environment, virtual testing and validation, marketing collateral. TOOLS OF COMMUNICATION FOR COLLABORATIVE WORK Creation of 3DXML and CAD drawing using CAD software. Creation of an animation for assembly instructions on 3D via composer, creation of an acrobat 3D document. Applied problems and solutions on tools of communication for collaborative work.

UNIT III [CO:3] **(12)**

KNOWLEDGE AND OPTIMIZATION OF DESIGN PRODUCTS Know how, best practices, parameterization of design, Applied problems and Solution on optimization of products using power copy, publication, parameters, formula, rule, check, design table, configuration, reaction.

UNIT IV [CO:4] **(12)**

DIGITAL MANUFACTURING – PLM Digital manufacturing, benefits manufacturing, manufacturing the first-one, Ramp up, virtual learning curve, manufacturing the rest, production planning. Developing a PLM strategy and conducting a PLM assessment: Strategy, Impact of strategy, implementing a PLM strategy, PLM initiatives to support corporate objectives. Infrastructure assessment, assessment of current systems and applications.

LEARNING RESOURCES:

TEXT BOOK(s):

1. Grieves, Michael. “Product Lifecycle Management”, McGraw-Hill, 2006.
2. Burden, Rodger “PDM: Product Data Management”:, Resource Pub, 2003

REFERENCE BOOK(s):

1. Fabio Guidice, Guido La Rosa, “Product Design for the environment- A life cycle approach”, Taylor and Francis 2006
2. Robert J. Thomas, “New product development: managing and forecasting for strategic success”, J.Wiley, 1993.
3. Gerd Hartmann, Ulrich Schmidt, “Product life cycle management” with SAP, Galileo Press, Incorporated, 2005.
4. Stark, John, “Product Life Cycle Management: Paradigm” for 21st Century Product Realization, Springer-Verlag, 2004.
5. Saaksvuori, Antti and Immpnen, Anselmi. “Product Lifecycle Management”, Springer-Verlag, 2004

MEEL12 PRINCIPLES OF INDUSTRIAL MANAGEMENT L T P C Int Ext

COURSE OBJECTIVES:

Course Objectives

1. Outline the historical evolution of management theories.
2. Explain how decisions are made within an organization and how those decisions are communicated to
   the various stakeholders.
3. Relate the basic concepts of planning: the importance of planning, strategic planning, and the types of objectives and plans developed by organizations.
4. Describe the directing and control process including: the importance of control, tools for measuring organizational performance, and managerial actions.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Demonstrate the roles, skills and functions of management.
2. Describe the various forms of structure available to an organization.
3. Describe the various forms of structure available to an organization.
4. Understand the complexities associated with management of human resources in the organizations and integrate the learning in handling these complexities.

UNIT I [CO:1] **(12)**

Introduction to Management: Definition of management, science or art, manager vsentrepreneur; Types of managers, managerial roles and skills; Evolution of management-scientific, human relations, system and contingency approaches; Current trends and issues inmanagement.Managing for competitive advantage - the Challenges of Management.

UNIT II [CO:2] **(12)**

Organization: Nature and purpose of Organizing, formal and informal organization, organizationstructure,types, line and staff authority, departmentalization, delegation of authority,centralization and decentralization.Types of Business Organizations: sole proprietorship,partnership, company, public and privateenterprises; Organization culture and environment;

UNIT III [CO:3] **(12)**

Planning: Nature and purpose of Planning, types of Planning, objectives, setting objectives,policies,Strategic Management, Planning Tools and Techniques, Decision making steps &processes.job design, human resource management, HR planning, Recruitment, selection,Training & Development, Performance Management, Career planning and Management.

UNIT IV [CO:4] **(12)**

Directing and Controlling: leadership, types & theories of leadership, Directing, individual andgroup behavior, motivation, motivation theories, motivational techniques, job satisfaction, jobenrichment, effective communication.Controlling- system and process of controlling, budgetary and non-budgetarycontrol techniques, use of computers and IT in management control, productivity problemsand management, control and performance, direct and preventive control, reporting.

LEARNING RESOURCES:

TEXT BOOK(s):

1. Robins S.P. and Coulter. M., Management, Prentice Hall India, 10th ed., 2009.
2. Stoner JAF, Freeman RE and Gilbert DR, Management, 6th ed., Pearson Education, 2004.
3. Tripathy PC & Reddy PN, Principles of Management, Tata McGraw Hill, 1999.

MEEL13 PROCESS PLANNING AND COST ESTIMATION L T P C Int Ext

COURSE OBJECTIVES:

1. Gain knowledge in fundamental concepts of process planning.
2. Understand process planning activities.
3. To know the components in cost estimation.
4. Develop the skills to estimate the machining time and production costs.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Able to describe process planning.
2. Able to interpret process planning activities.
3. Able to differentiate various elements of cost and solve basic problems.
4. Able to estimate the machining time and production costs.

UNIT I [CO:1] **(12)**

Introduction of Process Planning- methods of process planning, drawing interpretation,material evaluation, steps in process selection, production equipment and tooling selection

UNIT II [CO:2] **(12)**

Process planning activities- process parameter calculation for various production processes,selection of jigs and fixtures, selection of quality assurance methods, documents for processplanning, economics of process planning, case studies

UNIT III [CO:3] **(12)**

Introduction to cost estimation- importance of costing and estimation, methods of costing,elements of cost estimation, types of estimates, estimating procedure, estimation of laborcost, material cost, allocation of overhead charges, calculation of depreciation cost, break even analysis and related problems

UNIT IV [CO:4] **(12)**

Machining time estimation- importance of machine time calculation, machining time fordifferent lathe operations, drilling and boring time calculations, Machining time calculationfor Milling, Shaping, Planing and GrindingProduction costs- different production processes for different jobs, estimation of forging cost,estimation of welding cost, estimation of foundry cost, estimation of machining cost

LEARNING RESOURCES:

TEXT BOOK(s):

1. Peter Scalon, Process Planning, Design/ Manufacture Interface, Elsevier Sci.&Tech. 2002.
2. Ostwaal P.F. and Munez J., Manufacturing Processes and Systems, 9th ed., John Wiley 1998.
3. Chitale A.V. and Gupta R.C., Product Design and Manufacturing, 2nd ed., Prentice Hall 2002

MEEL14 TOTAL QUALITY MANAGEMENT L T P C Int Ext

COURSE OBJECTIVES:

Course Objectives

1. To understand the concept of Quality
2. To understand the Implication of Quality on Business
3. To Implement Quality Improvement Programs
4. Exposure to challenges in Quality Improvement Programs

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Apply the principles of quality control
2. Realize the importance of significance of quality
3. Manage quality improvement teams
4. Identify requirements of quality improvement programs

UNIT I [CO:1] **(12)**

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions ofmanufacturing and service quality. Basic concepts of TQM - Definition of TQM – TQM Framework -Contributions of Deming, Juran and Crosby – Barriers to TQM.

UNIT II [CO:2] **(12)**

TQM PRINCIPLES- Leadership – Strategic quality planning, Quality statements - Customer focus–Customer orientation, Customer satisfaction, Customer complaints, Customer retention -Employeeinvolvement– Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performanceappraisal. Continuous process improvement – PDSA cycle, 5s, Kaizen - Supplier partnership – Partnering,Supplier selection, Supplier Rating.

UNIT III [CO:3] **(12)**

The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology,applications to manufacturing, service sector including IT. Bench marking– Reason to bench mark, Benchmarking process – FMEA – Stages, Types.

UNIT IV [CO:4] **(12)**

Quality circles – Quality Function Deployment (QFD) – the voice of the customer, house of quality, QFDprocess. TPM Concepts, improvement needs – Cost of Quality – Taguchi quality loss function -Performance measures.Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing- QS9000 – ISO 14000 – Concepts, Requirements and Benefits Case studies of TQM, Implementation inmanufacturing and service sectors including IT.

LEARNING RESOURCES:

TEXT BOOK:

Dale H.Besterfiled, at., “Total Quality Management”, Pearson Education Asia, Third Edition, Indian Reprint (2006).

REFERENCE BOOK(s):

1. James R. Evans and William M. Lindsay, “The Management and Control of Quality”, 6th Edition, South-Western (Thomson Learning), 2005.

2. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, 3 rd Edition, 2003.
3. Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd.,2006.
4. Janakiraman,B and Gopal, R.K, “Total Quality Management – Text and Cases”, Prentice Hall (India) Pvt.
5. Girish Pathak ,”Total Quality Management- Macmillan publishers India Ltd.

MEEL15 COMPOSITE MATERIALS L T P C Int Ext

COURSE OBJECTIVES:

1. To introduce different types of composites and their applications.
2. To discuss various types of fabrication methods of polymer composites.
3. To know about MMC's and their fabrication procedures.
4. To study about various types of Ceramic composites and their processing techniques.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Know various types of composite materials and their practical importance.
2. gain knowledge on different fabrication processes of polymer composites
3. familiarize on different reinforcements and their mixing processes in metal matrix composites.
4. understand various types of CMC's and their fabrication procedures and applications.

UNIT I [CO:1] **(12)**

UNIT I : INTRODUCTION TO COMPOSITES Fundamentals Of Composites – Need For Composites – Enhancement Of Properties – Classification Of Composites – Matrix-Polymer Matrix Composites (PMC), Metal Matrix Composites (MMC), Ceramic Matrix Composites (CMC) – Reinforcement – Particle Reinforced Composites, Fibre Reinforced Composites. Applications Of Various Types Of Composites. Fiber Production Techniques For Glass, Carbon And Ceramic Fibers

UNIT II [CO:2] **(12)**

Polymer Resins – Thermosetting Resins, Thermoplastic Resins – Reinforcement Fibres – Rovings – Woven Fabrics – Non Woven Random Mats – Various Types Of Fibres. PMC Processes – Hand Lay Up Processes – Spray Up Processes – Compression Moulding – Reinforced Reaction Injection Moulding – Resin Transfer Moulding – Pultrusion – Filament Winding – Injection Moulding. Fibre Reinforced Plastics (FRP), Glass Fibre Reinforced Plastics (GFRP). Laminates- Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates.-Applications Of PMC In Aerospace, Automotive Industries

UNIT III [CO:3] **(12)**

METAL MATRIX COMPOSITESCharacteristics Of MMC, Various Types Of Metal Matrix Composites Alloy Vs. MMC, Advantages Of MMC, Limitations Of MMC, Reinforcements – Particles – Fibres. Effect Of Reinforcement – Volume Fraction – Rule Of Mixtures. Processing Of MMC – Powder Metallurgy Process – Diffusion Bonding – Stir Casting – Squeeze Casting, A Spray Process, Liquid Infiltration In-Situ Reactions-Interface-Measurement Of Interface Properties- Applications Of MMC In Aerospace, Automotive Industries

UNIT IV [CO:4] **(12)**

CERAMIC MATRIX COMPOSITES AND SPECIAL COMPOSITESEngineering Ceramic Materials – Properties – Advantages – Limitations – Monolithic Ceramics – Need For CMC – Ceramic Matrix – Various Types Of Ceramic Matrix Composites- Oxide Ceramics – Non Oxide Ceramics – Aluminium Oxide – Silicon Nitride – Reinforcements – Particles- Fibres- Whiskers. Sintering – Hot Pressing – Cold Isostatic Pressing (CIPing) – Hot Isostatic Pressing (HIPing). Applications Of CMC In Aerospace, Automotive IndustriesCarbon /Carbon Composites – Advantages Of Carbon Matrix – Limitations Of Carbon Matrix Carbon Fibre – Chemical Vapour Deposition Of Carbon On Carbon Fibre Perform. Sol-Gel Technique- Processing Of Ceramic Matrix Composites

LEARNING RESOURCES:

TEXT BOOK(s):

1. Mathews F. L. And Rawlings R. D., “Composite Materials: Engineering And Science”, 1st Edition, Chapman And Hall, London, England, 1994.
2. Chawla K. K., “Composite Materials”, Second Edition, Springer – Verlag, 1998.

REFERENCE BOOK(s):

1. Clyne, T. W. And Withers, P. J., “Introduction To Metal Matrix Composites”, Cambridge University Press, 1993.
2. Strong, A.B., “Fundamentals Of Composite Manufacturing”, SME, 1989.
3. Sharma, S.C., “Composite Materials”, Narosa Publications, 2000.
4. Broutman, L.J. And Krock,R.M., “ Modern Composite Materials”, Addison-Wesley, 1967.
5. ASM Hand Book, “ Composites”, Vol.21, ASM International, 2001

WEB RESOURCES:

1. http://emtool box.nist.gov
2. CambridgeViscosity.com/Viscometer
3. www.e.FlukeCal.com/Calibration
4. www.inscotemperature.com/

MEEL16 DESIGN OF EXPERIMENTS L T P C Int Ext

COURSE OBJECTIVES:

1. Use statistics in experimentation and understand the important role of experimentation in new product design, manufacturing process development, and process improvement;
2. Learn the experimental designs most widely used in practice and choose an appropriate experimental design based on the study objectives.
3. Identify the importance of factorial designs
4. Explain how to choose an orthogonal array for an experiment

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Formulate objective(s) and identify key factors in designing experiments for a given problem.
2. Develop appropriate experimental design to conduct experiments for a given problem.
3. Analyze experimental data to derive valid conclusions.
4. Design the experiments using the orthogonal arrays.

UNIT I [CO:1] **(12)**

INTRODUCTION: Strategy of experimentation, some typical applications of experimental design, Basic principles, Guidelines for designing experiments, a brief history of statistical design, using statistical design in experimentation.SIMPLE COMPARATIVE EXPERIMENTS: Introduction, Basic statistical concepts, Sampling and Sampling Distribution, Inferences about the Differences in means, randomized designs, paired comparison Designs, Inferences about the Variances of Normal Distributions.

UNIT II [CO:2] **(12)**

Simple designs of ANOVA: Need for ANOVA, Randomized Block Designs, Randomized complete block design, Latin square design, and balanced incomplete block design.

UNIT III [CO:3] **(12)**

Introduction To Factorial Design: Basic definition and principles, Advantages of factorials, the two factor factorial design, complete factorial experiment with three factors.

UNIT IV [CO:4] **(12)**

Orthogonal arrays: Introduction, degrees of freedom of orthogonal arrays, Design of orthogonal arrays, linear graph, column effect method, ANOVA for orthogonal array.

LEARNING RESOURCES:

TEXT BOOK(s):

1. Douglas C Montgomery, “Design and Analysis of Experiments”, John Wiley.
2. John P.W.M., “Statistical Design and Analysis of Experiments”, Macmillan.

REFERENCE BOOK(s):

1. Montgomery D.C., Runger G.C., “Introduction to Linear Regression Analysis”, John Wiley.
2. R. Panneerselvam “Design and analysis of experiments”
3. Taguchi, “Introduction to Quality Engineering”, Asian Productivity Organisation, G. UNIPUB, White Plains, New York.

WEB RESOURCES:

1. http://nptel.ac.in/courses/111104075/
2. http://nptel.ac.in/courses/111104078/
3. http://home.iitk.ac.in/~shalab/anova/chapter4-anova-experimental-design-analysis.pdf
4. https://onlinecourses.science.psu.edu/stat503/node/5

MEEL17 FARM MACHINERY AND EQUIPMENT L T P C Int Ext

COURSE OBJECTIVES:

1. To Study different farm machines and their operations
2. To get an idea about tillage and earth moving equipment
3. to gain knowledge on fertilizer application equipment and constructional features.
4. To identify various principles and mechanisms of cutting, harvesting machinery

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. to get familiar with principle of operation and selection of different farm machines.
2. Know about the use of tillage and earth moving equipment
3. Identify various constructional features of different components in fertilizer equipment
4. get familiar with various cutting and crop harvesting machineries

UNIT I [CO:1] **(12)**

Objectives of farm mechanization. Classification of farm machines. Materials of construction& heat treatment. Principles of operation and selection of machines used for production of crops. Field capacities & economics.

UNIT II [CO:2] **(12)**

Tillage; primary and secondary tillage equipment. Forces acting on tillage tools. Field operation patterns. Draft measurement of tillage equipment : Earth moving equipment: their construction & working principles viz Bulldozer, Trencher, Excavators etc.; sowing, planting & transplanting equipment ‐ their calibration and adjustments

UNIT III [CO:3] **(12)**

Fertilizer application equipment. Weed control and Plant protection equipment : sprayers and dusters, their calibration, selection, constructional features of different components and adjustments. Work physiology of men and women.

UNIT IV [CO:4] **(12)**

Principles & types of cutting mechanisms. Construction & adjustments of shear &impact‐type cutting mechanisms. Crop harvesting machinery: mowers, windrowers, reapers, reaper binders and forage harvesters. Forage chopping & handling equipment. Threshing mechanics & various types of threshers. Threshers, straw combines & grain combines, maize harvesting & shelling equipment, Root crop harvesting equipment:potato, groundnut etc., Cotton picking & Sugarcane harvesting equipment.

LEARNING RESOURCES:

TEXT BOOK(s):

1. Bosoi, E.S. (1990). Theory, Construction and Calculation of Agricultural Machines (Vol. 1 and 2). Oxonion Press Pvt. Ltd., New Delhi.
2. Donnel Hunt. Farm Machinery and management. Iowa State University Press, Ames, USA
3. Ghosh, P.K, and Swain, S. (1993). Practical Agricultural Engineering. Naya Prokash, Calcutta.
4. Kelnin, N.I.,Popov, I.F., and Sakun, V.A. (1985). Agricultural Machines. Amerind Publishers, New Delhi
5. Srivastava, A.C. (1990). Elements of Farm Machinery. Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.

REFERENCE BOOK(s):

1. Kepner, R.A., Bainer Roy, and Barges, E.C. (1978). Principals of Farm Machinery, . CBS Publishers and Distributors, Delhi‐17.
2. Kurtz,G.L., Thompson and Claer, P. (1984). Design of Agricultural Machinery. John Wiley & Sons, New York

MEEL18 COMPUTIONAL FLUID DYNAMICS L T P C Int Ext

COURSE OBJECTIVES:

1. To know the various applications of CFD and basic governing equations of fluid flow
2. To know the classification of PDE and discretization techniques
3. To know the implicit and explicit methods and VN stability criteria for parabolic and hyperbolic equations
4. To know difference CFD techniques

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Understand the philosophy of CFD and derive governing equations of fluid flow
2. Understand the principles of discretization.
3. Formulate solution techniques for parabolic and hyperbolic equations.
4. Apply some of the popular FD techniques in the solution of fluid flow problems

UNIT I [CO:1] **(12)**

Importance and applications of CFD, Models of flow, governing equations of fluid flow – Navier Stokes and Euler's equations: Continuity, Momentum and Energy equations in differential form, Physical boundary conditions

UNIT II [CO:2] **(12)**

Classification of partial differential equations, Discretization techniques- FDM, FEM, FVM, Finite Difference equations- Taylor series, order of accuracy, forward, backward and central differences for first order and second order differential equations.

UNIT III [CO:3] **(12)**

Difference equations, Explicit and Implicit approaches, Thomas Algorithm (TDMA). Analysis of stability, VN stability criteria for parabolic (1-D unsteady heat equation) and Hyperbolic (1st order wave equation) equations, Courant number.

UNIT IV [CO:4] **(12)**

Simple CFD techniques: Lax-Wendroff technique, MacCormack's technique and Iterative and Relaxation techniques. Pressure correction technique, staggered grid, SIMPLE algorithm, Boundary conditions for pressure correction method

LEARNING RESOURCES:

TEXT BOOK(s):

1. Computational Fluid Dynamics - Basics with Applications - John. D. Anderson, JR. McGraw Hill Education (India) Edition 2012.
2. Computational Fluid Dynamics - T. J. Chung, Cambridge University Press, 2nd Edition, 2014.

REFERENCE BOOK(s):

1. Introduction to computational fluid mechanics - Niyogi, Chakravarty, Laha, Pearson pub. 1st Edition, 2009.
2. Numerical heat transfer and fluid flow - S.V. Patankar, Hemisphere Pub., 1st Edition.
3. Computational Fluid flow and Heat transfer - K. Muralidhar and T. Sundararajan-, Narosa Pub. 2nd Edition, 2003.

WEB RESOURCES:

1. http://ocw.mit.edu/courses/mecharlical-engineering/2-29-numerigal-fluidmechanicsfall2011/
2. http:/inptel.ac.in/courses/112105045/ (IIT Kharagpur)
3. http://nptel.ac.in/courses/112107080/ (IIT Roorkee)
4. http://nptel.ac.in/courses/112104030/ (IIT Kanpur)

MEEL19 ELEMENTS OF AEROSPACE ENGINEERING L T P C Int Ext

COURSE OBJECTIVES:

1. To learn the components of airplane and different types of flight vehicles, Function of structural components in flight vehicle.
2. To know the basic aspects of aerodynamics and airfoils forces and moments acting on an airfoil
3. To know the elements of propulsive systems and performance parameters of Airplanes
4. To Learn the generalized concepts of aircraft stability and control along with basic concepts of space flight

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Describe functions of various external and internal components of an airplane.
2. Classify the various forces and moments acting on an airfoil.
3. Describe the working principles of various aircraft engines systems
4. Describe the stability and control aspect of air planes and describe the basic aspects of space flight.

UNIT I [CO:1] **(12)**

HISTORICAL EVOLUTION AND AIRCRAFT CONFIGURATIONS: History- Early Planes-Developments in aerodynamics- Multi-planes, biplanes and monoplanes-Components of an Airplane and Their functions, Types of Flight Vehicles, Classification-Standard Atmosphere, Altitude, Hydrostatic Equation, Geopotential and Geometric Altitudes FLIGHT VEHICLE STRUCTURES: Introduction, Fuselage-Monocoque, Semi-Monocoque Structures, Components of Wing-Spars, Ribs, Longerons, Stringers, Bulkheads, Aircraft Materials-Metallic and Non-Metallic Materials, Use of Aluminium Alloy, Titanium, Stainless Steel and Composite Materials.

UNIT II [CO:2] **(12)**

BASIC AERODYNAMICS: Continuity equation, Incompressible and Compressible flow, Momentum equation, Energy equation, Speed of sound, Measurement of air speed, Compressible flow, Compressibility, Introduction to viscous flow, Laminar and Turbulent boundary layer, compressibility effect on Skin friction, Flow separation- Introduction-Airfoils - Airfoil Nomenclature, Classifications of NACA Airfoils, Wing Geometry, Aerodynamic Forces, Lift, Drag and Moment Coefficients, Co-Efficient of Pressure, Centre of Pressure, Aerodynamics Centre, Pressure Distribution Over Aerofoil, Types of Drag.

UNIT III [CO:3] **(12)**

PROPULSION: Introduction, Propeller, Reciprocating Engine, Jet Propulsion-The Thrust Equation, Elements of Turbojet Engine-Turbofan Engine-Rocket Engine, Rocket Propellants- Liquid Propellants, Solid Propellants, Rocket StagingELEMENTS OF AIRPLANE PERFORMANCE: Introduction: The Drag polar, Equations of Motion-Thrust required for Level, Unaccelerated Flight, Thrust available and Maximum Velocity-Power required for Level, Unaccelerated Flight, Power available and Maximum velocity- Altitude effects on Power required and Available, Rate of Climb, Gliding Flight, Absolute and Service Ceilings, Time of Climb, Range and Endurance-Propeller Driven Airplane , Jet Airplane

UNIT IV [CO:4] **(12)**

PRINCIPLES OF STABILITY AND CONTROL: Introduction, Definition of Stability and Control – Static stability, Dynamic stability, Control- Moments on the Airplane-Absolute angle of attack, Criteria for Longitudinal Static Stability Directional static stability –Lateral Static stabililtySPACE FLIGHT: Introduction, Orbit Equation, Basic Aspects of Space Vehicle Trajectories, Kepler's Laws, Earth and

Planetary Entry,Space Explorations- Space Vehicles and Its Types, Reusable Space Vehicles, Space Shuttle, Satellites, Types of Satellites and Their Functions.

LEARNING RESOURCES:

TEXT BOOK:

Anderson. J. D, Introduction to Flight, Eighth Edition, McGraw-Hill Education,2017.

REFERENCE BOOK(s):

1. Houghton. E. L., Carpenter P.W., Aerodynamics for Engineering Students, Seventh Edition, Butterworth-Heinemann,2017.

2. Kermode. A. C, Mechanics of Flight, Eleventh Edition, Pearson Education,2007.
3. Kermode, A.C., “Flight without Formulae”, McGraw Hill, 1987.

4. Clancy, L.J., “Aerodynamics”, Pitman, 1986

WEB RESOURCES:

http://nptel.ac.in/

MEEL20 PRODUCTION PLANNING AND CONTROL L T P C Int Ext

COURSE OBJECTIVES:

COURSE OBJECTIVES

1. To provide the students with an understanding of the basics of elements of PPC and types of production systems
2. To know the basic Techniques and their application which are used in project management and to grasp basic knowledge about Materials Management, inventory control and MRP
3. To expose to Aggregate planning, its methods and Routing
4. Gain knowledge in fundamental concepts in the field of standard Scheduling methods, Dispatching and follow up

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Define and understand concepts of PPC and types of production systems
2. State techniques and their methodology in project management, Material Management, inventory control and MRP
3. Appreciate and distinguish the importance of Aggregate planning and its methods and know about Routing
4. Differentiate the concepts of Scheduling methods, Dispatching and follow up

UNIT I [CO:1] **(12)**

INTRODUCTION: Definition – Objectives of production Planning and Control – Functions of production planning and control – Elements of production control – Organization of production planning and control departmentProduction systems: Continuous and intermittent production. Mass and flow production, batch production, job order production, production functions

UNIT II [CO:2] **(12)**

Project Planning through networks: Arrow (Network) diagram representation, rules for constructing an arrow diagram, PERT, CPM, Critical path calculations, Determination of critical path, Determination of floats, Probability considerations in project. Introduction to CrashingMaterials Management, inventory control and MRP: Functions of materials management, inventory control, Inventory control techniques - ABC, VED and FSN analysis. Materials requirement planning (MRP): Importance of MRP, MRP system inputs and outputs, bill of materials, MRP logic.

UNIT III [CO:3] **(12)**

Aggregate planning: Long range, intermediate range and short range plans, the aggregate planning problem, aggregate planning methods, mathematical planning models, theoretical planning models (LDR) and heuristic and computer search models, problems. Master Production Schedule; Master Schedule formation – inputs and outputsRouting: Routing procedure – Route sheets– Factors affecting routing.

UNIT IV [CO:4] **(12)**

Scheduling –definition –Difference with loading, Scheduling and loading guidelines, Standard scheduling methods – forward scheduling and backward scheduling, Johnson‘s rules.Dispatching – activities of dispatcher – dispatching procedure – follow up –definition –for existence of functions – types of follow up, applications of computer in production planning and control.

LEARNING RESOURCES:

TEXT BOOK(s):

1. Elements of Production, Planning and Control by Samuel Eilon
2. Operations management by Joseph G.Monks,Tata McGraw-Hill Inc,

REFERENCE BOOK(s):

1. Production and Operations management by R.Pannerselvam,PHI, 2nd edition, 2006.
2. Production and Operations Management by S.N.Chary, TMH(4th edition).
3. Production Planning and Control, Mukhopadyay, PH

ME V01	ENGLISH COMPETENCY DEVELOPMENT PROGRAMME	L	T	P	C	Int	Ext
	[NON-CREDIT COURSE - ACTIVITY BASED]	2	-	-	-	100	-

LECTURE PLAN

Session	Topic
1.	Self Introduction
2.	Self Introduction
3.	Introducing Others
4.	Mind Mapping -Small Talk
5.	Random Operation
6.	JAM & Extempores
7.	Starting a Conversation-Rapid Fire
8.	Story Telling
9.	Narrating Life Stories
10.	Tense Buster
11.	Describing people
12.	Picture Perception & Description
13.	Movie Reviews
14.	News Articles-Open Discussion & Debate
15.	Everyday Life-Communicative Activities
16.	Role Plays
17.	Short Versions
18.	Contemporary Novels-Critical Appreciation Round

References :

* Contemporary Novels-Critical Appreciation Round
* eslflow.com/Personality Vocabulary Survey
* eslflow.com/Celebrity Interview
* eslflow.com/Telling stories
* eslflow.com/ First Impressions/speaking activity
* Speaking work sheets/Out & About 1 - PHOTOCOPIABLE, Cambridge University Press 2015
* Speaking Unplugged: 30 activities for one-to-one classes by online TEFL training
* Think Teen work book
* The guardian weekly/News based English language activities
* Walkietalkie https://www.teacherspayteachers.com/Store/Walkietalkie
* Alen Maley's Conversation/Rob Nolasco & Lois Arthur/Oxford University Press
* Alen Maley's Project Work/Diana L.Fried-Booth/Oxford University Press
* Cambridge English/Objective PET/Louise Hashemi & Barbara Thomas
* Cambridge English Business Benchmark/Guy Brook-Hart
* British Council / Learn English Select Face-to-Face Course / APSCHE Communication Skills Project
* Self- Designed Handouts

ME V02	AI TOOLS , TECHNIQUES & APPLICATIONS [NON-CREDIT COURSE]	L T P C Int Ext - - - - 100 -

UNIT I **(7)**

What is Artificial Intelligence : The AI problem, The underlying Assumption, what is AI Techniques, The level of the Model, Criteria of success, Some general references, One final Word and Beyond.

Problems, Problem Spaces and search : Defining the problem as a state Space search, Production syatems, problem characteristic, Issues in the design of serch programs, Additional problems

Heuristic search technique : Generate-and-test, Hill Climbing, Best-first-Search, problem reduction, Constraint satisfaction, Means-ends analysis.

UNIT II **(7)**

Knowledge representation issues : Representation and Mappings, Approaches to knowledge reprsentation. Issues in knowledge representation, The frame problem.

Using Predicate Knowledge : Representing simple facts in Logic, Representing instances and ISA Relationships, Computable functions and Predicates, Resolution,Natural Detection.

Representing Knowledge using Rules : Procedural Versus Declarative knowledge, Logic Programming, Forward Versus Backward Reasoning, Matching, Control Knowledge.

UNIT III **(7)**

Introduction : What is machine learning ,Examples of machine learning Applications, Learning Associations, Classification, Regression, Unsupervised Learning, Reinforcement Learning.

Supervised Learning : Learning a class form Examples, Vapnik-Chervonenkis(VC) Dimension, Probably Approximately correct(PAC) Learning, Noise, Learning Multiple classes, Regression, Model selection and Generalization, Dimension of a Supervised machine learning algorithm.

UNIT IV **(7)**

Dimensionality Reduction : Introduction, Subset selection, Principal Component Analysis, Factor Analysis, Multidimensional Scaling, Linear Discriminant Analysis, Isomap,Locally linear Embedding.

Clustering : Introduction,Mixture Densities, K-Means clustering, Expectation-Maximization Algorithm, Mixtures of Latent Variable models, Supervised learning after clustering, Hierarchical Clustering, Choosing the number of clusters

LEARNING RESOURCES:

TEXT BOOK(s):

1. Artificial Intelligence, Third Edition, Elaine Rich & Kevin Knight. (Unit-1 & Unit-2)
2. Introduction to Machine Learning, Second Edition, Ethem Alpaydm (Unit-3 & Unit -4)

REFERENCE BOOK:

Getting Started with Artificial Intelligence. by Josh Zheng, Tom Markiewicz. Publisher: O'Reilly Media

ME V03	ADVANCED MODELLING LAB (DELMIA)	L	T	P	C	Int	Ext
		-	-	2	-	100	-

COURSE OBJECTIVES:

1. Learn how to create engineering connections and kinematic mechanism for a device.
2. learn how to create fundamental and complex multi-phase macro simulation activities and to simulate a manikin in a work environment.

COURSE OUTCOMES:

After the successful completion of the course,students are able to

1. Create engineering connections, Generate device resources using kinematic mechanisms,Define Robot and NC Machine attributes,
2. Prepare the Simulation environment to create activities,Create Macro Simulation Activities, Simulate a manikin in a work environment

EXPERIMENTS:

1. DELMIA
   Introduction
2. Manufactured Item Definition, Process planning
3. Product flow and resource allocation
4. Time motion Calculation
5. Gantt Chart & Work Load Balance

Note:**

ME V04	ADVANCED MODELLING LAB (SIMULIA)	L	T	P	C	Int	Ext
		-	-	2	-	100	-

COURSE OBJECTIVES:

1. Learn how to create fundamental and complex multi-phase macro simulation activities and to simulate a manikin in a work environment.
2. This Course provides an in-depth look at several advanced Abaqus/CAE capabilities: CAD geometry import and repair, meshing and partitioning of complicated geometry.

COURSE OUTCOMES:

After the successful completion of the course,students are able to

1. Import, edit, and repair CAD geometry.Use virtual topology to ease the meshing of complicated geometry.
2. Partition geometry to enable different meshing techniques.

EXPERIMENTS:

1. SIMULIA Introduction to Finite Element Analysis
2. Linear static analysis of cantilever beam
3. Meshing
4. Structural Analysis
5. Thermal Analysis

Note:**

MEOL01 AUTOMOTIVE ENGINEERING L T P C Int Ext

COURSE OBJECTIVES:

1. Acquisition of sufficient knowledge to classify Engines, Fuel Supply Systems.
2. The students acquires sufficient knowledge about Cooling Methods, Lubrication Methods, Ignition systems.
3. Acquisition of sufficient knowledge to Clutch, Power train Systems.
4. The students get the working knowledge of assembly of various components of layout and also alternative energy sources.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Identify the components and fuel supply system of an automobile.
2. Analyze the working of each of the components.
3. Modify the design of the components.
4. Analyzing various possible alternative sources to the IC engines.

UNIT I [CO:1] **(12)**

Introduction: Classification of vehicles - applications, options of prime movers, arrangements of drive. I.C.Engines: Introduction, Engine nomenclature, Classification of I.C.Engines, Working principles of S.I. and C.I. Engines (both 4 stroke and 2-stroke)-Valve Timing and Port Timing diagrams - Differences between S.I. & C. I. and 2 Stroke & 4 stroke engines.Fuel Supply Systems: S.I. Engines- Carburetion, Simple float type carburetor, Fuel injection System for SI engines, MPFI. C.I.Engines- Air- fuel requirements, fuel injection systems, Electronic injection system, CRDI.

UNIT II [CO:2] **(12)**

Cooling Systems: Need for cooling system, Air and water cooling. Lubricating Systems: Objects of lubrication, Requirements of lubricants, various lubricating systems for I.C. Engines.Ignition System: Battery Ignition system, Ignition advance, ignition advance methods, Spark plugs, Magneto ignition system, Electronic Ignition system.

UNIT III [CO:3] **(12)**

Clutches: Single-plate and Multi-plate clutches, Centrifugal clutches, actuating mechanisms.Transmission: Gear Box - Theory, Four Speed and Five Speed Sliding mesh, Constant mesh & Synchro-mesh type, selector mechanism, propeller shaft, differential – principle of working. Suspension Systems: Need for suspension systems, springs, shock absorbers.

UNIT IV [CO:4] **(12)**

Alternative energy sources: natural gas, LPG, biodiesel, gasohol and hydrogen in automobiles and modification needed.Options of prime movers: Electric Vehicle, Hybrid vehicle, Fuel cell vehicle.

LEARNING RESOURCES:

TEXT BOOK(s):

1. I.C. Engines - V.Ganesan - T.M.H., New Delhi, 3rd Edition.
2. Automobile Engineering - S.Srinivasan, 2007, TMH.
3. Automobile Engineering - Vol I & II - Kirpal Singh, Standard Publishers, 2011.

REFERENCE BOOK(s):

1. Automobile Engineering - G.B.S.Narang, Khanna Publishers, 7th Reprint, 2011
2. Automobile Engineering - K. Ramakrishna, PHI, New Delhi, 2012.

MEOL02 ROBOTIC ENGINEERING L T P C Int Ext

COURSE OBJECTIVES:

1. To provide an introduction to Robotics and Automation including robot classification, design and selection, analysis and applications in industry.
2. To provide information on various types of end effectors, their design,interfacing and selection.
3. To provide the details of operations for a variety of sensory devices that are used on robot , the meaning of sensing, classification of sensor, that measure position, velocity & acceleration of robot joint.
4. The goal of the course is to familiarize the students with the basic concepts of transformations performed by robot.
5. Familiarize students to perform kinematics and to gain knowledge on programming of robots.

COURSE OUTCOMES:

After successful completion of the course,

1. Students will be familiarized in basic components of robotics, classification of robots and their applications.
2. They will have knowledge on types of robot grippers, their usage and design considerations.
3. They attain knowledge on various types of sensory devices their working and applications.
4. Students will apply basic transformations related to the movement of manipulator and able to design a robot mechanism to meet kinematics requirements.

UNIT I [CO:1] **(12)**

Introduction to Robotics, major component of a robot, robotic like devices, classification of robots Classification by coordinate system and by control method, Specifications of robots, fixed versus flexible automation, economic analysis and overview of robot application.

UNIT II [CO:2] **(12)**

Robot End Effectors: Introduction, end effectors, interfacing, types of end effectors, grippers and tools, considerations in the selection and design of remote centered devices, Requirements of End effectors. Robot Actuators: Pneumatic Drives Hydraulic Drives Mechanical Drives Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives

UNIT III [CO:3] **(12)**

Robotic Sensory Devices: Objective, Non optical position sensors potentiometers, synchros, inductosyn, optical position sensors opto interrupters, optical encoders (absolute & incremental)Proximity Sensors: Contact type,non-contact type inductive,capacitive proximity sensor, fibre optic proximity sensor, laser scanning proximity sensor, and reflected light sensor.Touch & Slip Sensors: Touch sensors proximity rod & photo detector sensors, slip sensors Forced oscillation slip sensor, interrupted type slip sensors.

UNIT IV [CO:4] **(12)**

Robot Programming: Methods of robot programming, generation of Robot programming Languages Motion Commands, Sensor Commands, End effector commands, and Simple programs.Transformations and Kinematics:Objectives,homogenous coordinates, basic transformation operations, homogeneous transformation, Forward solution Denavit Hartenberg procedure. Problems involving 2 and 3 DOF manipulators.

LEARNING RESOURCES:

TEXT BOOK(s):

1. Robotic Engineering by Richard D.Klafter, Prentice-Hall of India Pvt Ltd, 2010.
2. Industrial Robotics by Mikell P. Groover, Tata McGraw-Hill Int. Edition 2, 2012.
3. Robotics and Control, R.K. Mittal and I.J. Nagarath, TMH, 2005.

REFERENCE BOOK(s):

1. Introduction To Robotics: Mechanics And Control, John J. Craig 3rd edition, pearson ,2008
2. Robotics: Control, Sensing, Vision, and Intelligence, K. S. Fu, R. C. Gonzales, and C. S. G. Lee, Tata McGraw-Hill, NY, 2008.
3. Introduction to Robotics: Analysis, Systems, Applications, Saeed B. Niku, Prentice Hall, NJ, 2010.

WEB RESOURCES:

1. http://nptel.iitm.ac.in/courses.php?branch=Mechanical
2. http://academicearth.org/courses/introduction-to-roboticsVideo references
3. http://nptel.iitm.ac.in/video.php?courseId=1052

MEOL03 INTRODUCTION TO OPERATIONS RESEARCH L T P C Int Ext

COURSE OBJECTIVES:

1. Grasp the methodology of OR problem solving and formulate linear programming problem
2. Develop formulation skills in transportation models and assignment problems.
3. Understand the basics in the field of queuing theory and game theory
4. Be able to know how project management techniques help in planning and scheduling a project and to provide basics of simulation and its application to queuing and inventory problems.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Recognize the importance and value of Operations Research and linear programming in solving practical problems in industry.
2. Interpret the transportation models' solutions and infer solutions to the real-world problems.
3. Recognize and solve queuing and game theory problems
4. Gain knowledge of drawing project networks for quantitative analysis of projects and know when simulation can be applied in real world problems

UNIT I [CO:1] **(12)**

Linear Programming : Definition and Scope of Operations Research, Mathematical formulation of the problem, graphical method, Simplex method, artificial basis technique, dual Simplex method, Degeneracy, alternative optima, unbounded solution, infeasible solution.

UNIT II [CO:2] **(12)**

Transportation Problem: Introduction to the problem, LP formulation of a transportation problem. Basic feasible solution by north-west corner method, Vogel's approximation method, least cost method. Finding optimal solution by MODI method, degeneracy, unbalanced transportation matrix and Maximization in transportation model.Assignment Problem: One to one assignment problem, optimal solutions, unbalanced assignment matrix, travelling sales man problem, maximization in A.P.

UNIT III [CO:3] **(12)**

Queuing Theory: Queuing systems and their characteristics. Classification, Models -(M/M/1:FCFS/∞/∞), (M/M/1:FCFS/N/∞).Theory of Games: Introduction, rectangular two person zero sum games, solution of rectangular games in terms of mixed strategies, solution of 2x2 games without saddle point, concept of dominance to reduce the given matrix, Graphical method for 2xn and nx2 games

UNIT IV [CO:4] **(12)**

Project Planning through Networks: Introduction, Basic steps in PERT/CPM techniques, Network diagram presentation, Rules of drawing network diagram, Fulkerson's rule, Time estimates and Critical path in network analysis, floats, Project evaluation and review technique, Application areas of PERT/CPM techniques. Simulation: Introduction, Monte-Carlo Simulation, Application to Inventory Control, Application to Queuing Problems

LEARNING RESOURCES:

TEXT BOOK(s):

1. S.D. Sharma, 'Operations Research' Kedarnath, Ramnath & Co.,Meerut , 11th Edition , 2002..

2. Gupta and Hira, 'Operations Research' , S.Chand Publishers, 2011.
3. H.A. Taha, 'Operations Research', Pearson, 7th Edition, June 2002

REFERENCE BOOK(s):

1. S.S. Rao, 'Optimization Theory and Applications,, John Wiley & Sons , 1996
2. Phillips, Ravindran, James Soldberg, 'Introduction to Operations Research', Wiley 1976
3. Hiller and Liberman ,'Introduction to Operations Research' , MGH, 7th Edition, 2002

WEB RESOURCES:

1. http://www2.informs.org/Resources/
2. http://www.mit.edu/~orc/
3. http://www.ieor.columbia.edu/

MEOL04 **MECHATRONICS** **L T P C Int Ext**

COURSE OBJECTIVES:

To provide knowledge on

1. Mechatronics system design and simulation, ergonomics and safety
2. Theoretical and practical aspects of computer interfacing, real time data acquisition and control
3. Study of different types of actuators and to study pneumatics & hydraulic system and its components
4. Ability to use the techniques, by modern engineering tools necessary for engineering practice

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Know how mechatronics integrates knowledge from different disciplines
2. Identify sensors, transducers and actuators to monitor and control the behavior of a system
3. Realize the concepts of real time interfacing and data acquisition
4. Understanding the concepts of design of Mechatronics system through case studies

UNIT I [CO:1] **(12)**

Introduction: Key elements. Mechatronics design process , design parameters , mechatronics and traditional design. Advanced approaches in mechatronics design , Introduction to industrial design, modelling, simulation and analysis , Ergonomics and safety.

UNIT II [CO:2] **(12)**

Sensors and Transducers: Introduction, sensor for motion and position measurement, force, torque and tactile sensors, sensor for flow measurement, temperature sensing devices. Actuating Devices: DC Motors, Stepper motors, fluid power Actuation, fluid power design elements: Input devices, Modulation Devices, Output Devices, graphical representation of hydraulic and pneumatic elements and equipments.

UNIT III [CO:3] **(12)**

Signal Conditioning : Introduction , Hardware , Digital I/O , Analog input , ADC , resolution, Filtering Noise using passive components , Registors, capacitors , Amplifying signals using OP amps software - Digital Signal Processing , Low pass , high pass , notch filteringReal Time Interfacing: Introduction , Selection of interfacing standards, elements of data acquisition and control systems

UNIT IV [CO:4] **(12)**

Programmable Logic Controllers : Basic Structure Programming : Ladder diagram Timers, Internal Relays and Counters - Shift Registers - Master and Jump Controls, Data Handling ,Analog input / output ,PLC Selection Application.CASE STUDIES: Pick and place robot, Car park barriers, car engine management.

LEARNING RESOURCES:

TEXT BOOK(s):

1. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering/ W Bolton/ Pearson.
2. Devdas shetty, Richard A. Kolk, Mechatronics System Design, 2nd Edition,Cengage Learning

REFERENCE BOOK(s):

1. Bishop, Robert H, Mechatronics Hand book, CRC Press, 2002.
2. Bradley, D.Dawson, N.C. Burd and A.J. Loader, Mechatronics: Electronics in Products and Processes, CRC Press 1991 , First Indian print 2010.
3. De Silva, Mechatronics: A Foundation Course, Taylor & Francis, Indian Reprint, 2013

MEOL05 APPLIED MECHANICS & MECHANICAL ENGINEERING L T P C Int Ext

COURSE OBJECTIVES:

Course Objectives

1. To understand the various coplanar forces applied to a body and method of resolving the forces and determination of resultant force, and conditions required for equilibrium, and also to know what is centre of gravity and moment of inertia and their importance and determining them for simple objects
2. To know the different stresses developed/induced when the body is subjected to external forces or temperature changes and to know the hoop and longitudinal stresses developed in the thick and thin cylinders when subjected to internal pressure and also determine the change in the dimensions of the cylinder due to these stresses and strains.
3. To understand the formation of steam and different properties associated with it and working principles of boilers, different mountings and accessories used for the safety operation of boilers and also to understand the basic principles and Refrigeration & Air-Conditioning and Applications.
4. To impart the knowledge about different drive systems like belts and gear drives and to know about the working principles and importance of different bearing and couplings.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. The student must be in a position to understand different coplanar forces and determine the resultant forces. He/she is also able to estimate centre of gravity and moment of inertia for simple objects.
2. The student must be able to estimate the tensile, compressive, shear and thermal stresses in a body when subjected for different forces, change in temperature etc., He/she can also understand the difference between thick and thin cylinders and able to estimate hoop and longitudinal stresses, changes
3. The student can understand the formation of steam, working principles of Babcock and Wilcox boilers, different mountings and accessories used in the boilers and the principles of Refrigeration & Air-Conditioning.
4. The student must be in a position to know how the power is transmitted through belt and gear drives, estimate the tensions, power transmitted, length of the belt required etc., He is also in position to understand the importance of bearing and couplings in power transmission and different types of b

UNIT I [CO:1] **(12)**

Forces: Concurrent Forces, Composition and Resolution of coplanar Forces, Equilibrium of Coplanar forces.Section Properties: Centre of gravity and Moment of Inertia of simple and composite elements (Problems related to simple objects only).

UNIT II [CO:2] **(12)**

Stress and Strain: Simple stress and strain, Hooke's Law, Stress strain diagram for brittle and ductile materials- Factor of safety, Thermal stresses, Lateral strain, Modulus of rigidity, Bulk modulus-Relation between G,K and C, (Problems on simple stresses, elongations only)Thin and Thick Cylinders: Thin and thick circular cylinders subjected to internal and external pressure. Thin and thick cylinders with spherical ends. Lame's theorem and application to thick cylinders.

UNIT III [CO:3] **(12)**

Steam: Generation of steam, Properties of steam, Use of steam tables and Mollier chart-(Problems related to enthalpy, entropy, specific volume calculations for different conditions of steam only- No problems on non flow processes). Steam Generators: Classification – Working of Cochran and Babcock-Wilcox boilers only- Accessories and mountings (Listing and functions only).Refrigeration & Air-Conditioning Basics: Principles of Refrigeration & Air-Conditioning –Applications – COP – Turn of Refrigeration – Measures of Refrigeration – Air-Refrigeration System – Vapour Compression Refrigeration System – Psychrometry – Psychometric properties – Psychometric Processes, Psychometric Chart – Summer Air-conditioning Systems.

UNIT IV [CO:4] **(12)**

Drives: Belts Classification, Expression for the ratio of tensions on the slack and tight side, Power transmitted, V-belts, Chain drives-Simple problems only.Gears: Classification –Spur, Bevel, Helical gears and applications.Bearings: Purpose of bearings, Slipper bearing, Thrust bearing, Ball and Roller bearings.Couplings: Flange, Flexible couplings, Hook's joint, Universal coupling

LEARNING RESOURCES:

TEXT BOOK(s):

1. Strength of Materials, S. Ramamrutham, 17thEdition, Dhanpath Rai Publishers, Delhi (Unit – I, II) (2011)
2. Elements of Mechanical Engineering, Mathur, and Mehta Jain Brothers, Delhi (Unit – III, IV), (2005)
3. Treatise on Heat Engineering, V. P.Vasandhani&Kuma, Metropolitan Publishers.
4. Refrigeration & Air-Conditioning by R.S.Kurmi & Gupta, Chand & Company.

REFERENCE BOOK(s):

1. Applied Mechanics & Strength of Materials, R. S. Khurmi, 13thEdition, S. Chand & Co. (1977).
2. Basic Mechanical Engineering, T.J.Prabhu & Others, 1stEdition, SciTech Publishers (2010).