Programme Ordinance, POs, PSOs & Course Outcomes (COs)

DEPARTMENT OF MECHANICAL ENGINEERING
FACULTY OF ENGINEERING & TECHNOLOGY
UNIVERSITY OF LUCKNOW

PROGRAMME ORDINANCE

1. GENERAL INFORMATION:

The degree of Bachelor of Technology (B. Tech.) of University of Lucknow, Lucknow shall be conferred on the candidates who have pursued the prescribed course of study and have passed the examinations as prescribed in the ordinances. The course will be conducted on full time basis.

2. ELIGIBILITY FOR ADMISSION:

2.1 Admission to B. Tech. First year in First Semester (from 2017-18 and onwards) and lateral entry to B. Tech. Second year in Third Semester (from 2018-19 and onwards) will be made through U. P. State Entrance Examination conducted by AKTU, Lucknow, or as decided by Executive Council of the University.

2.2 The minimum academic qualification for appearing in the Entrance Examination will be a pass in the final examination of 10+2 system or its equivalent with Chemistry, Mathematics and Physics or as notified. The candidate should be domiciled of U.P.

2.3 For admission to B. Tech. Second year (lateral entry) in third semester, candidate who have passed 3/4 Year Diploma (with minimum 60% marks) from institutions recognized by the U.P. Board of Technical Education in any branch of Engineering /Technology except Agriculture Engineering are eligible.

2.4 Up to 5% of the seats may be filled by NRI / direct / sponsored admission. These shall be supernumerary seats. They shall be admitted without any entrance examination on the basis of past academic record as notified. The fee structure for such students will be as notified.

2.5 In all cases, the admission of an applicant to the B. Tech, program requires that the applicant has:

1. The minimum academic qualification as notified,
2. Fulfilled the prescribed admission procedure and paid the prescribed fees.

3. ATTENDANCE:

3.1 Students are required to attend 100% classes. Any relaxations in attendance are subject to the satisfaction of concerned HOD/Dean. Normally student shall not be allowed to appear in a semester examination unless he / she has an overall average 75% attendance and 60% attendance in each of the theory / practical subjects in that semester. Attendance for dissertation work shall be verified by the supervisor / guide. However, an additional shortage by an amount not exceeding 15% of the total number of lectures delivered or practical work done in each subject may be condoned for special reasons as given below.

(a) A shortage up-to 5% of the total number of lectures delivered or practical work done in each subject may be condoned by the Head of the Department.

(b) A further shortage upto 10% may be condoned by the Dean of the Faculty on the specific recommendation of the concerned Head of Department.

3.2 No student will be allowed to appear in the end semester examination if he/she does not satisfy the overall average attendance requirements of Clause Nos. 3.1 and such candidate(s) shall be treated as having failed and will be further governed by clause no. 4.2 & 4.3.

3.3 The attendance shall be counted from the date of admission in the Faculty or start of academic session whichever is later.

(Note: For the purpose of the attendance not more than three periods including lecture and tutorial in the same subject shall be counted on any one day).

4. DURATION OF COURSES:

4.1 Total duration of the B. Tech. Course shall be 4 years, each year comprising of two semesters. Each semester shall normally have teaching for the 90 working days or as prescribed by A.I.C.T.E. from time to time.

4.2 A candidate, who has failed twice in first year due to any reason, including due to his/her non-appearance or he/she being not permitted to appear in semester examinations, shall not be allowed to continue his/her studies further subject to clause 8.
Provided further that if a student wishes to continue third time in first year he/she may be allowed on the recommendation of a committee constituted by the Vice Chancellor. However, the maximum time allowed for completing the course shall remain the same as in clause 4.3.

4.3 The maximum time allowed for a candidate admitted in 1st /3rd semester (for lateral entry) for completing the B. Tech. course shall be 7 (seven)/ 6 (Six) years respectively, failing which he/she shall not be allowed to continue for his/her B. Tech. degree.

4.4 The minimum credit requirement for B. Tech. degree is 192. The lower and upper limit for course credit registered in a semester by a full time student are :
Lower limit - 16 credits & Upper limit - 28 credits

5. CHANGE OF BRANCH:

5.1 Change of branch may be allowed against the vacant seats at the following two stages, provided criteria in the following sub clauses are satisfied.

(i) In first year, after the last date of admission to the B. Tech. 1st semester, on the basis of merit of entrance examination on vacant seats subject to clause 5.2

(ii) In the second year, on the basis of merit at the B. Tech. first year examination for those who are passed without any carry over papers subject to clause 5.2

5.2 After change of branch, number of students in branch (s) shall neither increase over the approved intake nor will it decrease below 75% of approved intake.

5.3 Change of branch is not applicable to the candidates admitted in Second Year of B. Tech. courses (lateral entry) as per clause 2.

5.4 The change of branch if allowed will become effective from B. Tech. 3rd semester.

5.5 Further change of branch shall not be permitted.

6. CURRICULUM:

6.1 The 4 year curriculum has been divided into 8 semester and shall include lectures, tutorials, practicals, seminars and projects etc. in addition to industrial training and educational tour etc. as defined in the scheme and executive instructions issued by the Institute from time to time.

6.2 The curriculum shall also include such other curricular, co-curricular and extracurricular activities as may be prescribed by the Faculty from time to time.

7. CURRICULUM STRUCTURE OF THE PROGRAMME:

The Faculty shall follow credit-based semester system. Every programme will have a specific curriculum for all semesters (semester I to semester VIII) with a syllabi consisting of theory, practical, project work, etc. and shall be in accordance with the prescribed syllabus. The courses

shall be covered through lectures, tutorials, laboratory classes, seminar, industrial and practical training, project, tours etc.

7.1 Course Coverage

The course coverage for all the B. Tech. Programmes shall have the following categories:

(i) Humanities and Social Sciences (HS)
(ii) Management (M)
(iii) Basic Applied Sciences (BAS)
(iv) Basic Engineering Sciences (BES)
(v) Departmental Core (DC)
(vi) Departmental Electives (DE)
(vii) Open Electives (OE)
(viii) Project Work, Seminar and Industrial Training (PST)
(ix) Mandatory Audit Courses (MAC)
(x) Few audit courses as per demand and requirement of students may be offered.

Each course is assigned a certain number of credits as follows.

(a) 1 credit per lecture hour per week
(b) 1 credit per tutorial hour per week
(c) 1 credit per 2 hours laboratory/practice/project per week.
(d) 2 credits per 3 hours laboratory/practice/project per week.

7.2 Grading System and Assessment Procedure:

An **Absolute Grading System** wherein the marks shall be converted into grades and the result of each semester will be declared with **Semester Grade Point Average** (SGPA) and **Cumulative Grade Point Average** (CGPA). The CGPA will be calculated for every semester, except the first semester. The grading system to be adopted with Letter Grades and Grade Points Scale shall be as given below:

Letter Grade	**Description**	**Grade Point**	**% (Marks Range)**
O	Outstanding	10	Greater than or equal to 90
A^+	Excellent	09	Less than 90 but greater than or equal to 80
A	Very Good	08	Less than 80 but greater than or equal to 70
B^+	Good	07	Less than 70 but greater than or equal to 60
B	Above Average	06	Less than 60 but greater than or equal to 50
C	Average	05	Less than 50 but greater than or equal to 45
P	Poor	04	Less than 45 but greater than or equal to 40
F	Fail	00	Less than 40
U	Short Attendance	-	-
W	Withdrawal	-	-
I	Incomplete	-	-
UFM	Unfair Means	-	-
AP	Audit Pass	-	-
AF	Audit Fail	-	-
S	Satisfactory Completion	-	-
Z	Course Continuation	-	-

Rounding of the numeric value of grades obtained will be done till two places of decimal.

7.3 Tests & Examinations

The theory and practical examinations shall consist of continuous assessment throughout the semester in all subjects. The End Semester Examination (ESE) will be conducted by University at the end of the semester. The assessment of courses will be done on absolute marks basis. However, for the purpose of reporting the performance of a candidate, letter grades, each carrying certain points, will be awarded as per the range of total marks obtained by the candidate as detailed below.

7.4 Marks Distribution:

S. No.	Exam Category	Evaluation									
		Sessional								ESE	Grand Total
		CT		TA					Total		
		CT 1	CT 2	V	V	W	R	CP			
01	Theory Subject	10	10					10	30	70	100
02	Lab			05	05			10	20	30	50
03	Industrial Training				10	20	20		50		50
04	Seminar				10	20	20		50		50
05	Project 1			20	20	40	20		100		100
06	Project 2			25	25	50	50		150	100	250
07	MAC	10	10						20	30	50

CT: Class Test; TA: Teacher's Assessment; ESE: End Semester Examination; V 1: Viva-Voce 1; V 2: Viva-Voce 2; W: work; R: Report; CP: Class Performance (Tutorial + Attendance)

Notes:

A. The course coverage for Class Test-I, Class Test-II and End Semester Exam (ESE) will be respectively 40%, 80% and 100% of the syllabus.

B. Students who remain absent in either of the class tests on genuine grounds such as medical reasons. Institute representation in academic/extra-curricular activities with prior permission of the concerned Head of Department may be permitted for a special test. Students, who remain absent in both the class tests with prior permission will be allowed one special test covering 80% of the syllabus.

C. Class Performance will be based on assignments/tutorials, quizzes/viva-voce and attendance.

7.5 General Proficiency:

A **qualitative Assessment Remark** for General Proficiency as detailed in the table below will be given in the transcript on the basis of cumulative percentages of marks scored by the student during each semester through various components. Distribution / Weightage for award of marks in each component is prescribed in the subsequent table.

S.N.	Assessment	Weightage of Marks	Marks
1.	**Discipline/Behavior of Students Inside/Outside Institute campus by DSW**	**40%**	**20**
2.	**Games/Sports/Cultural/Literary/PFAC/Hobby Events by Chairman, CSA**	**40%**	**20**
3.	**Academic Activities/Special Lecture/ Industrial Visits by HOD**	**20%**	**10**

S.N.	Marks Secured	Remark
1.	80-100%	Excellent
2.	60-79%	Very Good
3.	40-59%	Good
4.	20-39%	Satisfactory
5.	<20%	Poor

8. CRITERIA FOR PASSING:

The performance of a student in a semester shall be evaluated through continuous class assessment and end semester examination. The continuous assessment shall be based on class tests, assignments/tutorials, quizzes/viva-voce and attendance. The marks for continuous assessment (sessional marks) shall be awarded at the end of the semester. The end semester examination shall comprise of written papers, practical and viva-voce, inspection of certified course work in classes and laboratories, project work, design reports or by means of any combination of these methods.

The distribution of marks for sessional, end semester theory papers, practical and other examinations, seminar, project and industrial training shall be as prescribed in the course structure. The practical, viva-voce, projects and reports shall be examined/evaluated through internal and external examiners as and when required.

The marks obtained in a subject shall consist of marks allotted in end semester theory paper and sessional work.

8.1 A Student who secures Grade O to P shall be considered as passed. If a student secures "F" grade, he /she has to reappear for the concerned subject examination. It is mandatory for a student to earn the required credits as mentioned in each semester.

(a) To pass in a Theory Subject, a student shall have to secure minimum 30% of the maximum marks prescribed for the End Semester Examination (ESE) and 40% of marks in the aggregate of End Semester Examination (ESE) and sessional marks assigned for that particular subject, i.e. **Minimum Passing Grade** shall be **"P".**

(b) For passing a Practical/Internship/Project/Viva-voce examination, a student shall have to secure a minimum of 50% of the prescribed maximum marks in the End Semester Examination of Practical/Internship/Project/Viva-voce and 50% of marks in the aggregate of Practical/Internship/Project/Viva-voce ESE and assigned sessional marks i.e. Minimum Passing Grade shall be "B".

(c) To pass in Seminar, a student shall require to secure a minimum of 50% of the maximum marks prescribed, i.e. Minimum Passing Grade shall be "B".

8.2 The student who do not satisfy the condition 8.1 or the student who remains absent shall be deemed to have failed in that subject and may appear for the University examination in the subsequent examinations the sessional marks awarded to the student/s at previous attempt in the concerned subject will be carried forward. However, if the student has secured less than 40% marks in the sessional, he/she will also be required to complete the sessional work of the concerned subject by way of assignments, quizzes and both class tests. The SGPA of the concerned semester will be calculated on the basis of the new grade secured by the student in

the repeat examination of the subject (with new or old sessional marks as the case may be). Number of attempts taken to pass a subject/s shall be recorded in the transcript.

8.3 A student may, at his/her desire, opt to abandon his/her performance of a semester in following manner.

(a) A student may opt to abandon his/her performance only in University Examination of the Semester.

(b) A student may opt to abandon his/her total performance of the Semester which includes performance in University Examination and Sessional Marks.

(c) A student may opt of abandon his/her performance in University Examination of any or both semester of the same academic year only.

(d) A student shall be allowed to abandon the performance maximum twice during the entire course of study.

(e) Performance of a semester, once abandoned, cannot be claimed again.

8.4 The student, who opts to abandon the performance of a semester as per clause 8.3, shall abandon performance in all the courses of that semester, irrespective of fact whether the student has passed or failed in any subject of that semester.

8.5 A student, who opt to abandon the total performance of the semester including sessional marks, has to take readmission for the relevant semester. Readmission to the First semester in such cases shall not be considered as fresh admission i.e., the student will continue to have the same University Roll Number, which was allotted earlier.

8.6 The Student, who opted to abandon his/her performance only in the University examination of a semester and does not desire readmission, shall be permitted to re-appear for examinations of all the subjects of the semester in the subsequent examinations as an Ex-Student, However, the sessional marks obtained by the student in the abandoned semester shall be retained as per clause 8.2.

8.7 Such students who opted to abandon the performance at final year are eligible for the award of Class and Distinction at the B. Tech. degree level.

8.8 A student shall be declared to have completed the programme of B. Tech. degree, provided the student has undergone the stipulated course work as per the regulations and has earned atleast 192 Credits.

8.9 A student can avail one chance to improve his/her grade in one subject of just preceding semester in the next corresponding End Semester Examination, provided that he/she has secured P or higher grade in that subject. The grade secured in **"Improvement Attempt"** will be used for calculation of SGPA of the concerned semester and old grade secured in that particular subject will stand nullified.

8.10 For Audit Courses, Grade AP (Audit Pass) or AF (Audit Fail) shall be awarded and this will not be counted for the computation of SGPA/CGPA. Audit Fail students have to pass the course as per clause 8.2.

9. ELIGIBILITY FOR PROMOTION:

9.1 There shall not be any restriction for promotion from an odd semester to the next even semester.

9.2 For promotion from even semester to the next odd semester (i.e. of the next academic year) the student has to secured 24 credits in the immediately preceding two semesters including theory and practical credits.

Minimum Credit Threshold for Promotion

Check Point	Credit Threshold
First Year to Second Year	24 Credits in First Year
Second Year to Third Year	24 Credits in Second year
Third Year to Fourth Year	24 Credits in Third year

9.3 The result of the semester shall be declared pass only on securing P or above grades in all subjects and minimum semester Grade Point Average (SGPA) is 5.0.

9.4 Student himself can decide to abandon the performance of any or both the semesters of same academic year as per clause 8.3 and reappear in abandoned semester examination as per clauses 8.4, 8.5, & 8.6.

10. COMPUTATION OF SGPA AND CGPA :

(i) The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.

$$\boldsymbol{SGPA(S_i)} = \sum(\boldsymbol{C_i} \times \boldsymbol{G_i}) / \sum \boldsymbol{C_i}$$

Where $\boldsymbol{C_i}$ is the number of credits of the ith course and $\boldsymbol{G_i}$ is the grade point scored by the student in the ith course.

(i) The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

$$\boldsymbol{CGPA} = \sum(\boldsymbol{C_i} \times \boldsymbol{S_i}) / \sum \boldsymbol{C_i}$$

Where $\boldsymbol{S_i}$ is the SGPA of the ith semester and $\boldsymbol{C_i}$ is the total number of credits in that semester.

(ii) The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

(iii) Formula for the conversion of CGPA into percent marks is CGPA x 10 = (% Marks)

11. AWARD OF DIVISION & RANK:

Division shall be awarded only after the eighth and final semester examination based on integrated performance of the candidate for all the eight semesters (six semesters for lateral entry) as per following details:

11.1 A candidate who qualifies for the award of the degree securing P or above grades in all subjects pertaining to all semesters in first attempt within eight consecutive semesters (four academic years)/ six consecutive semesters (three academic years) as applicable, and in

addition secures a CGPA of 7.5 and above for the semesters I to VIII or IE to VIE shall be declared to have passed the examination in **FIRST DIVISION WITH HONOURS.**

11.2 A candidate who qualifies for the award of the degree by securing P or above grades in all subjects of all the semesters within maximum permissible period and secures CGPA not less than 6.5 shall be declared to have passed the examination in **FIRST DIVISION.**

11.3 All other candidates who qualify for the award of degree by securing P or above grades in all subjects of all semesters and secures CGPA not less than 5.0 shall be declared to have passed the examination in **SECOND DIVISION.**

11.4 For award of ranks in a branch, the first **Three** students will be awarded ranks, provided they have secured Grade P or above in all subjects pertaining to all semesters in first attempt within eight consecutive semesters (four academic years)/ six consecutive semesters (three academic years) as applicable.

12. SCRUTINY AND RE-EVALUATION:

12.1 Scrutiny shall be permitted within two weeks after declaration of result and will only be allowed in theory papers on the request of a student after deposition of prescribed fee for each subject decided by the University.

12.2 Re-evaluation of theory/practical papers is not permitted.

13. UNFAIR MEANS:

Cases of unfair means in the End Semester Examinations and Mid-Term Tests shall be dealt as per the rules of the University of Lucknow.

14. EX-STUDENTSHIP:

14.1 A candidate opting for ex-studentship shall be required to fulfill the conditions 8.3, 8.4, 8.5 & 8.6 and to appear in all the theory & practical subjects in the End Semester Examinations of both semesters of the same Academic Year. However, the marks of Sessional, Industrial Training, Seminar and General Proficiency shall remain the same as those secured by him/her in the previous Academic Year(s) as per clause 8.2.

14.2 A candidate opting for ex-studentship shall be required to apply to the Dean's office by paying only examination fee within 15 days from the start of new session.

15. RE-ADMISSION:

A candidate may be allowed for re-admission provided he/she satisfies one of the following conditions:

15.1 A candidate is declared failed.

15.2 A candidate did not appear in a semester examination/or he/she was not granted permission to appear in the examination.

15.3 A candidate has been detained by the University and subsequently has been permitted to take re-admission.

15.4 A candidate promoted with carry over subjects and he/she opted for readmission.

16. CANCELLATION OF ADMISSION:

The admission of a student at any stage of study shall stand cancelled if:

(i) He/she is not found qualified as per AICTE/State Government norms and guidelines or the eligibility criteria prescribed by the University.

or

(ii) If he/she fails to submit qualifying examination result/mark sheet after getting admission to B. Tech. First Semester/Third Semester (lateral entry) within a prescribed time.

or

(iii) He/she is found unable to complete the course within the stipulated time as prescribed in clause 4.2.

or

(iv) He/she is found involved in creating indiscipline in the University.

17. INTERPRETATION CLAUSE:

In case of any difficulty arising during the course of implementation of these ordinances or in case of any unforeseen circumstance, the interpretation/decision of the Vice-Chancellor shall be final.

18. The Academic Council shall have the power to relax/change any provision provided in the ordinance in any specific matter/situation.

19. Any legal issues arising out of the rules/provisions contained in the ordinances shall fall under the jurisdiction of District Lucknow.

PROGRAMME OUTCOMES (POs)

1. The graduates will be able to apply knowledge of basic sciences which includes mathematics, physics, chemistry etc. with engineering concepts in getting solutions to real life mechanical engineering related problems.
2. The graduate will be able to use modern tools, softwares, equipments etc. to analyze and obtain solution to the industrial and day to day life problems.
3. The graduates will be able to develop industrial and professional ethics along with managerial skills.
4. The graduates will be able to build their career in modern industry as well they can participate in competitive examinations for success.
5. The graduates will be able to undertake multi disciplinary courses and tasks.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. To impart to the students knowledge of applied science, mechanical engineering and management related subjects.
2. To enhance analytical and decision making skills of the students.
3. Try to bridge the existing gap between modern industry demands and the academics.
4. To create global awareness towards social, environmental and energy related issues among students.
5. To develop the professionalism and effective communication skills of students.

Course Structure and Evaluation Scheme for B.Tech.

SEMESTER-I

S. No.	Subject Code	Subject Name	L – T - P	Evaluation					Credit
				Sessional			ESE	Grand Total	
				CT	TA	Total			
	Theory								
01.	AS 103	Engineering Mathematics-I	**3-1-0**	**20**	**10**	**30**	**70**	**100**	**4**
02.	AS 101	Engineering Physics-I	**3-1-0**	**20**	**10**	**30**	**70**	**100**	**4**
03.	EE 101/ ME 101	Basic Electrical Engineering/ Elements of Mechanical Engineering	**3-1-0**	**20**	**10**	**30**	**70**	**100**	**4**
04.	AS 104 CS 101	Professional Communication/ Computer System & Programming in	**3-0-0**	**20**	**10**	**30**	**70**	**100**	**3**
05.	EC 101/ AS 102	Basic Electronics/Engineering Chemistry	**3-1-0**	**20**	**10**	**30**	**70**	**100**	**4**
	Practical								
06.	AS 151/ AS 152	Engineering Physics Lab/ Engineering Chemistry Lab	**0-0-2**	**-**	**20**	**20**	**30**	**50**	**1**
07.	EE151/ ME 151	Basic Electrical Engineering Lab Elements of Mechanical Engineering Lab	**0-0-2**	**-**	**20**	**20**	**30**	**50**	**1**
08.	AS 154/ CS 151	Professional Communication Lab/ Computer Programming . Lab	**0-0-2**	**-**	**20**	**20**	**30**	**50**	**1**
09.	ME 152/ CE 151	Workshop Practice/Computer Aided Engineering Graphics	**0-0-3**	**-**	**20**	**20**	**30**	**50**	**2**
10.	GP	General Proficiency	**-**	**-**	**-**	**50**	**-**	**50**	**-**
Total								**700**	**24**

Abbreviations: CT - Class Test TA - Teacher's Assessment
ESE - End Semester Examination

SEMESTER-II

S. No.	Subject Code	Subject Name	L - T - P	Evaluation					Credit
				Sessional			ESE	Grand Total	
				CT	TA	Total			
	Theory								
01.	AS 203	Engineering Mathematics-II	**3-1-0**	**20**	**10**	**30**	**70**	**100**	**4**
02.	AS 201	Engineering Physics-II	**3-1-0**	**20**	**10**	**30**	**70**	**100**	**4**
03.	ME 201/ EE 201	Elements of Mechanical Engineering/ Basic Electrical Engineering	**3-1-0**	**20**	**10**	**30**	**70**	**100**	**4**
04.	CS 201/ AS 204	Computer System & Programming in C/ Professional Communication	**3-0-0**	**20**	**10**	**30**	**70**	**100**	**3**
05.	AS 202/ EC 201	Engineering Chemistry/ Basic Electronics	**3-1-0**	**20**	**10**	**30**	**70**	**100**	**4**
	Practical								
06.	AS 252/ AS 251	Engineering Chemistry Lab/ Engineering Physics Lab	**0-0-2**	**-**	**20**	**20**	**30**	**50**	**1**
07.	ME 251/ EE 251	Elements of Mechanical Engineering Lab/ Basic Electrical Engineering Lab	**0-0-2**	**—**	**20**	**20**	**30**	**50**	**1**
08.	CS 251/ AS254	Computer Programming. Lab/ Professional Communication Lab	**0-0-2**	**-**	**20**	**20**	**30**	**50**	**1**
09.	CE 251/ ME 252	Computer Aided Engineering Graphics/Workshop Practice	**0-0-3**	**-**	**20**	**20**	**30**	**50**	**2**
10.	GP	**General Proficiency**				**50**		**50**	
Total								**700**	**24**

SEMESTER-III

S. No.	Subject Code	Subject Name	L-T-P	Evaluation					Credit
				Sessional			ESE	Grand Total	
				CT	TA	Total			
	Theory								
1.	AS - 301	Mathematics – III	3--1--0	20	10	30	70	100	4
2.	CE - 301	Fluid Mechanics	3--1--0	20	10	30	70	100	4
3.	ME - 301	Strength of Materials	3--0--0	20	10	30	70	100	3
4.	ME - 302	Materials Science	3--0--0	20	10	30	70	100	3
5.	ME – 303	Engineering Thermodynamics	3--0--0	20	10	30	70	100	3
6.	AS - 302/ AS - 303	Human Values & Ethics / Environment & Ecology	3—0--0	20	10	30	70	100	3
	Practical								
7.	CE - 351	Fluid Mechanics Lab	0--0--2	-	20	20	30	50	1
8.	ME - 351	Strength of Materials Lab	0--0--2	-	20	20	30	50	1
9.	ME – 352	Materials Science Lab	0--0--2	-	20	20	30	50	1
10.	ME - 353	Machine Drawing Lab	0--0--2	-	20	20	30	50	1
11.	GP -301	General Proficiency				**50**		**50**	
Total			**18-2-8**					**800**	**24**

SEMESTER-IV

S. No.	Subject Code	Subject Name	L-T-P	Evaluation					Credit
				Sessional			ESE	Grand Total	
				CT	TA	Total			
	Theory								
1.	AS - 401	Computer Oriented Numerical Techniques	3--1--0	20	10	30	70	100	4
2.	ME - 401	Manufacturing Science & Engineering – I	3--0--0	20	10	30	70	100	3
3.	ME - 402	Applied Thermodynamics	3--1--0	20	10	30	70	100	4
4.	ME – 403	Measurements& Metrology	3--0--0	20	10	30	70	100	3
5.	ME – 404	Kinematics of Machines	3--0--0	20	10	30	70	100	3
6.	AS - 402/ AS - 403	Human Values & Ethics/ Environment & Ecology	3--0--0	20	10	30	70	100	3
	Practical								
7.	ME - 451	Manufacturing Science & Engg Lab.- I	0--0--2	-	20	20	30	50	1
8.	ME – 452	Applied Thermodynamics Lab	0--0--2	-	20	20	30	50	1
9.	ME - 453	Measurements& Metrology Lab	0--0--2	-	20	20	30	50	1
10.	ME - 454	Numerical Techniques Lab	0--0--2	-	20	20	30	50	1
11.	GP - 401	General Proficiency				**50**		**50**	
Total			**18-2-8**					**800**	**24**

SEMESTER-V

S. No.	Subject Code	Subject Name	L-T-P	Evaluation					Credit
				Sessional			ESE	Grand Total	
				CT	TA	Total			
	Theory								
01.	ME - 501	Machine Design – I	**3--1--0**	**20**	**10**	**30**	**70**	**100**	**4**
02.	ME – 502	Manufacturing Science and Engineering - II	**3--1--0**	**20**	**10**	**30**	**70**	**100**	**4**
03.	ME – 503	Heat and Mass Transfer	**3--1--0**	**20**	**10**	**30**	**70**	**100**	**4**
04.	ME – 504	Fluid Machinery	**3--0--0**	**20**	**10**	**30**	**70**	**100**	**3**
05.	ME – 505	Industrial Engineering	**3--0--0**	**20**	**10**	**30**	**70**	**100**	**3**
	Practical								
06.	ME - 551	Machine Design Lab	**0--0--3**	**-**	**40**	**40**	**60**	**100**	2
07.	ME – 552	Manufacturing Science and Engineering Lab – II	**0--0--3**	**-**	**40**	**40**	**60**	**100**	2
08.	ME – 553	Heat and Mass Transfer Lab	**0--0--2**	**-**	**20**	**20**	**30**	**50**	**1**
09.	ME – 554	Fluid Machinery Lab	**0--0--2**	**-**	**20**	**20**	**30**	**50**	**1**
10.	**GP - 501**	**General Proficiency**				**50**		**50**	
Total			**15-3-10**					**800**	**24**

SEMESTER-VI

S. No.	Subject Code	Subject Name	L-T-P	Evaluation					Credit
				Sessional			ESE	Grand Total	
				CT	TA	Total			
	Theory								
01.	ME - 601	I.C. Engines	**3--1--0**	**20**	**10**	**30**	**70**	**100**	**4**
02.	ME – 602	Dynamics of Machines	**3--1--0**	**20**	**10**	**30**	**70**	**100**	**4**
03.	ME – 603	Machine Design – II	**3--1--0**	**20**	**10**	**30**	**70**	**100**	**4**
04.	ME – 604	Power Plant Engineering	**3--0--0**	**20**	**10**	**30**	**70**	**100**	3
05.	ME – 605	Any one from the list (DE – 1)	**3--0--0**	**20**	**10**	**30**	**70**	**100**	3
	Practical								
06.	ME - 651	I.C. Engines Lab	**0--0--2**	**-**	**20**	**20**	**30**	**50**	**1**
07.	ME – 652	Theory of Machines Lab	**0--0--2**	**-**	**20**	**20**	**30**	**50**	1
08.	ME – 653	**Mini Project**	**0--0--3**	**-**	**40**	**40**	**60**	**100**	2
09.	ME – 654	Seminar	**0--0--3**	**-**	**40**	**40**	**60**	**100**	2
10.	**GP - 601**	**General Proficiency**				**50**		**50**	
Total			**15-3-10**					**800**	**24**

Note: Students have to undergo Industrial Training for a period of six weeks during summer vacation. The report of Industrial Training will be submitted to the Head of the Department in the beginning of seventh semester.

Departmental Elective –1 (DE-1):-

ME – 6051 Operations Research
ME – 6052 Mechanical System Design
ME – 6053 Six Sigma
ME – 6054 Industrial Ergonomics
ME – 6055 Robotics and Automation

SEMESTER- VII

Sr. No.	Subject Code	Subject Name	L-T-P	Evaluation					Credit
				Sessional			ESE	Grand total	
				CA	TA	Total			
Theory									
01	ME 701	Refrigeration & Air Conditioning	3--1--0	20	10	30	70	100	4
02	ME 702	Computer Aided Design	3--1--0	20	10	30	70	100	4
03	ME 703	Computer Aided Manufacturing	3--1--0	20	10	30	70	100	4
04	ME-704X	Any One from the List (DE-2)	3--1--0	20	10	30	70	100	4
05	AS701/ AS-702	EngineeringEconomics/ Industrial Management	3--0--0	20	10	30	70	100	3
Practical									
06	ME 751	Refrigeration & Air Conditioning Lab	0--0--2	-	20	20	30	50	1
07	ME 752	CAD/CAM Lab	0--0--2	-	20	20	30	50	1
08	ME 753	Industrial Training	0--0--2	-	-	50	-	50	1
09	ME 754	Project Lab	0--0--3	-	-	150	-	150	2
10	GP 701	General Proficiency				50		50	
		Total	**15-4-9**					**800**	**24**

Abbreviations:

CT-ClassTest

TA- Teacher's Assessment

ESE- EndSemester Examination

DE- DepartmentalElective

Departmental Elective (DE-2):

1. ME-7041 Non DestructiveTesting
2. ME-7042 Finite ElementMethod
3. ME-7043 MechanicalVibration
4. ME-7044 Mechanical SystemDesign
5. ME-7045 Reverse Engineering and RapidPrototyping

SEMESTER- VIII

Sr. No.	Subject Code	Subject Name	L-T-P	Evaluation					Credit
				Sessional			ESE	Grand Total	
				CA	TA	Total			
Theory									
01	OE 80XX	Any One from the Open Elective List	3--1--0	20	10	30	70	100	4
02	ME-801X	Any One from the List (DE-3)	3--1--0	20	10	30	70	100	4
03	ME 802	Automobile Engineering	3--1--0	20	10	30	70	100	4
04	AS 801/ AS 802	EngineeringEconomics/ Industrial Management	3--0--0	20	10	30	70	100	3
Practical									
05	ME 851	Automobile Engineering Lab	0--0--2	-	20	20	30	50	1
06	ME 852	Project	0--0-12	-	-	100	250	350	8
07	GP 801	General Proficiency				50		50	
	Total		**12--3-14**					**800**	**24**

Abbreviations:

CT-ClassTest

TA- Teacher's Assessment

ESE- EndSemester Examination

DE- DepartmentalElective

Departmental Elective (DE-3):

1. ME-8011 Advance Welding
2. ME-8012 Energy Conservation andManagement
3. ME-8013 Total QualityManagement
4. ME-8014 Theory ofElasticity
5. ME-8015 Advanced ProductionEngineering

Open Electives: Refer list of Open Electives in APPENDIX.

AS 103

Engineering Mathematics - I

COURSE OUTCOMES (COs):
After completion of the course student will be able to

1. Use matrices, determinants and techniques for solving systems of linear equations in the different areas of Linear Algebra, Understand the definitions of Vector Space and its linear Independence, Solve Eigen value problems and apply Cayley Hamilton Theorem.
2. Study the functions of more than one independent variable and calculate partial derivatives along with their applications
3. Explore the idea for finding the extreme values of functions and integrate a continuous function of two or three variables over a bounded region.
4. Understand Curl, divergence and gradient with their applications and have the idea of directional derivatives and derive the equations of tangent planes and normal lines.
5. Calculate line integral, surface integral and volume integral and correlate them with the application of Stokes, Green and Divergence theorem.

L	T	P
3	1	0

Unit - 1: Matrix Algebra
Types of Matrices, Inverse of a matrix by elementary transformations, Rank of a matrix (Echelon & Normal form). Linear dependence. Consistency of linear system of equations and their solution, Characteristic equation. Eigen values and Eigen vectors, Cayley-Hamilton Theorem, Diagonalization, Complex and Unitary Matrices and its properties

Unit -2: Differential Calculus -I
Successive Differentiation, Leibnitz's theorem, Limit , Continuity and Differentiability of functions of several variables. Partial derivatives, Euler's theorem for homogeneous functions, Total derivatives, Change of variables, Curve tracing: Cartesian and Polar coordinates.

Unit - 3: Differential Calculus – II
Taylor's and Maclaurin's Theorem, Expansion of function of several variables, Jacobian, Approximation of errors. Extrema of functions of several variables, Lagrange's method of multipliers (Simple applications).

Unit - 4: Vector Calculus
Point function. Gradient, Divergence and Curl of a vector and their physical interpretations. Vector identities. Tangent and Normal, Directional derivatives. Line, Surface and Volume integrals. Applications of Green's, Stake's and Gauss divergence theorems (without proof).

Unit - 5: Multiple Integrals
Double and triple integrals. Change of order of integration. Change of variables. Application of integration to lengths, Surface areas and Volumes - Cartesian and Polar coordinates. Beta and Gamma functions, Diri chiefs integral and its applications.

Text Books:

1. E. Kreyszig, Advanced Engineering Mathematics,John-Wiley & Sons
2. B. V. Ramana, Higher Engineering Mathematics, Tata Me Graw- Hill Publishing Company Ltd.
3. R.K.Jain & S.R.K. lyenger. Advance Engineering Mathematics, Narosa Publishing House.

Reference Books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
2. Peter V. O' Neil, Advanced Engineering Mathematics, Thomas (Cengage) Learning.
3. Thomas & Finley, Calculus, Narosa Publishing House
4. Rukmangadachari, Engineering Mathematics -1, Pearson Education.
5. A.C.Srivastava & P.K.Srivastava, Engineering Mathematics, Vol.l, PHI Learning Pvt. Limited, NewDelhi.

AS 101

Engineering Physics – I

COURSE OUTCOMES (COs):
After completion of the course student will be able to

1. To develop the concept of relativistic mechanics and to explain it in different domains.
2. To develop the understanding of Modern Physics and their application in various micro and macro systems.
3. To develop the understanding of Interference and Diffraction with different experimental results.
4. To illustrate the nature of EM waves and to apply the ideas of production of different types of polarized light and to know about the components and types of laser i.e pulsed and continuous wave.
5. To develop the understanding of components and types of optical fiber with light propagation mechanism and to illustrate construction and reconstruction of holograms.

L	T	P
3	1	0

Unit -1: Relativistic Mechanics **08 Hrs.**

Inertial & non-inertial frames of reference, Galilean transformations, Michelson-Morley experiment, Einstein's postulates, Lorentz transformation equations. Length contraction & Time dilation. Relativistic addition of velocities; Variation of mass with velocity. Mass energy equivalence. Mass less particle.

Unit-II: Modem Physics **10 Hrs.**

Black body radiation, Weins law and Rayleigh-Jeans law. Quantum theory of radiation, Planck's law. Wave-particle duality, de-Broglie matter waves, Bohr's quantization rule. Phase and Group velocities, Davisson-Germer experiment, Heisenberg uncertainty principle and its applications. Wave function and its significance, Time dependent and time independent Schrodinger's wave equations - particle in one dimensional potential box. Eigen values and Eigen function.

Unit - III: Wave Optics **10 Hrs.**

Interference: Coherent sources, condition for sustained Interference in thin films (parallel and wedge shaped film), Newton's rings and its applications.
Diffraction: Types of diffractions, Single, double and N- Slit Diffraction, Diffraction grating. Grating spectra, dispersive power, Rayleigh's criterion and resolving power of grating.

Unit - IV: Polarization and Laser **08 Hrs.**

Polarization: Phenomena of double refraction, Construction and working of Nicol prism. Production and analysis of plane, circular and elliptical polarized light. Retardation Plate, Optical Activity, Fresnel's theory. Specific rotation.
Laser: Spontaneous and stimulated emission of radiation, population inversion, Einstein's Coefficients, Coherence, Concept of 3 and 4 level Laser, Construction and working of Ruby, He-Ne lasers , Laser applications.

Unit - V: Fiber Optics and Holography **06 Hrs.**

Fiber Optics: Fundamental ideas about optical fiber. Propagation mechanism. Acceptance angle and cone. Normalized frequency, Numerical aperture. Single and Multi Mode Fibers, Dispersion and Attenuation.
Holography: Basic Principle of Holography, Construction and reconstruction of Image on hologram and applications of holography.

Reference Books:

1. Concepts of Modem Physics - Aurthur Beiser (Mc-Graw Hill)
2. Introduction to Special Theory of Relativity- Robert Resnick (Wielly)
3. Optics -Ajoy Ghatak (Tata McGraw Hill Education Private Ltd. New Delhi)
4. Optics - Brijlal & Subramanian (S. Chand)
5. Engineering Physics- C. Mani Naidu(Pearson)
6. Lasers Principles, Types and Applications- K R Nambiar (New Age)
7. Applied Physics for Engineers- Neeraj Mehta (PHI Learning, New.

AS 102/AS 202

Engineering Chemistry

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

1. The students will gain knowledge of basic theories of solid materials, nano-materials and liquid crystals.
2. To demonstrate the knowledge of synthesis of polymeric material, which are required for engineering applications.
3. Apply basic knowledge of Science and fundamental aspect of cell working, equations in solving electrochemistry problems, functioning of lubricants and the techniques controlling the corrosion.
4. Analyze the water sample parameters & identify the impurities and its effects. Able to design process for purification of water that is concern with safety of public health & environment.
5. Apply basic knowledge of fuels and experimental techniques used in identification of structure of organic/inorganic moieties.

L	T	P
3	1	0

Unit-1	Molecular orbital theory and its applications to homo-nuclear diatomic molecules. Band theory of solids. Liquid crystals and its applications. Point defects in Solids. Structure and applications of Graphite and Fullerenes. Concepts of nano-materials and its applications	**8**
Unit-2	Polymers: Basic concepts of polymer- blends and composites. Conducting and biodegradablepolymers. Preparations and applications of some industrially important polymers(Buna N, Buna S, Neoprene, Nylon 6, Nylon 6,6 , Terylene). General methods of synthesis of organometallic compound (Giignard Reagent) and their applications in polymerization.	**8**
Unit-3	Electrochemistry: Galvanic cell, electrode potential. Lead storage battery. Corrosion, causes and its prevention. Setting and hardening of cement, applications of cement. Plaster of paris. Lubricants- Classification, mechanism and applications..	**8**
Unit-4	Hardness of water. Disadvantage of hard water. Boiler troubles. Techniques for water softening; Lime-soda, Zeolite, Ion exchange resin. Reverse osmosis. Phase Rule and its application to water system.	**8**
Unit-5	Fuels; Classification of fuels. Analysis of Coal. Determination of Calorific values (bomb calorimeter & Dulong's method). Biogas. Elementary ideas and simple applications of UV, Visible, IR and H^NMR spectral Techniques.	**8**

Text Book :

1. Chemistry for Engineers, by S. Vairam and Suba Ramesh; Wiley India

Reference Books :

1. Textbook of Engineering Chemistry by Dr. Gopal Krishna Bhatt, Acme Publishers
2. Chemistry (9th ed), by Raymond Chang, Tata McGraw-Hill
3. Chemistry Concepts and Applications by Steven S. Zumdahl; Cengage Learning
4. Engineering Chemistry, Wiley India
5. Engineering Chemistry Author: Abhijit Mallick, Viva Books
6. Text Book of Engineering Chemistry by Harsh Malhotra; Sonali Publications
7. Concise Inorganic Chemistry by J.D. Lee; Wiley India

8. Organic Chemistry (6 ed) by Morrison & Boyd; Pearson Education
9. Physical Chemistry by Gordon M. Barrow; Mc-Graw Hill
10. Organic Chemistry, Volume 1(6 ed)& 2 (5ed) by I. L. Finar; Pearson Education
11. Atkins' Physical Chemistry by Peter Atkins & Julio De Paula; Oxford University Press.

EC101/EC 201

Basic Electronics Engineering

Course outcomes (COs)

1. Acquire basic knowledge on the working of various semi-conductor devices.
2. Develop analysis capability in BJT and FET Amplifier Circuits
3. Identify functions of digital multimeter,voltmeter,Cathode ray oscilloscope and Digital storage oscilloscope in measurement of physical variables
4. Understand fundamentals of radio communication

L	T	P
3	1	0

Unit-I

PN junction diode: **Introduction of Semiconductor Materials** Semiconductor Diode: Depletion layer, V-I characteristics, ideal and practical, diode resistance, capacitance. Diode Equivalent Circuits, Transition and Diffusion Capacitance, Diodes breakdown mechanism (Zener and avalanche) Diode Application: Series, Parallel and Series, Parallel Diode Configuration, Half and Full Wave rectification. Clippers, Clampers, Zener diode as shunt regulator. Voltage-Multiplier Circuits Special Purpose two terminal Devices: Light-Emitting Diodes, Liquid-Crystal Displays.

12 Lectures

Unit-II

Bipolar Junction Transistor and Field Effect Transistor: Bipolar Junction Transistor: Transistor Construction, Operation, Amplification action. Common Base, Common Emitter, Common Collector Configuration DC Biasing BJTs: Operating Point, Fixed-Bias, Emitter Bias, Voltage-Divider Bias Configuration.Emitter-Follower Configuration. Bias Stabilization. CE, CB, CC amplifiers and AC analysis of single stage CE amplifier (re Model). Field Effect Transistor: Construction and Characteristic of JFETs. AC analysis of CS amplifier, MOSFET (Depletion and Enhancement) Type, Transfer Characteristic.

10 Lectures

Unit-III

Operational Amplifiers: Introduction and Block diagram of Op Amp, Ideal & Practical characteristics of Op Amp, Differential amplifier circuits. Practical Op- Amp Circuits (Inverting Amplifier, Non inverting Amplifier, Unity Gain Amplifier, Summing Amplifier, Integrator, Differentiator). **OP AMP Parameters: Input offset voltage, Output** offset **voltage, Input biased current. Input offset current** Differential and Common-Mode Operation.

6 Lectures

Unit-IV

Electronic Instrumentation and Measurements: Digital Voltmeter : Introduction, RAMP Techniques, Analog and Digital Multimeters: Introduction Oscilloscope: Introduction, Basic Principle, Block Diagram of Oscilloscope, Simple CRO, Measurement of voltage, current phase and frequency using CRO, Introduction of Digital Storage Oscilloscope and Comparison of DSO with Analog Oscilloscope.

6 Lectures

Unit-V

Fundamentals of Communication Engineering: Elements of a Communication System, Need of Modulation, Electromagnetic spectrum and typical applications. Basics of Signal Representation and Analysis, **Introduction of various analog modulation techniques.** Fundamentals of amplitude and frequency modulation. Modulation and Demodulation Techniques of AM.

6 Lectures

Text Books:

1. Robert L. Boylestand / Louis Nashelsky*"Electronic Devices and Circuit Theory" Latest*Edition, Pearson Education.
2. H S Kalsi, "Electronic Instrumentation", Latest Edition, TMH Publication,.
3. George Kennedy, "Electronic Communication Systems", Latest Edition, TMH,

Reference Books:

1. David A. Bell, *""Electronic Devices and Circuits",* Latest Edition, Oxford University Press.
2. Jacob Millman, C.C. Halkias, StayabrataJit, *""Electronic Devices and Circuits'",* Latest Edition , TMH.
3. David A. Bell, Electronic Instrumentation and Measurements, Latest Edition, Oxford University Press India.

ME101/ME 201

Elements of Mechanical Engineering

COURSE OUTCOMES (COs)

1. On successful completion of this course, a student would be able to identify and analyze the problems by applying the fundamental principles of engineering mechanics and to proceed to design and development of the mechanical systems.
2. Understand the representation of forces and moments.
3. Understand the concept of static equilibrium of particles and rigid bodies.
4. Able to understand the concept of stress and strain.
5. Understand the basic concepts of Thermodynamics.

L	T	P
3	1	0

UNIT-I

Force System: Law of Parallelogram of forces, Lami's theorem. Principle of Transmissibility of forces. Moment of a force. Couple, Varignon's theorem. Resolution of a force into a force and a couple. Resultant and equilibrium of coplanar force system. Determination of reactions.Free body diagrams.

Concept of Centre of Gravity, Centroidand Area Moment of Inertia, Perpendicular axis theorem and Parallel axis theorem

9 Lectures

UNIT-II

Plane Trnss: Perfect Deficient and Redundant Truss. Assumptions and Analysis of Plane Truss by Method of joints and Method of section.

Beams: Types of beams., Shear force and bending moment in Statically Determinate Beams. Shear force and bending moment diagrams. Relationships between load, shear and bending moment.

8 Lectures

UNIT-III

Simple stress and strain: Normal and shear stresses. One Dimensional Loading; members of varying cross section, bars in series. Tensile Test diagram for ductile and brittle materials. Elastic constants. Strain energy.

Bending (Flexural) Stresses: theory of pure bending, neutral surface and neutral axis, stresses in beams.

Engineering Materials: Importance of engineering materials, classification, mechanical properties and applications of Ferrous, Nonferrous and composite materials.

8 Lectures

UNIT-IV

Basic Concepts and Definitions of Thermodynamics: Introduction and definition of thermodynamics. Microscopic and Macroscopic approaches. System, surrounding and universe. Concept of continuum. Thermodynamic equilibrium. Thermodynamic properties, path, process and cycle. Quasi static process. Energy and its forms. Work and heat.

Zeroth law of thermodynamics: Temperature and its' measurement.

First law of thermodynamics: First law of thermodynamics. Internal energy and enthalpy. First law analysis for non-flow processes. Steady flow energy equation; Boilers, Condensers, Turbine, Throttling process. Pumps etc.

8 Lectures

UNIT-V

Second law: Thermal reservoir, Kelvin Planck statement. Heat engines. Efficiency; Clausius' statement Heat pump, Refrigerator. Coefficient of Performance. Carnot cycle, Carnot theorem and it's corollaries.Clausius inequality. Concept of Entropy.

Properties of Pure Substances: P-v, T-s and h-s diagram, dryness fraction and steam tables. Rankine Cycle. **Internal Combustion Engines:** Classification of I.C. Engines, working principle and comparison between 2 Stroke and 4 stroke engine , difference between SI and Cl engines. P- V and T-s diagramsof Otto and Diesel cycles, comparison of efficiency. **9 Lectures**

Reference Books:

1. Engineering Mechanics: Statics by J.L Meriam , Wiley
2. Engineering Mechanics : Statics and Dynamics by R. C. Hibbler, Pearson
3. Strength of Materials by Thimoshenko& Young
4. Mechanics of Solid by R. C. Hibbler, Pearson
5. Introduction to Mechanical Engineering : Thermodynamics, Mechanics & strength of Material,Onkar Singh, New Age International (P) Ltd.
6. Engineering Thermodynamics by P.K.Nag, McGraw Hill
7. Thermodynamics An Engineering Approach by Cengel& Boles, McGraw Hill
8. Internal Combustion Engine by V Ganesan, McGraw Hill Pub .
9. Engineering Mechanics By S. S. Bhavikatti, K. G. Rajashekarappa, New Age International
10. Engineering Mechanics by R K Bansal, Laxmi Publications
11. Elements of Workshop Technology by Hajra Choudhary Media Promoter

EE101/EE 201

BASIC ELECTRICAL ENGINEERING

COURSE OUTCOMES (COs):

After completion of the course student will be able to

1. To understand fundamentals of DC circuits and apply knowledge for analyzing network theorems in DC circuits.
2. To learn the fundamentals and analyze single phase AC circuits.
3. To learn the fundamentals and analyze three phase AC circuits.
4. To learn the basic operation and analyze the performance of single phase transformer.
5. To understand the construction and basic operation of DC motors and generators.

L	T	P
3	1	0

Unit-I: Electrical Circuit Analysis:

Introduction, Circuit Concepts: Concepts of network. Active and passive elements. Voltage and current sources. Concept of linearity and linear network. Unilateral and bilateral elements. Source transformation, Kirchhoff's laws, Loop and nodal methods of analysis. Star-delta transformation,

AC fundamentals: Sinusoidal, square and triangular waveforms - Average and effective values. Form and peak factors, Concept of phasors, phasor representation of sinusoidally varying voltage and current.

Unit-II: Steady- State Analysis of Single Phase AC Circuits:

Analysis of series and parallel RLCCircuits, Concept of Resonance in series & parallel circuits, bandwidth and quality factor; Apparent, active & reactive powers. Power factor, Concept of power factor improvement and its improvement (Simple numerical problems)

Network theorems (AC & DC with independent sources): Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem (Simple numerical problems)

Unit-III: Three Phase AC Circuits:

Three phase system-its necessity and advantages, Star and delta connections, Balanced supply and balanced load, Line and phase voltage/current relations. Three-phase power and its measurement (simple numerical problems).

Measuring Instruments: Types of instruments, Construction and working principles of PMMC and moving iron type voltmeters & ammeters, Single phase dynamometer wattmeter, Use of shunts and multipliers (Simple numerical problems on shunts and multipliers), Single phase energy meter.

Power system : basic concept, power line diagram, concept of grid.

Unit-IV:Magnetic Circuits:

Magnetic circuit concepts, analogy between electric & magnetic circuits, B-H curve, Hysteresis and eddy current losses, Magnetic circuit calculations (Series & Parallel).

Single Phase Transformer: Principle of operation, Construction, EMF equation, Phaser diagram Equivalent circuit. Power losses, Efficiency (Simple numerical problems), Introduction to auto transformer.

Unit-V: Electrical Machines:

DC machines:Principle & Construction, Types, EMF equation of generator and torque equation of motor, applications of DC motors (simple numerical problems)

Three Phase Induction Motor:Principle & Construction, Types, Slip-torque characteristics. Applications (Numerical problems related to slip only)

Single Phase Induction motor: Principle of operation and introduction to methods of starting, applications.

Three Phase Synchronous Machines: Principle of operation of alternator and synchronous motor and their applications.

Text Books:

1 . Basic Electrical Engineering, S N Singh; Prentice Hall International
2. Basic Electrical Engineering, Kuldeep Sahay, New Age International Publishers

3 . Fundamentals of Electrical Engineering, B Dwivedi, A Tripathi; Wiley India
4. Principles of Electrical Engineering, V. Del Toro,; Prentice Hall International
5. Electrical Engineering, J. B. Gupta, Kataria and Sons
6. Basic Electrical Engineering, T.K. Nagsarkar,M.S. Shukhija; Oxford University Press.

Reference Books:

1. Electrical and Electronics Technology, Edward Hughes; Pearson
2. Engineering Circuit Analysis, W.H. Hayt& J.E. Kimerly; Me GrawHill
3. Basic Electrical Engineering, C L Wadhwa; New Age International

CS 101/CS 201

Computer System and Programming in C

COURSE OUTCOMES (COs):

After completion of the course student will be able to

1. This course will let students understand the basics of solving a problem using the computer system.
2. Students will be able to solve simple and precise problems using the computer.
3. Students can develop the attitude to solve the problems in hand in logical manner.
4. To able to understand the basic concepts of digital computer, binary arithmetic.
5. To be able to understand the importance of algorithm and flowcharts in programming.
6. To be able to understand the basic concepts of writing a program in C language: write, compile, and run programs in C language.
7. To understand role of constants, variables, identifiers, operators, type conversion and other building blocks of C Language
8. To be able to write programs that involve decisions and iterations.
9. To be able to understand how to use functions, arrays, pointers, preprocessor directives along with fare confidence in file handling.

L	T	P
3	0	0

Unit 1: **(10 Lectures)**

Basics of Computer: Introduction to digital computer, basic operations of computer, functional components of computer. Classification of computers.

Introduction to operating system: [DOS, Windows, Linux and Android] purpose, function, services and types.

Number system: Binary, octal and hexadecimal number systems, their mutual conversions. Binary arithmetic.

Basics of programming: Approaches to Problem Solving, Concept of algorithm and flow charts. Types of computer languages:- Machine Language, Assembly Language and High Level Language, Concept of Assembler, Compiler, Loader and Linker.

Unit2: **(8 Lectures)**

Standard I/O in "C", **Fundamental data types-** Character type, integer, short, long, unsigned, single and double floating point. Storage classes- automatic, register, static and external. Operators and expression using numeric and relational operators, mixed operands, type conversion, logical operators, bit operations, assignment operator, operator precedence and associatively.

Fundamentals of C programming: Structure of C program, writing and executing the first C program. Components of C language. Standard I/O in C.

Units3: **(10 Lectures)**

Conditional program execution: Applying if and switch statements, nesting if and else, use of break and default with switch, program loops and iterations: use of while, do while and for loops, multiple loop variables, use of break and continue statements.

Functions: Introduction, types of functions, functions with array, passing values to functions, recursive functions.

Unit 4: **(6 Lectures)**

Arrays: Array notation and representation, manipulating array elements, using multi dimensional arrays. Structure, union, enumerated data types

Unit 5: **(8 Lectures)**

Pointers: Introduction, declaration, applications File handling, standard C preprocessors, defining and calling macros, conditional compilation, passing values to the compiler.

Reference:

1. The C programming by Kemighan Brain W. and Ritchie Dennis M., Pearson Education .
2. Computer Basics and C Programming by V.Rajaraman, PHI Learning Pvt. Limited - 2015.
3. Programming in C by Kochan Stephen G. Pearson Education - 2015.
4. Computer Concepts and Programming in C by D.S. Yadav and Rajeev Khanna, New Age International Publication.
5. Computer Concepts and Programming in C by Vikas Gupta, Wiley India Publication
6. Computer Fundamentals and Programming in C. Reema Thareja, Oxford Publication
7. Computer Concepts and Programming in C, E Balaguruswami, McGraw Hill
8. Computer Science- A Structured Programming Approach Using C, by Behrouz A. Forouzan, Richard F. Gilberg, Thomson, Third Edition , Cengage Learning - 2007.
9. Problem Solving and Program Design in C, by Jeri R. Hanly, Elliot B. Koffman, Pearson Addison-Wesley, 2006.
10. Computer Concepts and Programming by Anami, Angadi and Manvi, PHI Publication
11. Computer Fundamental and C programming by K K Gupta, Acme Learning Publication

AS 104/AS 204

Professional Communication

COURSE OUTCOMES (COs)

Students are able to demonstrate the following:

1. Understand the communication system for specific purpose.
2. Be able to communicate professionally.
3. Be able to communicate across organizational levels and cultures effectively.
4. Be able to negotiate with the odds and bring in best of the results with specific success.
5. Be able to understand the human needs and adjust accordingly the set goals

L	T	P
3	0	0

Unit-I: Fundamentals of Communications

Technical Communication: features: Distinction between General And Technical Communication; Language as a tool of communications; Levels of communication: Interpersonal, Organizational, Mass communication; The flow of communication: Downward, Upward, Lateral/Horizontal (Peer group): Importance of technical communication; Barriers to Communication

Unit-II: Written Communication

Words and Phrases: Word formation, Synonyms and Antonyms; Homophones; Select vocabulary of about 500-1000 New words; correct Usage: all Parts of Speech; Modals; Concord; Articles; Infinitives; Transformation of sentences; Requisites f Sentence Construction: Paragraph Development: Techniques and Methods- Inductive, Deductive, Spatial, Linear, Chronological etc.

Unit-III: Business Communication

Principles, Sales & Credit letters; Claim and Adjustment Letters; Job Application and Resumes. Reports: Types; Significance; Structure, Style & Writing of Reports.
Technical Proposal; Parts; Types; Writing of Proposal; Significance; Negotiation skills.

Unit-IV: Presentation Strategies and Soft Skills.

Nuances and Modes of Delivery; Body Language; Dimensions of Speech: Syllable; Accent; Pitch; Rhythm; Intonation; Paralinguistic features of voice; Interpersonal communication: Definition; Types; Team work; Attitude; Way to improve Attitude Listening Skills : Types; Methods for improving Listening Skills.

Unit –V: Value- Based Text Readings

Following essays from the prescribed text book with emphasis on Mechanics of writing.

1. Humanistic and Scientific Approaches to Human Activity by Moody E. Prior
2. The Language of Literature and Science by A. Huxley
3. Man and Nature by J. Bronowski
4. Science and Survival by Barry Commoner
5. The Mother of the Sciences by A.J. Bahm.

Text Book:

1. Improve your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, New Delhi.

2. Technical Communication- Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2007, New Delhi.
3. Functional skills in Language and Literature, by R.P. Singh, Oxford Univ. Press, 2005, New Delhi.

Reference Books:

1. Communication Skills for Engineers and Scientists, Sangeeta Sharma et.al. PHI Learning Pvt. Ltd, 2011, New Delhi.
2. Business Correspondence and Report Writing by Prof R.C.,Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd. ,2001, New Delhi.
3. Word Power Made Easy by Norman Lewis, W.R. Goyal Pub. & Distributors, 2009, Delhi.
4. Developing Communication skills by Krishna Mohan, Mecra Bannerji- Macmillan India Ltd. 1990, Delhi.
5. Manual of Practical Communication by L.U.B. Pandey: A.I.T.B.S. Publications India Ltd.; Krishan Nagar, 2013, Delhi.
6. English Grammar and Usage by R.P.Sinha, Oxford University Press, 2005, New Delhi.
7. Spoken English- A manual of Speech and Phonetics by R.K. Bansal & J.B. Harrison Orient Blackswan, 2013, New Delhi.

CE151/CE 251

Computer Aided Engineering Graphics

COURSE OUTCOMES (COs):

1. On successful completion of this course, a student would be able produce geometric construction, multiview, dimensioning and detail drawings of typical 3-D engineering objects.
2. Apply the skill for preparing detail drawing of engineering objects.
3. Understand and visualize the 3-D view of engineering objects.
4. Understand and apply computer software to prepare engineering drawing.
5. Able to visualize better and understand the various engineering problems.

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Introduction

Drawing Instruments and their uses, BIS conventions. Lettering, Dimensioning line conventions and free hand practicing, AUTO CAD, layout of the software, standard tool bar/menus and description of most commonly used tool bars, navigational tools. Co-ordinate system and reference planes. Definitions of HP, VP, RPP & LPP. Creation of 2D/3D environment. Selection of drawing size and scale. Commands and creation of Lines,Co-ordinate points, axes, poly-lines, square, rectangle, polygons, splines, circles, ellipse, text, move, copy, off-set, mirror, rotate, trim, extend, break, chamfer, fillet, curves, constraints.
2 - Sheets

Orthographic Projections Introduction, Definitions - Planes of projection, reference line and conventions employed, Projections of points in all the four quadrants, Projections of straight lines (located in First quadrant/first angle only), True and apparent lengths. True and apparent inclinations to reference planes.
2 - Sheets

Orthographic Projections of Plane Surfaces (First Angle Projection Only)Introduction, Definitions-projections of plane surfaces-triangle, square, rectangle, rhombus, pentagon, hexagon and circle, planes in different positions by change ofposition method only.
1 - Sheet

Projections of Solids (First Angle Projection Only) Introduction, Definitions - Projections of right regular tetrahedron, hexahedron (cube), prisms, pyramids, cylinders and cones in different positions.
2-Sheets

Sections And Development of Lateral Surfaces of Solids Introduction, Section planes. Sections, Section views, Sectional views, Apparent shapes and True shapes of Sections of right regular prisms, pyramids, cylinders and cones resting with base on HP.
1 - Sheet

Isometric Projection (Using Isometric Scale Only)
Introduction, Isometric scale, Isometric projection of simple plane figures. Isometric projection of tetrahedron, hexahedron(cube), right regular prisms , pyramids, cylinders, cones, spheres, cut spheres.
1-Sheet

Text Books:

1. Engineering Drawing - N.D. Bhatt & V.M. Panchal, 48thedition, 2005-Charotar Publishing House, Gujarat.
2. Computer Aided Engineering Drawing - S. Trymbaka Murthy, -I.K International Publishing House Pvt. Ltd., New Delhi, 3rdrevised edition- 2006.

Reference Books:

1. Engineering Graphics - K.R. Gopalakrishna, 32”** edition, 2005- Subash Publishers Bangalore.
2. Fundamentals of Engineering Drawing with an Introduction to Interactive Computer Graphics for Design and Production-Luzadder Warren J., Duff John M., Eastern Economy Edition, 2005- Prentice-Hall of India Pvt. Ltd., New Delhi.
3. Engineering Drawing - M.B. Shah, B.C.Rana, 2nd Edition,2

AS 203

Engineering Mathematics – II

COURSE OUTCOMES (COs):

After completion of the course student will be able to

1. Understand and implement the concept of differential equations and learn various methods to solve ordinary differential equation.
2. Extend the concept of series solutions to solve differential equations and learn orthogonality about the functions.
3. Implement the integral transformation using the concept of Laplace transformation and application to solve differential equations.
4. Learn Fourier series and Fourier transformations for initial and boundary values problems.
5. Application of Partial differential equation as heat equation, wave equation and Laplace equation.

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Unit - 1: Ordinary Differential Equations

Linear differential equations of order with constant coefficients. Complementary function and Particular integral. Simultaneous linear differential equations. Solution of second order differential equations by changing dependent & independent variables. Method of variation of parameters. Applications to engineering problems (without derivation).

Unit - 2: Series Solution and Special Functions

Series solution of second order ordinary differential equations with variable coefficient (Frobenius method), Bessel and Legendre equations and their series solutions. Properties of Bessel function and Legendre polynomials.

Unit - 3: Laplace Transform

Laplace transform. Existence theorem, Laplace transforms of derivatives and integrals. Initial and final value theorems. Unit step function, Dirac- delta function, Laplace transform of periodic function. Inverse Laplace transform. Convolution theorem. Application to solve simple linear and simultaneous differential equations.

Unit - 4: Fourier Series and Partial Differential Equations

Periodic functions, Dirichlet's Conditions, Fourier series of arbitrary periods, Euler's Formulae, Even and odd functions, Half range sine and cosine series, Gibbs Phenomena.

Solution of first order Lagrange's linear partial differential equations. Second order linear partial differential equations with constant coefficients.

Unit - 5: Applications of Partial Differential Equations

Classification of second order partial differential equations, Method of separation of variables for solving partial differential equations, Solution of one and two dimensional wave and heat conduction equations, Laplace equation in two dimension, Equation of transmission lines.

Text Books:

1. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
2. B. V. Ramana, Higher Engineering Mathematics, Tata Me Graw- Hill Publishing Company Ltd.
3. R.K.Jain & S.R.K. lyenger, Advance Engineering Mathematics, Narosa Publishing House.

Reference Books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
2. Peter V. O' Neil, Advanced Engineering Mathematics, Thomas (Cengage) Learning.

3. Chandrika Prasad, Advanced Mathematics for Engineers, Prasad Mudranalaya
4. A. C. Srivastava & P. K. Srivastava, Engineering Mathematics, Vol. - II, PHI Learning Pvt. Ltd.
5. Rukmangadachari, Engineering Mathematics - II, Pearson Education.

AS 201

Engineering Physics – II

COURSE OUTCOMES (COs):

After completion of the course student will be able to

1. To know about the fundamentals of crystal physics and illustrations of Nacl and diamond structures.
2. To understand the concepts of dielectrics and its polarization and different properties of magnetic materials with their hysteresis curve.
3. To formulate and solve the engineering problems on electromagnetism with the help of Maxwell's equations.
4. To understand the basics of band theory of solids and discuss the Fermi energy for semiconductors.
5. To develop the understanding of superconductors and its types, superconductivity with BCS theory and to understand the various applications of nanotechnology with the help of nano materials.

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Unit -1: Crystal Structures and X-ray Diffraction 10Hrs.

Space lattice, basis. Unit cell. Lattice parameter. Seven crystal systems and Fourteen Bravais lattices. Co-ordination number. Atomic radius and Packing factor of different cubic structures. Crystal structure of NaCl and diamond. Lattice planes and Miller Indices, Diffraction of X-rays by crystal, Laue's experiment, Bragg's Law, Bragg's spectrometer. Compton Effect.

Unit - II: Dielectric and Magnetic Properties of Materials 10 Hrs.

Dielectric Properties: Dielectric constant and Polarization of dielectric materials. Relation between E, D and P, Types of Polarization (Polarizability). Equation of internal fields in liquid and solid (One-Dimensional), Claussius-Mossotti equation. Frequency dependence of dielectric constant, Dielectric Losses, Important applications of dielectric material, Ferroelectricity, Piezoelectricity.

Magnetic Properties: Magnetization, Origin of magnetic moment, Dia, para and ferro magnetism, Langevin's theory for diamagnetic material. Phenomena of hysteresis and its applications.

Unit - III: Electromagnetic Theory 06 Hrs.

Equation of continuity, Maxwell's Equations (Integral and Differential Forms) and its derivations, Displacement Current, Poynting vector and Poynting theorem, EM - Wave equation and its propagation characteristics in free space, non-conducting and conducting media, energy density of electromagnetic wave, Skin depth.

Unit - IV: Band Theory of Solids 06 Hrs.

Free electron Theory, Formation of bands in Solids, Classification of solids on band theory. Density of states, Fermi-Dirac distribution, Concept of effective mass. Charge carrier density (electrons and holes), Conductivity of semiconductors, carrier concentrations Fermi energy. Position of Fermi level in intrinsic and in extrinsic semiconductors. Temperature dependence of conductivity in semiconductors.

Unit - V: Physics of some technologically important Materials 08Hrs.

Superconductors: Temperature dependence of resistivity in superconducting materials. Effect of magnetic field (Meissner effect), Temperature dependence of critical field, London equations, Josephson theory, persistent currents. Type I and Type II superconductors, BCS theory (Qualitative), High temperature superconductors and Applications of Super-conductors. **Nano-Materials:** Basic principle of nanoscience and technology, structure, properties and uses of Fullerene, Carbon nanotubes Single and double walled nanotubes, synthesis of nanotubes. Properties and Applications of nanotubes.

Reference books:

1. Concept of Modem Physics - by Beiser (Tata Mc-Graw Hill)
2. Solid State Physics - by C. Kittel, 7th edition (Wiley Eastern)
3. Materials Science and Engineering - by V. Raghavan (Prentice- Hall India)
4. Solid State Physics - by S.O. Pillai, 5th edition (New Age International).
5. Introduction to Electrodynamics - by David J. Griffith (PH I)
6. Engineering Physics- C. Mani Naidu(Pearson)
7. Applied Physics for Engineers- Neeraj Mehta (PHI Learning, New Delhi)

AS - 301
MATHEMATICS- III

COURSE OUTCOMES (COs):

1. Deal with sequences and various types of series and their convergence,
2. Determine whether a given complex function is differentiable, and if so find its derivative. Express complex- differentiable functions as power series, find the Singularities, Zeroes and Poles, Residue .
3. Identify of Integral Transforms Fourier integral, Applications of Fourier transform and Z-transform and its application to solve difference equations.
4. Analyze of different Statistical Techniques – I Moments, Moment generating functions, Skewness, Kurtosis, Curve fitting, , Correlation, Linear, nonlinear and multiple regression analysis,.
5. Analysis of Statistical Techniques – II Binomial, Poisson and Normal distributions, Sampling theory, Tests of significations: Chi- square test, t-test, and Analysis of variance (one way), Application of. Time series and forecasting.

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Unit- I: Sequences and Series **08**

Sequences, Limit of a sequence, Convergence, Divergence and Oscillation of a sequence, Infinite series, Necessary condition for convergence, Standard infinite series, Geometric series and Harmonic series. Tests for convergence and divergence, Comparison test (only for series with positive terms), Cauchy's integral test, D'alembert's ratio test, Cauchy's nth root test, Raabe's test (higher ratio test), Logarithmic test, Demorgan's and Bertrand's tests, Alternating series Leibnitz's theorem (without proof), Absolute convergence and Conditional convergence, Power series.

Unit- II: Function of Complex variable **08**

Analytic function, C-R equations, Harmonic functions, Cauchy's integral theorem, Cauchy's integral formula, Derivatives of analytic functions, Taylor's and Laurent's series, Singularities, Zeroes and Poles, Residue theorem, Evaluation of real integrals of the type $\int_0^{2\pi} f(cos\theta,\ sin\theta)d\theta$ and $\int_{-\infty}^{+\infty} f(x)dx$.

Unit- III: Integral Transforms **08**

Fourier integral, Complex Fourier transform, Inverse transform, Convolution theorem, Fourier sine and cosine transform, Applications of Fourier transform to simple one dimensional heat transfer equations, wave equations and Laplace equations, Z- transform and its application to solve difference equations.

Unit- IV: Statistical Techniques – I **08**

Moments, Moment generating functions, Skewness, Kurtosis, Curve fitting, Method of least squares, Fitting of straight lines, Polynomials, Exponential curves etc., Correlation, Linear, non-linear and multiple regression analysis, Probability theory.

Unit- V: Statistical Techniques – II **08**

Binomial, Poisson and Normal distributions, Sampling theory (small and large), Tets of significations: Chi- square test, t-test, Analysis of variance (one way), Application to

engineering, medicine, agriculture etc. Time series and forecasting (moving and semi- averages), Statistical quality control methods, Control charts, $\bar{X}$, R, p, np and c charts.

Test Books :-

1. Peter V. O'Neil, Advance Engineering Mathematics Thomson (Cengage) Learning, 2007.
2. J.N. Kanpur, Mathematical Statistics, S. Chand & company Ttd., 2000

Reference Books :-

1. R.K. Jain & S.R.K. Iyenger, Advance Engineering Mathematics, Narosa Publication House, 2002.
2. Chandika Prasad, Advanced Mathematics for Engineers, Prasad Mudralaya, 1996.
3. B. V. Ramana, Higher Engineering Mathematics, Mc Gra Hill Education, 2016.
4. E. Kreysig, Advanced Engineering Mathematics, John Wiley & Sons, 2005.
5. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2005.
6. S.P. Gupta, Statistical Methods, Sultan and Sons, New Delhi, 2004.
7. Devore, Probability and Statistics, Thomson (Cengage) Learning, 2007.
8. Walpole, Myers, Myers & Ye, Probability and Statistics for Engineers & Scientists, Pearson Education, 2003.

CE – 301
FLUID MECHANICS

COURSE OUTCOMES (COs):
After completion of the course student will be able to

1. General introduction of different types of fluid and influence of pressure and temperature in different properties of fluid.
2. Determination of value of acting pressure on plane and curved surfaces due to fluid. Calculation of pressure force and buoyancy force and their acting point in plane and curved surfaces in static condition.
3. General understanding of different types of flows. Dimensional analysis and hydraulic similitude between model and prototype, model classification and important dimensionless numbers and their significance.
4. Understand Bernoulli's equation and its application. Momentum equation and its application to pipe bends. Calculation of Kinetic energy and Momentum correction factors for laminar flow. Determine the relationship between shear and pressure gradient in laminar flow.
5. Performance of Reynolds experiment and classification of flow by visual inspection and Reynold number value in pipe flow. Finding equation of motion for laminar flow through pips and between parallel plates.
6. Measurement of scale and intensity of turbulence, velocity distribution in turbulent flow over smooth and rough surfaces. Major and minor losses in flow through pipes, drawing Energy and Hydraulic grade lines. Understand the concept of Boundary layer. Calculation of value of acting forces on submerged bodies.

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Unit-I **08**

Introduction: Fluid and continuum, physical properties of fluids, rheology of fluids.

Fluid Statics: Pressure-density-height relationship, manometers, pressure on plane and curved surfaces, centre of pressure, buoyancy, stability of immersed and floating bodies, fluid masses subjected to linear acceleration and uniform rotation about an axis.

Unit-II **08**

Kinematics of Fluid Flow: Continuum and free molecular flows, steady and unsteady, uniform and non-uniform, laminar and turbulent flows, rotational and irrotational flows, compressible and incompressible flows, subsonic, sonic and supersonic flows, sub-critical, critical and supercritical flows, one, two and three dimensional flows, ideal and real flow.

System versus control volume approach, fundamentals of flow visualization, streamlines, streak lines and path lines, continuity equation in Cartesian and polar co-ordinate system, rotation and circulation, stream function and potential function, flow nets.

Dimensional Analysis and Hydraulic Similitude: Rayleigh's method, Buckingham's Pi theorem, important dimensionless numbers and their significance, geometric, kinematics and dynamic similarity, model studies, distorted and undistorted models.

Unit - III **08**

Potential flow: source, sink, doublet and half-body, free and forced vortex flow.

Dynamics of Fluid Flow: Euler's Equation of motion along a streamline and its integration, Bernoulli's equation and its applications- Pitot tube, orifice meter, venturi meter and bend meter, Hot-wire anemometer and LDA, flow through orifices, mouthpieces, notches and weirs, aeration of nappe, momentum equation and its application to pipe –bends, flow through nozzles.

Unit - IV **08**

Laminar Flow: Relation between shear and pressure gradient in laminar flow,introduction toNavier-Stokes equations, Reynolds experiment**,** equation of motion for laminar flow through pipes, flow between parallel plates, Kinetic energy and Momentum correction factors.

Turbulent Flow: Types of turbulent flow, isotropic, homogenous turbulence, scale and intensity of turbulence, measurement of turbulence, eddy viscosity, Prandtl's mixing length concept and velocity distribution in turbulent flow over smooth and rough surfaces.

Flow through Pipes: Major and minor losses, energy and hydraulic grade lines, combination of pipes, flow through siphon pipes, pipe network, power transmission through pipes, surge tanks, water hammer.

Unit- V **08**

Theory of Boundary Layer: Boundary layer thickness, boundary layer over a flat plate, application of Von-Karman integral momentum equation, laminar sub-layer, boundary layer separation and its control.

Forces on Submerged Bodies: Drag and lift, drag on a sphere and on a cylinder, development of lift on a circular cylinder and an aerofoil, Magnus effect.

Compressible Flow: Thermodynamic relations, basic equations of compressible flow, expression for velocity of sound wave in a fluid.

Text Books:

1. Bansal, R.K., 'Fluid Mechanics and Hydraulics Machines', Laxmi Pub. Ltd., New Delhi
2. Cengel&Cinbala,' Fluid Mechanics', TMH, New Delhi.

Reference Books:

1. Modi, L.P.N, Seth, S.M., 'Hydraulics and Fluid Mechanics', Std. Book House Pub.
2. Ojha, C.S.P., Berndtsson, R., Chandramouli, P.N. 'Fluid Mechanics and Machinery', Oxford University Press.
3. R. W. Fox, P. J. Pritchard, A. T Mcdonald, Introduction to Fluid Mechanics, John Wiley
4. F. M White, Fluid Mechanics, Tata McGraw Hill Eduction.
5. Munsan et.al, 'Fundamentals of Fluid Mechanics', Wilay New York.
6. Garde, R.J., 'Fluid Mechanics'.
7. Jain, A.K., Fluid Mechanics, Khanna Publishers, New Delhi.

ME- 301

STRENGTH OF MATERIALS

COURSE OUTCOMES (COs):

1. To understand the concept of stress and strain under different conditions of loading.
2. To determine the principal stresses and strains in structural members.
3. To determine the stresses and strains in the members subjected to axial, bending and torsional loads.
4. To apply the concepts of stresses and strain in solving problems related to springs, column and pressure vessels.
5. To calculate the slope, deflection and buckling of loaded members.

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Unit I **10**

Stresses in Beams: Review of pure Bending. Direct and shear stresses in beams due to transverse and axial loads, composite beams.

Curved Beams: Bending of beams with large initial curvature, position of neutral axis for rectangular, trapezoidal and circular cross sections, stress in crane hooks, stress in circular rings subjected to tension or compression.

Unit II **10**

Unsymmetrical Bending: Properties of beam cross-section, slope of neutral axis, stress and deflection in unsymmetrical bending, determination of shear center and flexural axis(for symmetry about both axis and about one axis) for I-section and channel section.

Deflection of Beams: Equation of elastic curve, cantilever and simply supported beams, Macaulay's method, area moment method Fixed beams. Castigliano's Theorem.

Unit III **07**

Helical and Leaf Springs: deflection of springs by energy method, helical springs under axial load and under axial twist (respectively for circular and square cross sections) axial load and twisting moment acting simultaneously both for open and closed coiled springs, laminated springs.

Unit IV **07**

Columns and Struts: Combined bending and direct stress, middle third and middle quarter rules. Struts with different end conditions, Euler's theory and experimental results, Ranking Gardon Formulae, Examples of columns in mechanical equipments and machines.

Unit V **06**

Thin cylinders & spheres: Hoop and axial stresses and strain. Volumetric strain. Thick cylinders: Radial, axial and circumferential stresses in thick cylinders subjected to internal or external pressures, Compound cylinders Stresses due to interference fits.

Text Books:

1. Strength of Materials by G.H. Ryder, Macmillan
2. Strength of Materials: Elementary Theory and Problems - Vol. I and Vol. II by Stephen Timoshenko, CBS Publishers
3. Strength of materials R. K. Rajput, S.Chand Publications

Reference Books:

1. Mechanics of Materials by E P Popov, Pearson.
2. Mechanics of Materials by Bear Johnston, McGraw Hill
3. Advanced Mechanics of Solids by L.S. Srinath, McGraw Hill

ME - 302
MATERIALS SCIENCE

COURSE OUTCOMES (COs):

1. To classify the materials.
2. To identify the properties of metals with respect to crystal structure and grain size
3. To interpret the phase diagrams of materials.
4. To classify and distinguish different types of cast irons, steels and non ferrous alloys
5. To describe the concept of heat treatment of steels & strengthening mechanisms

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Unit I **10**

Introduction: Importance of materials, historical perspective, Future aspects of engineering materials.
Crystal Structure: Brief description of BCC, FCC and HCP Structures, coordination number and atomic packing factors. Bravais lattices, Miller indices, crystal imperfections-point line and surface imperfections. Atomic Diffusion: Phenomenon, Ficks laws of diffusion, factors affecting diffusion.
Ferrous and non- ferrous materials: Properties, Composition and uses of Grey cast iron, malleable iron, SG iron and steel, copper alloys-brasses and bronzes, Aluminium alloys.

Unit II **08**

Mechanical Behaviour: Stress-strain diagram showing ductile and brittle behaviour of materials, mechanical properties in plastic range, yield strength off set yield strength, ductility, ultimate tensile strength, toughness, Plastic deformation of single crystal by slip and twinning, Hardness Tests.
Fracture, Creep and Fatigue: Fracture: Type I, Type II and Type III. Creep: Description of the phenomenon with examples. Three stages of creep, creep properties, stress relaxation. Fatigue: Types of fatigue loading with examples, Mechanism of fatigue, fatigue properties, fatigue testing and S-N diagram.

Unit III **06**

Solidification: Mechanism of solidification, Homogenous and Heterogeneous nucleation, crystal growth, cast metal structures. Phase Diagram I: Solid solutions Hume Rothery rule, substitutional and interstitial solid solutions, intermediate phases, Gibbs phase rule.
Phase Diagram: Construction of equilibrium diagrams involving complete and partial solubility, lever rule. Iron carbon equilibrium diagram description of phases, solidification of steels and cast irons, invariant reactions.

Unit IV **06**

Heat Treating of Metals: TTT curves, continuous cooling curves, annealing and its types. Normalizing, hardening, tempering, mastempering, austempering, hardenability, surface hardening methods like carburizing, cyaniding, nitriding, flame hardening and induction hardening, age hardening of aluminium-copper alloys. Comparative study of microstructure of various Ferrous, nonferrous metals and alloys.

Unit V **10**

Composite materials: Definition, classification, types of matrix materials & reinforcements, fundamentals of production of FRP's and MMC's advantages and application of composites.
Ceramics: Structure types and properties and applications of ceramics. Mechanical/ Electrical behavior and processing of Ceramics.
Plastics: Various types of polymers/plastics and its applications. Mechanical behaviour and processing of plastics, Future of plastics. Introduction to Smart materials & Nano-materials and their potential applications.

Text Books:

1. Callisters Materials Science and Engineering, by William D. Callister, Jr, (Adopted by R. Balasubramaniam), Wiley India Pvt. Ltd.
2. Elements of Materials Science & Engineering by L.H. Van Vlack, Pearson

Reference Books:

1. Materials Science by Narula, Mcgraw Hill India.
2. Materials Science and Engineering - A First Course by Raghavan, PHI

ME - 303
ENGINEERING THERMODYNAMICS

COURSE OUTCOMES (COs):

1. To explain the basic concepts of thermodynamics like system, properties, equilibrium, pressure, specific volume, temperature, zeroth law of thermodynamics, temperature measurement and temperature scales.
2. To distinguish between ideal gas and pure substance. Calculate thermodynamic properties using tables of thermodynamic properties and analyze the processes on T-V diagrams to solve advanced engineering problems
3. To explain the concept of thermodynamic work. Calculate and compare work in case of a closed system executing different thermodynamic processes or different thermodynamic cycles.
4. State and apply the first law of thermodynamics for closed and open systems undergoing different thermodynamic processes. Evaluate the performance of steam power plants, refrigeration plants and their components using the first law of thermodynamics for open systems.
5. State and prove the equivalence of two statements of second law of thermodynamics. Define reversible process and state the propositions regarding efficiency of Carnot cycle. Evaluate the feasibility of a thermodynamic cycle using the second law of thermodynamics for typical engineering problems.

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Unit – I **12**

Fundamental Concepts and Definitions: Introduction and definition of thermodynamics, Dimensions and units, Microscopic and Macroscopic approaches, Systems, surroundings and universe, Concept of continuum, Control system boundary, control volume and control surface, Properties and states, Thermodynamic properties, Pressure and its measurement, Thermodynamic path, process and cycle, Thermodynamic equilibrium, Reversibility and irreversibility, Quasi static process, Energy and its forms, Work and heat, Gas laws, Ideal gas

Zeroth law of thermodynamics: Zeroth law of thermodynamics, Temperature and its' measurement, Temperature scales.

First law of thermodynamics: Thermodynamic definition of work, Thermodynamic processes, Calculation of work in various processes and sign convention, Non-flow work and flow work, Joules' experiment, First law of thermodynamics, Internal energy and enthalpy, First law of thermodynamics applied to open systems, Steady flow systems and their analysis, Steady flow energy equation, Boilers, Condensers, Turbines, Throttling process, Pumps etc. First law analysis for closed system (non flow processes), Analysis of unsteady processes such as filling and evacuation of vessels with and without heat transfer, Limitations of first law of thermodynamics, PMM-I.

Unit – II **10**

Second law: Devices converting heat to work, Thermal reservoir, Heat engines, Efficiency, Devices converting work to heat, Heat pump, refrigerator, Coefficient of Performance, Reversed heat engine, Kelvin Planck statement of second law of thermodynamics, Clausius statement of second law of thermodynamics, Equivalence of two statements of second law of thermodynamics, Reversible and irreversible processes, Carnot cycle and Carnot engine, Carnot theorem and it's corollaries, thermodynamic temperature scale, PMM-II.

Entropy : Clausius inequality, Concept of Entropy, Entropy change in different thermodynamic processes, Tds equation, Principle of entropy increase, T-s diagram, Statement of the third law of thermodynamics.

Unit – III **08**

Properties of steam and thermodynamics cycles: Pure substance, Property of steam, Triple point, Critical point, Sub-cooled liquid, Saturation states, Superheated states, Phase transformation process of water, Graphical representation of pressure, volume and temperature, P-T & P-V diagrams, T-s and h-s diagrams, use of property diagram, Steam-Tables & Mollier charts, Dryness fraction and its measurement, processes involving steam in closed and open systems. Simple Rankine cycle.

Unit – IV **08**

Availability and Irreversibility: Available and unavailable energy, Availability and Irreversibility, Second law efficiency, Helmholtz and Gibb's function.

Thermodynamic relations: Mathematical conditions for exact differentials. Maxwell Relations, Clapeyron Equation, Joule-Thompson coefficient and Inversion curve. Coefficient of volume expansion, Adiabatic and Isothermal compressibility. Real gas, Law of corresponding states,Dalton'slaw,Amagat's law, Property of mixture of gases.

Unit – V **04**

Fuels and Combustion: Combustion analysis, Heating Values and its measurement, Air requirement, Air/Fuel ratio, Standard heat of reaction and effect of temperature on standard heat of reaction, heat of formation, Chemical Equilibrium, adiabatic flame temperature.

Text Books:

1. Thermodynamics by J.P. Holman, McGraw Hill.
2. Basic and Applied Thermodynamics by P.K. Nag, McGraw Hill

Reference Books:

1. Engineering Thermodynamics by Jones and Dugans, PHI Learning Pvt. Ltd.
2. Fundamentals of Thermodynamics by Sonntag, Van Wylen, Borgnakke John Wiley & Sons India Pvt.Ltd.
3. Thermodynamics: An engineering approach by Cengel & Boles, McGraw Hill

AS – 302/402

HUMAN VALUES AND ETHICS

COURSE OUTCOMES (COs)

After completion of the course student will be able to

1. This course would help to assess ideas about ethics, self-exploration and happiness through reflective enquiry.
2. It will aid in evaluating the prevailing problems in society due to differentiation and understanding the importance of human values in relationships.
3. The course would lead to knowledge of the ideas of globalization and the world as a nation, for a transformative world order.
4. It will help in analyzing ideas of leadership and creativity and using leadership qualities in day-to-day lives.
5. It will augment an understanding of cross-cultural ethics and help students learn the art of resolving ethical dilemmas in business.

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UNIT 1

Course Introduction **08**

1. Understanding: Why humans are ethical, why they are not;
2. Understanding the need, basic guidelines, content and process for Value Education;
3. Self Exploration–what is it? – It's content and process;
4. 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration;
5. Right understanding of Relationship and Physical Facilities- the basic requirements for fulfilment of aspirations of every human being with their correct priority;
6. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario;
7. Method to fulfil the above human aspirations: understanding and living in **harmony** at various levels

UNIT 2 **08**

Understanding of Human Values and Ethics

1. Understanding the needs of Self ('I') and Body ('Me');
2. Understanding values in human-human relationship;
3. Meaning of Co-existence and Mutual Satisfaction;
4. Understanding Respect;
5. Understanding Comprehensive Human Goals;

UNIT 3 **08**

Effects of Holistic Harmony on Professional Ethics

1. World as a Nation;
2. Definitiveness of Ethical Human Conduct;
3. Basis for Humanistic Education and Humanistic Universal Order;
4. Competence in professional ethics:
    a) Ability to utilize the professional competence for augmenting universal human order;
    b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems,;

c) Ability to identify and develop appropriate technologies and management patterns for above production system;

5. Strategy for transition from the present state to Universal Human Order:
   a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers;
   b) At the level of society: as mutually enriching institutions and organizations;

UNIT 4 **08**

Effects of Holistic Personality for Success

1. Negotiation as a tool for success;
2. Leadership as an attribute of a successful Professional;
3. Managing Stress and Time;
4. Team Building--creating a harmonious environment with apathy to each other;
5. Understanding difference between evolution and revolution;

UNIT 5 **08**

Managing Relationship for Success

1. Understanding and valuing Cross-Cultural Ethics;
2. Managing Relationships (Networking), Personal Effectiveness and Self Leadership;
3. Theory of Constraints;
4. A Decision Making Model: Ethics as making decisions and choices;
5. Conflicts and Ethical Dilemmas;
6. Entrepreneurship and Ethics: A sense of business Ethics;
7. Pragmatic Behaviour of Business to its Colleagues/Competitors

Text Books:

1. Kazuo Ishiguro, 1989, *The Remains of the Day*, Faber and Faber
2. B. L. Bajpai, 2004, *Indian Ethos and Modern Management*. New Royal Book Co., Lucknow. Reprinted 2008;
3. Sussan George, 1976, *How the Other Half Dies*. Penguin Press, Reprint 1991;

Reference Books:

1. Amitabh Ghosh, 2008, *Sea of Poppies*. John Murray Publications.
2. R. K. Narayan, 1958, *The Guide*, Viking Press.
3. P. L. Dhar, R. R. Gour, 1990, *Science and Humanism*, Commonwealth Publishers;
4. R. R. Gaur, R. Sangal and G. P. Bagaria, 2010, *A Foundation Course in Human Values and Professional Ethics*, Excel Books.

Relevant movies and documentaries:

1. Story of Stuff (Documentary);
2. The Remains of the Day (Movie);
3. Pursuit of Happyness (Movie);
4. Fences (Movie);
5. Gifted (Movie)

AS – 303/ AS - 403
ENVIRONMENT AND ECOLOGY

COURSE OUTCOMES (COs):

After the completion of the course, students are expected to have the ability to:

1. Get the information about environment, ecosystem and also about its functions like Food chain, Ecological pyramids etc.
2. Get the complete information about EIA- Environmental Impact Assessment in which the student will get the knowledge about the projects and the process involved in getting the projects.
3. Get the knowledge about the different types of resources like land, water, mineral and energy and also about the effects of environment by the usage of these resources. Also get the knowledge about the analysis of polluted water.
4. Gain the knowledge about different types of pollution and their treatment techniques like waste water treatment, solid waste management etc.,
5. Get the complete information about the all legal aspects of environment protection.

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Unit I- Fundamentals of Environment & Ecology **08**

Definition, Scope & Importance and Need for public awareness.

Ecosystem- Definition, Energy flow in ecosystem, Ecological succession andBalanced ecosystem.

Effect of human activities on food, Shelter, Economic and social security.

Effect of human activities on environment- Agriculture, Housing, Industry, Mining and Transportation activities.

Basics of Environmental Impact, Assessment and Sustainable development.

Unit II- Natural Resources & Environmental Quality standard **09**

Water resources- Availability and quality aspects. Mineral resources, Material Cycle- Carbon, Nitrogen & Sulphur cycles, DO, BOD and COD.

Modern techniques used in analysis of Pollutants- Determination of disinfectants, Pesticides, Ambient Quality standards, Water quality parameters and standards, Turbidity, pH, Suspended solids and hardness,

Unit III- Environmental Pollution & Current Environmental issues **09**

Environmental Pollution-Definition, Causes, Effects and control measure of:

1. Air Pollution
2. Water Pollution
3. Soil pollution
4. Marine Pollution

Current environmental issues of importance: Population growth, Climate change & Global warming- effects, Urbanization, Cause of global warming, Acid rain. Ozone layer depletion-causes and effects on health, Control measures. Photochemical smog, Solid waste management, Waste water treatment.

Unit IV- Energy-Types , Sources and Uses **08**

Different types of energy, Conventional and nonconventional sources- Hydro-electric, Fossil fuel based, Nuclear, Solar, Biomass, Geothermal energy and Biogas. Hydrogen as alternative future source of energy.

Unit V- Environmental protection **06**

Role of Government, Legal aspects, Environment protection Act, Introduction to ISO 14000, Green building concept.

Text Book-

1. Environmental Studies- Dr. D. L. Manjunath, Pearson Education
2. Text book of Environment Science and Engineering- M. Anji Reddy- B S Publication
3. Elements of Environmental Science and Engineering- Dr. P. Meenakshi- Prentice-Hall of India Pvt Ltd, New Delhi, 2008.
4. Environment and Ecology- P.D. Sharma- Rastogi publication 2009.

Reference Books-

1. Principle of Environmental Science and Engineering- P. Venugopalan Rao, Prentice Hall of India.
2. Environmental studies- R. Rajagopalan- Oxford Publication-2005.

AS - 401
COMPUTER ORIENTED NUMERICAL TECHNIQUES

COURSE OUTCOMES (COs):

After completion of the course student will be able to

1. Apply numerical methods to obtain the approximate solutions to the linear and non-linear transcendental and polynomial equations and find error.
2. Identify numerical methods for various mathematical operations and tasks, such as interpolation formulae like forward, backward, and divided difference formulae.
3. Apply the appropriate techniques for numerical differentiation and integration problems
4. Design the numerical solution of initial value problems of the ordinary differential equations with implicit and explicit methods as appropriate
5. Work numerically on the partial differential equations using different methods through of finite difference.

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Unit I **08**

Problem solving on computer, Algorithms and flow charts.

Introduction to numerical computing, approximations and errors in numerical computations, truncation and round off errors, propagation of errors.

Root finding: Bisection method, regula-falsi method, iteration method, Newton Raphson method, Secant method, systems of nonlinear equations. Rate of convergence of iterative methods.

Unit II **06**

Matrix algebra & solution of simultaneous linear algebraic equations: Gauss elimination, Gauss Jordan method, LU Decomposition, Jacobi method, Gauss Seidel method, SOR method, convergence of iterative methods. Tridiagonal systems and Thomas algorithm, Condition of a system and stability issues.

Unit III **10**

Interpolation and Extrapolation: Finite differences, Newton's forward and backward interpolation formula, Lagrange interpolation formula. Divided differences and Newton's formula.

Numerical differentiation. Numerical integration: Trapezoidal and Simpson's rules. Newton-Cotes integration formulas, Romberg integration, Gaussian quadrature.

Unit IV **08**

Numerical solution of O.D.E.: Taylor series method, Euler's method, Runge Kutta method.

Multistep method: Milne,s method, Adams method, accuracy, convergence criteria, stiffness.

Unit V **08**

Boundary Value problems: Finte difference method, solving eigenvalue problems, polynomial method and power method.

Numerical solution of Partial Differential equations. Elliptic, Parabolic and hyperbolic PDEs.

Text Books :

1. Jain, Iyengar and Jain, Numerical Methods for Scientific and Engineering Computation (2003), New Age International, New Delhi.

2. Grewal B.S., Numerical Methods in Engineering and Science, Khanna Publishers, Delhi.
3. E.Balagurusamy, Numerical Methods, Tata Mc Graw hill.

Reference Books :

1. Sastry, S.S. Introductory Methods of Numerical Analysis, 3rd ed. Prentice Hall of India, New Delhi (2002).
2. Schaum's Outlines: Numerical Analysis, 2nd ed. Tata Mc Graw Hill Publishing Co. Limited (1968).
3. Kandasamy, P. Thialagawathy, K. & Gumawathy, K. Numerical Method, S Chand & Company Ltd., New Delhi (1999)
4. Balaguruswanmy, E. Numerical Methods. Tata Mc Graw Hilll Publishing Co. Limited, New Delhi (2001)

ME - 401
MANUFACTURING SCIENCE AND ENGINEERING-I

COURSE OUTCOMES (COs):

1. The student will be having the capability of selecting suitable manufacturing processes to manufacture the products optimally.
2. The student will be able to recommend the appropriate design of gating systems, forming processes, welding process and NDT technique.
3. The student will be able to develop simplified manufacturing processes with the aim of reduction of cost and manpower.
4. The student will be able to identify/control the appropriate process parameters, and possible defects of manufacturing processes so as to remove them.
5. The student will be able to make use of the softwares and CAD/Cam tools meant for optimizing manufacturing processes.

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Unit I **08**

Importance of manufacturing towards technological and social economic development. Classification of manufacturing processes. Survey of manufacturing processes. Manufacturing processes for common items, Concepts of Manufacturing Systems

Unit II **08**

Casting: Basic principle & survey of casting processes. Types of patterns and allowances.Types and properties of moulding sand.Elements of mould and design considerations, Gating, Riser, Runner, Core.Solidification of casting, Sand casting, defects & remedies and inspection.Cupola furnace. Die Casting, Centrifugal casting. Investment casting, CO_2 casting and Stir casting etc.

Unit III **08**

Metal Forming Processes: Elastic & plastic deformation, yield criteria. Hot working vs cold working. Analysis (equilibrium equation method) of Forging process for load estimation with sliding friction sticking friction and mixed condition for slab and disc. Work required for forging, Hand, Power, Drop Forging. Analysis of Wire/strip drawing and maximum-reduction, Tube drawing, Extrusion and its application.Condition for Rolling force and power in rolling.Rolling mills & rolled-sections.Design, lubrication and defects in metal forming processes.

Unit IV **08**

Sheet Metal working: Presses and their classification, Die & punch assembly and press work methods and processes. Cutting/Punching mechanism, Blankingvs Piercing. Compound vs Progressive die. Flat-face vs Inclined-face punch and Load(capacity) needed. Analysis of forming process like cup/deep drawing.Bending & spring-back.

Unit V **08**

Powder Metallurgy: Powder metallurgy manufacturing process. The need, process, advantage and applications. Introduction to rapid prototyping and tooling. Manufacturing of Plastic components: Review of plastics, and its past, present & future uses. Injection moulding.Extrusion of plastic section.Welding of plastics.Future of plastic & its applications.

Text Books

1. Manufacturing Science by AmitabhaGhosh and A.K. Mallik, Ellis Horwood Ltd.
2. Manufacturing Engineering & Technology by Kalpakjian, Pearson Pub.

Reference Books:

1. Production Engg. Science by P.C. Pandey and C.K. Singh, Standard Publishers Distributors.
2. Production Technology by R.K. Jain, Khanna Publishers.
3. Manufacturing Technology by P.N. Rao, TMH
4. DeGarmo's Materials and Processes in Manufacturing by J.T. Black and Ronald A. Kohser, Wiley.

ME - 402

APPLIED THERMODYNAMICS

COURSE OUTCOMES (COs):

1. To apply the knowledge of mathematics, science and engineering fundamentals to model the energy conversion phenomenon.
2. To identify and formulate power production based on the fundamentals laws of thermal engineering.
3. To instill upon to envisage appropriate experiments related to heat engines.
4. To investigate the effectiveness of energy conversion process in mechanical power generation for the benefit of mankind.
5. To appreciate concepts learnt in fundamentals laws of thermodynamics from which learning ideas how to sustain in energy crisis and think beyond curriculum in the field of alternative and renewable sources of energy.

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UNIT I **8**

Gas power cycles: Air Standard cycles: Carnot, Otto, Diesel, Dual and Stirling cycles, P-V and T-s diagrams, description, efficiencies and mean effective pressures, Comparison of Otto, Diesel and dual cycles.

I.C. Engines: Testing of two stroke and four stroke SI and CI engines for performance related numerical problems, heat balance, Willian's line method, Morse test.

UNIT II **8**

Vapour Power cycles and compressors: Simple steam power cycle, Rankine cycle, actual vapour cycle processes, mean temperature of heat addition, effect of pressure and temperature on Rankine cycle, Reheat cycle, Regenerative cycle, Feed water heaters, Binary vapour cycle, Combined cycles, **Process heat and by-product power:** Cogeneration plant, single stage reciprocating air compressor, volumetric efficiency and multistage compression

UNIT III **8**

Boilers: Classification and working of boilers, boiler mountings and accessories, draught and its calculations, air preheater, feed water heater, superheater, boiler efficiency, equivalent evaporation boiler trial and heat balance.

Condenser: Classification of condensers, air leakage, condenser performance parameters.

UNIT IV **8**

Steam and Gas Nozzles: Flow through convergent and convergent-divergent nozzles, variation of velocity, area and specific volume, choked flow, throat area, nozzle efficiency, effect of back pressure, shock waves, Rayleigh line and Fanno lines, effect of friction on nozzle, super saturated flow.

Steam Turbines: Classification of steam turbines, Impulse and Reaction turbines, Staging, Stage and Overall efficiency, Reheat factor, Bleeding, Velocity diagram of simple and compound multistage impulse and reaction turbines and related calculations, work done, efficiencies of reaction, Impulse reaction turbines, state point locus, Losses in steam turbines, Governing of turbines, Comparison with steam engine.

UNIT V **8**

Gas Turbine: Gas turbine classification, Brayton cycle, Principles of gas turbine, Gas turbine cycles with intercooling, reheat and regeneration and their combinations, Stage efficiency, Polytropic efficiency. Deviation of actual cycles from ideal cycles

Jet Propulsion: Introduction to the principles of jet propulsion, Turbojet and turboprop engines and their processes, Principle of rocket propulsion, Introduction to Rocket Engine.

Text Books:

1. Steam & Gas Turbines by R. Yadav, CPH Allahabad.
2. Basic and Applied Thermodynamics by P.K. Nag, MCGRAW HILL INDIA.
3. Gas turbine Theory by H. I. H. Saravanamuttoo, G. F. C. Rogers, Henry Cohen, Pearson Education
4. Gas Turbines, by V. Ganesan, Tata McGraw Hill Publishers.

Reference Books:

1. Theory of Steam Turbine by WJ Kearton
2. Thermal Engg. by PL Ballaney, Khanna Publisher

ME - 403
MEASUREMENTS AND METROLOGY

COURSE OUTCOMES (COs):

1. Explain the basics of standards of measurement, limits, fits & tolerances industrial applications.
2. Identify the uses of gauges and comparators.
3. Understand the significance of measurement system, errors, transducers, intermediate modifying and terminating devices.
4. Interpret measurement of field variables like force, torque and pressure.
5. Comprehend the fundamentals of thermocouple and strain measurement.

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Unit I **08**

Mechanical Measurements: Introduction to measurement and measuring instruments. General concept–Generalized measurement system and its elements-Units and standards measuring instruments: sensitivity, stability, range, accuracy and precision-static and dynamic response-repeatability-systematic, Sources of error, statistical analysis of error and random errors-correction, calibration. Dimensional and geometric tolerance

Sensors and Transducers: Types of sensors, types of transducers and their characteristics.

Unit II **08**

Time Related Measurements: Stroboscope, frequency measurement by direct comparison. Measurement of displacement

Measurement of Pressure: Gravitational, direct acting, elastic and indirect type pressure transducers. Measurement of very low pressures (high vacuum).

Strain Measurement: Types of strain gauges and their working, strain gauge circuits, temperature compensation. Strain rosettes, calibration.

Unit III **08**

Flow Measurement: Hot Wire Anemometry, Laser Doppler Velocimetry, Rotameter.

Temperature Measurement: Thermometers, bimetallic thermocouples, thermistors and pyrometers.

Measurements of Force, Torque: Different types of load cells, elastic transducers, pneumatic & hydraulic systems. Seismic instruments

Measurements of Acceleration, and Vibration: Accelerometers vibration pickups and decibel meters, vibrometers.

Unit IV **08**

Coordinate measuring machine (CMM): Need, constructional features and types, Metrology and Inspection: Standards of linear measurement, line and end standards. Interchange ability and standardization. Linear and angular measuring devices and systems

Comparators: Sigma, Johansson's Microkrator. Limit gauges classification, Taylor's Principle of Gauge Design.

Unit V **08**

Limits, Fits &Tolerance and Surface roughness: Introduction to Limits, Fits, Tolerances and IS standards, Limit-gauges, and surface-roughness. Measurement of geometric forms like straightness, flatness, roundness. Tool makers microscope, profile projector, autocollimator.

Interferometry: principle and use of interferometry, optical flat. Measurement of screw threads and gears. Surface texture: quantitative evaluation of surface roughness and its measurement.

Text Books:

1. Mechanical Measurements by Beckwith, Pearson
2. Mechanical Measurements and Control by D.S. Kumar, Metropoliton Book Company Pvt. Ltd.

Reference Books:

1. Experimental Methods for Engineers by Holman, MCGRAW HILL INDIA
2. Principles of Measurements Systems by Bentley, Pearson
3. Metrology of Measurements by Bewoor and Kulkarni, MCGRAW HILL INDIA
4. Measurement Systems, Application Design by Doeblein, MCGRAW HILL INDIA
5. Hume KJ, “Engineering Metrology”, MacDonald and Co
6. Jain, RK, “Engineering Metrology” Khanna Publishers
7. Jain, R.K., “Mechanical Measurement” Khanna Publishers
8.Gupta SC, Engineering Metrology, DhanpatRai Publications

ME - 404
KINEMATICS OF MACHINES

COURSE OUTCOMES (COs):

1. Understand the principles of kinematics of machines.
2. Calculate the velocity and acceleration for 4-bar and slider crank mechanism.
3. Apply the concept of gear, gear train and flywheel for power transmission.
4. Apply dynamic force analysis for slider crank mechanism and balance rotating & reciprocating masses in machines.
5. Apply the concepts of gyroscope, governors in fluctuation of load and brake & dynamometer in power transmission.

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Unit I **10**

Introduction: Aims & scope of the course & basic concepts of Mechanisms. Basic definitions, Difference between structure & Machine, Links & their types, Types of constrained motion, Kinematic pair & their classification, Grubler's mobility criteria, Inversion of a kinematic chain and applications, Hooks joint, Devis and Ackermann steering mechanism. An introduction to approximate and exact straight line mechanism.

Unit II **08**

Graphical (vector) method for velocity and acceleration of various mechanisms e.g. slider crank and four bar, Coriolis acceleration. Instantaneous centre method, Kennedy's theorem and Klien's construction

Unit III **08**

Transmission drives: Belt, Rope and Chain drives: Types and materials, Fundamentals of Power transmission Phenomena of slip & creep, centrifugal and initial tensions, Tight side and slack side tensions, Conditions of max. Power transmission.

Unit IV **07**

Brakes and Clutches: Types of braking systems, force and torque analysis for block, band and brake and block brake, disc brakes. Friction clutches: types, uniform pressure and uniform wear theory.

Unit V **07**

Theory of gearing: Classification of gears and terminology, Law of gearing, systems of gear teeth, gear profiles, Interference, and efficiency of gears, epicyclical gear train, Compound gear train, Torque analysis and various applications of complex gear trains.

Text Books

1. Theory of Machines by Thomas Beven, Pearson
2. Theory of Machines by S. S. Rattan, McGraw Hill

Reference Books:

1. Kinematics by HN Tyson, John Wiley and Sons
2. Theory of Machines and Mechanisms by Uicker, Pennock and Shigley, Oxford University Press

ME - 501
MACHINE DESIGN – I

COURSE OUTCOMES (COs)

1. Recall the basic concepts of Solid Mechanics to understand the subject.
2. Classify various machine elements based on their functions and applications.
3. Apply the principles of solid mechanics to machine elements subjected to static and fluctuating loads.
4. Analyze forces, bending moments, twisting moments and failure causes in various machine elements to be designed.
5. Design the machine elements to meet the required specification.

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UNIT I

Introduction : Definition, Design requirements of machine elements, Design procedure, Standards in design, Selection of preferred sizes, Indian Standards designation of carbon & alloy steels, Selection of materials for static and fatigue loads.

Design against Static Load : Modes of failure, Factor of safety, Principal stresses, Stresses due to bending and torsion, Theory of failure. **09**

UNIT II

Design against Fluctuating Loads : Cyclic stresses, Fatigue and endurance limit, Stress concentration factor, Stress concentration factor for various machine parts, Notch sensitivity, Design for finite and infinite life, Soderberg, Goodman & Gerber criteria

Riveted Joints : Riveting methods, materials, Types of rivet heads, Types of riveted joints, Caulking and Fullering, Failure of riveted joint, Efficiency of riveted joint, Design of boiler joints, Eccentric loaded riveted joint. **09**

UNIT III

Shafts : Cause of failure in shafts, Materials for shaft, Stresses in shafts, Design of shafts subjected to twisting moment, bending moment and combined twisting and bending moments, Shafts subjected to fatigue loads, Design for rigidity. **07**

UNIT IV

Keys and Couplings : Types of keys, splines, Selection of square & flat keys, Strength of sunk key, Couplings- Design of rigid and flexible couplings.

Mechanical Springs : Types, Material for helical springs, End connections for compression and tension helical springs, Stresses and deflection of helical springs of circular wire, Design of helical springs subjected to static and fatigue loading. **08**

UNIT V

Power Screws : Forms of threads, multiple threads, Efficiency of square threads, Trapezoidal threads, Stresses in screws, Design of screw jack. **07**

Note: Design data book is allowed in the examination

Text books:

1. J.E. Shigley, Mechanical Engineering Design, Tata McGrow Hill.
2. V.B Bhandari, Design of Machine Elements,McGraw Hill.

Reference books:

1. M.F. Spots, Design of M/C Elements, Pearson
2. Sadhu Singh, Machine Design, Khanna Publishers
3. Sharma & Agarwal, S. K.,Machine Design, Kataria& Sons
4. Mahadevan, Design Data Handbook,CBS Publishers & Distributors.
5. Design Data Book, PSG College of Technology

ME-502
MANUFACTURING SCIENCE AND ENGINEERING – II

COURSE OUTCOMES (COs):

1. Understand the basic ideas of welding processes.
2. Application of cutting mechanics to machining of metals based on cutting force and power consumptions.
3. Selection of suitable cutting tool materials and tool geometries for machining of different types of metals and selection of optimum parameters for the respective machining process.
4. Understanding of chip formation mechanism (both for ductile and brittle materials) and ability to measure the cutting forces during chip formation process and understanding of economics of machining, heat distribution in machining and its effects and ability for carrying out temperature measurement during machining.
5. Understanding of tool life, role and types of cutting fluids in machining, machinability index and ability to measure tool life, tool wear and flank wear during machining and description of different grinding processes, grinding wheel selection, temperature and force measurement during grinding.
6. Discussion of milling machines, various operations and Nomenclature of Cutters and explanation of the mechanisms of shaper, planner and slotter and various machining operations performed.

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UNIT I

Metal Cutting : Mechanics of metal cutting.Geometry of tool and nomenclature.ASA system Orthogonal vs. oblique cutting. Mechanics of chip formation, types of chips.
Shear angle relationship. Merchant's force circle diagram. Cutting forces, power required. Cutting fluids/lubricants.Tool materials. Tool wear and tool life. Machinability.Dynamometer.Brief introduction to machine tool vibration and surface finish.Economics of metal cutting. **08**

UNIT II

Machine Tools :

a. Lathe: Principle, construction, types, operations, Turret/capstan, semi/Automatic, Tool layout.
b. Shaper, slotter, planer : Construction, operations & drives.
c. Milling : Construction, Milling cutters, up & down milling. Dividing head & indexing. Max chip thickness & power required.
d. Drilling and boring : Drilling, boring, reaming tools. Geometry of twist drills.

08

UNIT III

Grinding &Super finishing :

(i) Grinding: Grinding wheels, abrasive& bonds, cutting action. Grinding wheel Specification. Grinding wheel wear - attritions wear, fracture wear. Dressing and Truing. Max chip thickness and Guest criteria. Surface and Cylindrical grinding. Centerless grinding.
(ii) Super finishing : Honing, lapping, polishing.Standardization &Interchangeability, Limits, Fits & Tolerance and Surface roughness: Introduction to Standardization &Interchangeability Limits, Fits, Tolerances and IS standards, Limit-gauges, and surface-roughness. **08**

UNIT IV

Metal Joining (Welding) : Survey of welding and allied processes.Gas welding and cutting, process and equipment.Arc welding : Power sources and consumables. TIG & MIG processes and their parameters. Resistance welding - spot, seam projection etc.Other welding processes such as atomic hydrogen, submerged arc, electroslag, friction welding. Soldering & Brazing. Thermodynamic and Metallurgical aspects in welding and weld, Shrinkage/residual stress in welds. Distortions & Defects in welds and remedies. Weld decay in HAZ. **08**

UNIT V

Introduction to Un-conventional Machining and Welding : Need & benefits, application and working principle of EDM, ECM, LBM, EBM, USM. AJM, WJM. Similarly, non-conventional welding applications such as LBW, USW, EBW, Plasma-arc welding, Diffusion welding, Explosive welding/cladding. **08**

Textbooks:

1. Ghosh and Mallik, Manufacturing science, Prentice Hall PTR
2. Degarmo's, Materials and Processes in Manufacturing, John Wiley & Sons

Reference books:

1. Boothroyd, Fundamentals of Metal Cutting and Machine tools,CRC Press
2. R.K. Jain, Production Technology,Khanna Publishers
3. P.C. Pandey, Production Engineering Science,Standard Publishers.
4. P.C. Pandey& H.S. Shan, Modern Machining Processes,Tata McGraw-Hill Education
5. Juneja, Shekhon& Seth, Fundamentals of metal cutting & machine tools, New Age Publ.
6. M.C. Shaw, Metal Cutting Principles,M.I.T. Press.

ME-503
HEAT & MASS TRANSFER

COURSE OUTCOMES (COs)

1. Understand the fundamentals of heat and mass transfer.
2. Apply the concept of steady and transient heat conduction.
3. Apply the concept of thermal behaviour of fins.
4. Apply the concept of forced and free convection.
5. Apply the concept of radiation for black and non-black bodies.
6. Conduct thermal analysis of heat exchangers.

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UNIT I

Introduction to Heat Transfer: Concepts of the mechanisms of heat flows; Conduction, convection and radiation; Effect of temperature on thermal conductivity of materials; Introduction to combined heat transfer mechanism.

Conduction: One-dimensional general differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems; Initial and boundary conditions.

Steady State one-dimensional Heat conduction: Composite Systems in rectangular, cylindrical and spherical coordinates withand without energy generation; Thermal resistance concept; Analogy betweenheat and electricity flow; Thermal contact resistance; Critical thickness of insulation. **09**

UNIT II

Fins: Heat transfer from extended surfaces, Fins of uniform cross-sectional area;Errors of measurement of temperature in thermometer wells.

Transient Conduction: Transient heat conduction; Lumped capacitance method; Time constant;Unsteady state heat conduction in one dimension only, Heisler charts. **07**

UNIT III

Forced Convection: Basic concepts; Hydrodynamic boundary layer; Thermal boundary layer; Approximate integral boundary layer analysis; Analogy between momentum and heat transfer in turbulent flow over a flat surface; Mixed boundary layer; Flow over a flat plate; Flow across a single cylinder and a sphere; Flow inside ducts; Empirical heat transfer relations; Relation between fluid friction and heat transfer; Liquid metal heat transfer.

Natural Convection : Physical mechanism of natural convection; Buoyant force; Empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates and cylinders, and sphere ; Combined free and forced convection. **09**

UNIT IV

Thermal Radiation : Basic radiation concepts; Radiation properties of surfaces; Black body radiation Planck's law, Wein's displacement law, Stefan Boltzmann law, Kirchoff's law; ; Gray body; Shape factor; Black-body radiation; Radiation exchange between diffuse non black bodies in an enclosure; Radiation shields; Radiation combined with conduction and convection; Absorption and emission in gaseous medium; Solar radiation; Green house effect. **07**

UNIT V

Heat Exchanger : Types of heat exchangers; Fouling factors; Overall heat transfer coefficient; Logarithmic mean temperature difference (LMTD) method; Effectiveness-NTU method; Compact heat exchangers.

Condensation and Boiling : Introduction to condensation phenomena; Heat transfer relations for laminar film condensation on vertical surfaces and on outside & inside of a horizontal tube; Effect of non-condensable gases; Dropwise condensation; Heat pipes; Boiling modes, pool boiling; Hysteresis in boiling curve; Forced convective boiling.

Introduction to Mass Transfer : Introduction; Fick's law of diffusion; Steady state equimolar counter diffusion; Steady state diffusion though a stagnant gas film. **08**

Textbooks:

1. J.P. Holman, Heat Transfer, McGraw-Hill Internationa l edition.
2. Cengel&Ghazar,Heat and Mass Transfer, TMH

Reference books:

1. Bayazitouglu&Ozisik, Elements of Heat transfer, McGraw-Hill Book Company.
2. Pitts & Sisson, Schaum's Outline of Heat Transfer, McGraw-Hill International edition.
3. Frank Kreith, Principles of Heat Transfer, McGraw-Hill Book Co.
4. James R.Welty; Fundamentals of Momentum, Heat and Mass Transfe, John Wiley & Sons(Pvt). Ltd.

ME – 504
FLUID MACHINERY

COURSE OUTCOMES (COs)

1. Impart the knowledge on pumps and turbines and impart the knowledge of impact of jets.
2. Able to calculate various parameters like efficiency, specific speed etc.
3. Impart the knowledge on miscellaneous hydraulic machines like hydraulic press, hydraulic ram, hydraulic lift, hydraulic coupling, gear pump etc.
4. To some extent the students will get expertise about the design methodologies of Fluid Machinery.

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UNIT I

Introduction : Classification of Fluid Machines & Devices, Application of momentum and momentum equation to flow through hydraulic machinery, Euler's fundamental equation.

Impact of jet: Introduction to hydrodynamic thrust of jet on a fixed and moving surface (flat & curve), Effect of inclination of jet with the surface.

Hydraulic Turbines : Classification of turbines, Impulse turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Governing of Pelton wheel. **10**

UNIT II

Reaction Turbines : Francis and Kaplan turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Degree of reaction, Draft tube, Cavitation in turbines, Principles of similarity, Unit and specific speed, Performance characteristics, Selection of water turbines. **08**

UNIT III

Centrifugal Pumps : Classifications of centrifugal pumps, Vector diagram, Work done by impellor, Efficiencies of centrifugal pumps, Specific speed, Model testing, Cavitation & separation and their control, Performance characteristics. **07**

UNIT IV

Positive Displacement Pumps : Reciprocating pump theory, Slip and coefficient of discharges, Indicator diagram, Effect and acceleration, Work saved by fitting air vessels, Comparison of centrifugal and reciprocating pumps, Positive rotary pumps, Gear and Vane-pumps, Performance characteristics. **08**

UNIT V

Other Machines: Hydraulic accumulator, Special duty pumps, Intensifier, Hydraulic press, Lift and cranes, Theory of hydraulic coupling and torque converters, Performance characteristics.

Water Lifting Devices: Hydraulic ram, Jet pumps, Air lift pumps. **07**

Text books:

1. R.K. Bansal, A Textbook of Fluid Mechanics and Hydraulic Machines, Laxmi Publications
2. R K Rajput, Fluid Mechanics & Hydraulic Machines, S. Chand Ltd.

Reference books:

1. V.P. Vasandhani, Hydraulic Machines: Theory & Design, Khanna Publishers.
3. D S Kumar, Thermal and Hydraulic Machines, Kataria& Sons.
4. V.P.Gupta, Alam Singh, Manish Gupta, Fluid Mechanics, Fluid Machines & Hydraulics,CBS

Publishers & Distributors.

ME- 505
INDUSTRIAL ENGINEERING

COURSE OUTCOMES (COs)

1. Understand the concept of production system, productivity, facility and process planning in various industries.
2. Apply the various forecasting and project management techniques
3. Apply the concept of break-even analysis, inventory control and resource utilization using queuing theory.
4. Apply principles of work study and ergonomics for design of work systems.
5. Formulate mathematical models for optimal solution of industrial problems using linear programming approach

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UNIT I

Introduction, engineering economy and costing, cost analysis, methods of depreciation, productivityconcepts and measurements, job evaluation, methods of job evaluation, merit rating, wage incentiveplan, types of wage incentive plans. **08**

UNIT II

Work measurement, time study,pre-determined motion and time study(PMTS), work sampling,method study, micro motion study, principles of motion economy. **07**

UNIT III

Plant location, Types of Layout, Principles of Facility Layout, Objective Functions, Steps in PPC,Planning, Routing, Scheduling, Loading, Despatching, Effectiveness of PPC. **08**

UNIT IV

PERT, CPM, Resource Allocation and GERT- Program Evaluation and Review Technique (PERT),Critical Path Method (CPM), Scheduling with Resource Constraints.Introduction to quality management, Ergonomics. **08**

UNIT V

High Volume Production Systems- Transfer Devices, Feeder classification, Construction andApplications, Automated Flow lines, Analysis of Automated Flow lines for Reliability and Efficiency,Assembly Systems, Robot Technology, Flexible Manufacturing Systems (FMS). **09**

Textbooks:

1. M.S. Mahajan,Industrial Engineering, Dhanpatai and Co. (P) Ltd.
2. S.K. Saha, Introduction to Robotics, Tata Magraw Hill

Reference Books:

1. Turner W.C. et Al., Introduction to Industrial System Engineering, Prentice Hall.
2. Ralph M. Barnes, Motion and Time Study, Design and Measurement of Work, Wiley Publishers.
3. John M Nicholas, Project Management for Business and Technology, PHI

4. Robotics by John M Nicholas, Pearson Education

ME - 601

I. C. ENGINES

COURSE OUTCOMES (COs)

1. Explain the working principle, performance parameters and testing of IC Engine.
2. Understand the combustion phenomena in SI and CI engines and factors influencing combustion chamber design.
3. Understand the essential systems of IC engine and latest trends and developments in IC Engines.
4. Understand the effect of engine emissions on environment and human health and methods of reducing it.
5. Apply the concepts of thermodynamics to air standard cycle in IC Engines.

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UNIT I

Introduction to I.C Engines: Engine classification, Air standard cycles, Otto cycle, Diesel cycle,Dual cycle, Comparison of Otto, Diesel and Dual cycles, Sterling cycle, Ericsson cycles, Actual cycleanalysis, Two and four stroke engines, SI and CI engines, Valve timing diagram, Rotary engines,stratified charge engine.

Fuels: Fuels for SI and CI engine, Important qualities of SI and CI engine fuels, Rating of SI engineand CI engine fuels, Vegetable oils, Biodiesel, Gaseous fuels, LPG, CNG, Biogas, Producer gas,Dopes, Additives, Alternative fuels for IC engines. **09**

UNIT II

SI Engines: Combustion in SI engine, Flame speed, Ignition delay, Abnormal combustion and it'scontrol,combustion chamber design for SI engines; Carburetion, Mixture requirements, Carburetortypes, Theory of carburetor, MPFI; Ignition system requirements, Magneto and battery ignitionsystems, ignition timing and spark plug, Electronic ignition. **07**

UNIT III

CI Engines: Combustion in CI engines, Ignition delay, Knock and it's control, Combustion chamberdesign of CI engines; Fuel injection in CI engines, Requirements, Types of injection systems, Fuelpumps, Fuel injectors, Injection timings; Scavenging in 2 Stroke engines. **07**

UNIT IV

Engine Cooling: Different cooling systems, Radiators and cooling fans.

Lubrication: Engine friction, Lubrication principle, Type of lubrication, Lubrication oils, Crankcaseventilation.

Supercharging: Effect of altitude on power output, Types of supercharging.

Testing and Performance: Basic measurements, Optical measurement techniques, Laser Doppleranemometry, Testing of SI and CI engines. **09**

UNIT V

Air Pollution from IC engines :IC engine emissions, Mufflers, Silencers, EGR, Effect of pollutants,Pollution measurement, Emission control in SI and CI engines, Pollution from I.C. Engines and itscontrol, Emission legislations and standards. **08**

Textbooks:

1. Mathur& Sharma, A Course in International Combustion Engines, DhanpatRai&Sons.

2. Ganeshan,I.C Engines, McGraw Hill Publishers.

Reference books:

1.Gill, Smit &,Ziurs, Fundamentals of Internal Combustion Engine Oxford IBH Publ.Co.
2. Rogowsky, IC Engines, International Book Co.
3.R. Yadav, I.C Engine, Central Publishing House, Allahabad

ME –602
DYNAMICS OF MACHINES

COURSE OUTCOMES (COs)

1. Be proficient in the use of mathematical methods to analyze the forces and motion of complex systems of linkages, gears and cams.
2. Be able to design linkage, cam and gear mechanisms for a given motion or a given input/output motion or force relationship.
3. Be able to analyze the motion and the dynamical forces acting on mechanical systems composed of linkages, gears and cams.
4. Apply the concepts of gyroscope, governors in fluctuation of load and brake & dynamometer in power transmission.
5. Develop cam profile for followers executing various types of motions.

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UNIT I

Introduction of cam and follower, Terminology, classification, types of follower motion,Analysis of cam and follower motion. **07**

UNIT II

Introduction to gyroscope, precisional motion and Gyroscopic couple, Effect of gyroscopecouple in aero plane, effect of gyroscopic couple on naval ship during steering, pitching and rolling,Stability of Four wheel and two-wheel vehicle during turning. **08**

UNIT III

Flywheels: Fluctuation of energy and speed, Application of flywheel to various operations andmechanisms of machine; Governor: Terminology, Classification of governors, function, analysis ofvarious types of governors viz. Wald's, Proel, Hartnell. **08**

UNIT IV

Velocity and acceleration of Slider crank mechanism, Analytical method for velocity and accelerationof the piston, angular velocity and acceleration of connecting rod. Force analysis of reciprocatingengine mechanism and inertia torque calculations; Balancing of rotating and reciprocating masses:methods of balancing the primary and secondary unbalanced forces, partial balancing, field balancing. **09**

UNIT V

Introduction to Mechanical Vibration: SHM, 1D and 2D problems of free, damped and forcedvibrations. Vibration isolation, transmissibility, critical speed of shaft.Vibration measuringinstruments.Exact and approximate numerical methods in vibrations. Raleigh, Dunkerlay, Stodolamethods. **08**

Text books:

1. S. S. Rattan, Theory of Machines, McGraw Hill.
2. Grover, G.K., Mechanical Vibrations, Nem Chand Publishers.

Reference books:

1. Thomas Beven, Theory of Machines by Longmans
2. J. Lal, Theory of Mechanisms &Machines, Metropolitan Book Company
3.R.S. Khurmi, J.K. Gupta, Theory of Machinesm, S. Chand, Limited

ME –603
MACHINE DESIGN – II

COURSE OUTCOMES (COs)

1. The students will demonstrate the ability to apply the fundamentals of stress analysis, theories of failure and material science in the design of machine components.
2. The students will demonstrate the preceding abilities by performing correctly the design, analysis and sizing of shafts.
3. They will able to select the material, sizing and analysis of springs.
4. They will able to the select type of bearing, sizing and analysis of rolling element bearings.
5. They will able to analyze the forces and design the basic components on IC engine.

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UNIT I

Spur Gears : Tooth forms, System of gear teeth, contact ratio, Standard proportions of gear systems, Interference in involute gears, Backlash, Selection of gear materials, Gear manufacturing methods, Design considerations, Beam strength of gear tooth, Dynamic tooth load, Wear strength of gear tooth, Failure of gear tooth, Design of spur gears, AGMA and Indian standards. **08**

UNIT II

Helical Gears : Terminology, Proportions for helical gears, Beam strength and wear strength of helical gears, herringbone gears, crossed helical gears, Design of helical gears.

Worm Gears : Types of worms, Terminology, Gear tooth proportions, Efficiency of worm gears, Heat dissipation in worm gearing, Strength and wear tooth load for worm gears, Design of worm gearing. **09**

UNIT III

Sliding Contact Bearing : Types, Selection of bearing, Plain journal bearing, Hydrodynamic lubrication, Properties and materials, Lubricants and lubrication, Hydrodynamic journal bearing, Heat generation, Design of journal bearing, Thrust bearing-pivot and collar bearing, Hydrodynamic thrust bearing. **08**

UNIT IV

Rolling Contact Bearing : Advantages and disadvantages, Types of ball bearing, Thrust ball bearing, Types of roller bearing, Selection of radial ball bearing, Bearing life, Selection of roller bearings, Dynamic equivalent load for roller contact bearing under constant and variable loading, Reliability of Bearing, Selection of rolling contact bearing, Lubrication of ball and roller bearing, Mounting of bearing. **08**

UNIT V

I.C Engine Parts : Selection of type of I.C engine, General design considerations, Design of Cylinder and cylinder head; Design of piston, piston ring and gudgeon pin; Design of connecting rod; Design of centre crankshaft. **07**

Text books:

1. J. E. Shigley, Mechanical Engineering Design, Tata McGraw Hill
2. V.B Bhandari, Design of Machine Elements, McGraw Hill.

Reference books:

1. P.C. Sharma & D.K. Agarwal, S. K., Machine Design, Kataria& Sons
2. Black and Adames, Machine Design, McGraw-Hill
3. Valance &Doughtie, Design of Machine Members,McGraw-Hill
4. Khurmi & Gupta, Machine Design, Eurasia Publishing House.
5. Stephen P. Radzevich, Dudley's Handbook of Practical Gear Design and Manufacture, CRC Press
6. Design Data book (PSG) for practical class, PSG College of Technology
7. Sadhu Singh, Machine Design, Khanna Publishers

ME –604
POWER PLANT ENGINEERING

COURSE OUTCOMES (COs)

1. Understand the different sources of power generation and their impact on environment.
2. Understand the elements of power generation using fossil fuels.
3. Understand the elements of power generation using nuclear and renewable energy sources.
4. Understand the concepts of electrical systems used in power plants.
5. Apply the basic concepts of thermodynamics to measure the performance of different power plants.
6. Determine the performance of power plants based on load variations.

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UNIT I

Introduction: Power and energy, sources of energy, review of thermodynamic cycles related to powerplants, fuels and combustion calculations. Load estimation, load curves, various terms and factorsinvolved in power plant calculations. Effect of variable load on power plant operation, Selection ofpower plant units.

Power plant economics and selection: Effect of plant type on costs, rates, fixed elements, energyelements, customer elements and investor's profit; depreciation and replacement, theory of rates. Economics of plant selection, other considerations in plant selection. **09**

UNIT –II

Steam power plant : General layout of steam power plant, Power plant boilers including critical andsuper critical boilers. Fluidized bed boilers, boilers mountings and accessories, Different systems suchas coal handling system, pulverizers and coal burners, combustion system, draft, ash handling system,Dust collection system, Feed water treatment and condenser and cooling towers and cooling ponds,Turbine auxiliary systems such as governing, feed heating, reheating, flange heating and glandleakage. Operation and maintenance of steam power plant, heat balance and efficiency, Site selectionof a steam power plant. **09**

UNIT III

Diesel power plant : General layout, Components of Diesel power plant, Performance of diesel powerplant, fuel system, lubrication system, air intake and admission system, supercharging system, exhaustsystem, diesel plant operation and efficiency, heat balance, Site selection of diesel power plant,Comparative study of diesel power plant with steam power plant.

Gas turbine power plant: Layout of gas turbine power plant, Elements of gas turbine power plants,Gas turbine fuels, cogeneration, auxiliary systems such as fuel, controls and lubrication, operation andmaintenance, Combined cycle power plants, Site selection of gas turbine power plant. **07**

UNIT IV

Nuclear power plant: Principles of nuclear energy, Lay out of nuclear power plant, Basiccomponents of nuclear reactions, nuclear power station, Nuclear waste disposal, Site selection ofnuclear power plants.

Hydro electric station: Hydrology, Principles of working, applications, site selection, classification and arrangements, hydroelectric plants, run off size of plant and choice of units, operation and maintenance, hydro systems, interconnected systems. **08**

UNIT V

Electrical system : Generators and generator cooling, transformers and their cooling, bus bar,etc.Instrumentation Purpose, classification, selection and application, recorders and their use, listing ofvarious control rooms.

Non Conventional Power Plants: Introduction to non-conventional power plants (Solar, wind,geothermal, tidal, Fuel cell based power plants etc.

Pollution: Pollution due to power generation. **07**

Textbooks:

1. P.K. Nag, Power Plant Engineering, Tata McGraw Hill.
2. R.Yadav, Steam & Gas Turbines & Power Plant Engineering, Central Pub.House.

Reference books:

1. F.T. Morse, Power Plant Engineering, Affiliated East-West Press Pvt. Ltd,.
2. Mahesh Verma, Power Plant Engineering, Metropolitan Book Company Pvt. Ltd.
3. M.M. El-Wakil, Power Plant Technology byMcGraw Hill.

ME –6051
OPERATIONS RESEARCH

COURSE OUTCOMES (COs)

1. Identify and develop operational research models from the verbal description of the real system.
2. Understand the mathematical tools that are needed to solve optimisation problems.
3. Use mathematical software to solve the proposed models.
4. Develop a report that describes the model and the solving technique, analyse the results and propose recommendations in language understandable to the decision-making processes in Management Engineering.
5. Develop linear programming (LP) models for shortest path, maximum flow, minimal spanning tree, critical path, minimum cost flow, and transshipment problems.

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UNIT-I

Introduction: Basic of Operation Research, Origin & development of Operation Research, Applications.

Linear Programming: Introduction & Scope, Problem formulation, Graphical Method, Simplex methods, primal and dual problem sensitivity analysis. **08**

UNIT-II

Transportation Problem: Methods of obtaining initial and optimum solution, degeneracy in transportation problems, unbalanced Transportation Problem.

Assignment Problem: Methods of obtaining optimum solution, Maximization problem, travelling salesman problem. **08**

UNIT-III

Game Theory: two person Zero sum game, Solution with/without saddle point, dominance rule, Different methods like Algebraic, Graphical and game problem as a special case of Linear Programming.

Sequencing: Basic assumptions, n Jobs through 2-3 machines, 2 Jobs on m machines. **08**

UNIT-IV

Stochastic inventory models: Single & multi period models with continuous & discrete demands, Service level & reorder policy.

Simulation: Use, advantages & limitations, Monte-carlo simulation, Application to queuing, inventory & other problems. **08**

UNIT-V

Queuing models: Characteristics of Queuing Model, M/M/1 and M/M/S system, cost consideration.

Project management: Basic Concept of network Scheduling, Rules for drawing network diagram, Applications of CPM and PERT techniques in Project planning and control; crashing of operations; resource allocation. **08**

Text Books:

1. Ravindran, Phillipsn & Solberg, Operations Research: Principles and Practice, Wiley & Sons.
2. Harvey M. Wagner, Principal of Operation Research, Prentice Hall.
3. Prem Kumar Gupta & D.S. Hira, Problems in Operations Research, S. Chand.

4. Yadav & Malik, Operation Research, Oxford University Press
5. Hamdy A. Taha, Operations Research - An Introduction, Pearson India.

Reference Books:

1.Gillett, Introduction to Operation Research, McGraw Hill.
2. Wayne L. Winston, Operation Research, Thomsan Learning.
3. Wayne L Winston, Operation Research Application and Algorithms, Duxbury Press.
4. Pradeep Jha,Operations Research, McGraw Hill.
5. Panneerselvam,Operations Research, PHI, India

ME –6052
MECHANICAL SYSTEM DESIGN

COURSE OUTCOMES (COs)

1. Able to design machine tool gear boxes using standard procedure and modify them for enhanced efficiency.
2. Able to assess the data by using concepts statistical and provide correct interpretation.
3. Identify different conveyors, categorize them for respective material handling systems and design them using related concepts.
4. Outline objectives of optimum design and develop ability to apply optimum design principles for design for manufacturing, assembly & safety.
5. Ability to analyse the path problems and network flow problems.

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UNIT I

Engineering process and System Approach: Basic concepts of systems, Attributes characterizing a system, types of system, Application of system concepts, Advantages of system approach, Problems concerning systems, Concurrent engineering, A case study-Viscous lubrication system in wire drawing.

Problem Formulation: Nature of engineering problems, Need statement, hierarchical nature of systems, hierarchical nature of problem environment, problem scope and constraint, A case study: heating duct insulation system, high speed belt drive system. **08**

UNIT-II

System Theories: Introduction, System Analysis, Black box approach, state theory approach, component integration approach, Decision process approach, a case study- automobile instrumentation panel system.

System modelling: Introduction, Model types and purpose, linear systems, mathematical modeling, concepts, A case study compound bar system. **08**

UNIT-III

Graph Modeling and Analysis: Graph Modeling and analysis process, path problem, Network flow problem, A case study: Material handling system.

Optimization Concepts: Optimization processes, Selection of goals and objectives-criteria, methods of optimization, analytical, combinational, subjective. A case study: aluminium extrusion system.

08

UNIT-IV

System Evaluation: Feasibility assessment, planning horizon, time value of money, Financial analysis, A case study: Manufacture of maize starch system.

Calculus Method for Optimization: Model with single decision variable, model with two decision variables, model with equality constraints, model with inequality constraints, A case study: Optimization of an insulation system. **08**

UNIT-V

Decision Analysis: Elements of a decision problem, decision making, under certainty, uncertainty risk and conflict probability, density function, Expected monetary value, Utility value, Baye's theorem, A case study: Installation of machinery.

System Simulation: Simulation concepts, simulation models, computer application in simulation, spread sheet simulation, Simulation process, problem definition, input model

construction and solution, limitation of simulation approach, A case study: Inventory control in production plant. **08**

Text Books:

1.DD Meredith, K W Wong, R W Woodhead, and R H Wortman, Design and Planning of Engineering systems, Prentice Hall Inc

2. Dieter&Schmidt, Engineering Design, McGraw Hill

3. JR Dixon, Design Engineering, TMH, New Delhi

4. V Gupta and PN Murthy, An Introduction to Engineering Design Method, TMH

References Books:

1. Robert Matousck, Engineering Design: A Systematic Approach, London: Blackie

2. S S Rao, Engineering Optimization: Theory and Practice, John Wiley & Sons

3.Devid I Cleland, William R King, System Analysis and Project Management, McGraw Hill.

ME –6053
SIX SIGMA

COURSE OUTCOMES (COs)

1. Ability to understand the concepts, implementation and objectives of six sigma.
2. Ability to use a structural approach to process improvement.
3. Ability to develop a skill to predict, prevent and control defects in a process.
4. Ability to achieve quality improvement through process improvement.
5. Understand the tools of process discovery.

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UNIT I

Quality Perception; Quality in Manufacturing, Quality in Service Sector; Differences between Conventional and Six Sigma concept of quality; Six Sigma success stories. Statistical foundation and methods of quality improvement. Descriptive statistics: Data Type, Mean, Median, Mode, Range, Variation, Standard Deviation, Skewness, Kurtosis. Probability Distribution: Normal, Binomial, Poisson Distribution. **08**

UNIT II

Basics of Six Sigma: Concept of Six Sigma, Defects, DPMO, DPU, Attacks on X'S, Customer focus, Six Sigma for manufacturing, Six Sigma for service. Z score, Understanding Six Sigma organization, Leadership council, Project sponsors and champions, Master Black Belt, Black Belt, Green Belts. **08**

UNIT III

Methodology of Six Sigma, DMAIC, DFSS, Models of Implementation of Six Sigma, Selection of Six Sigma Projects. **08**

UNIT IV

Six Sigma Tools: Project Charter, Process mapping, Measurement system analysis, Hypothesis Testing, Quality Function deployment, Failure mode effect analysis, Design of Experiments. **08**

UNIT V

Sustenance of Six Sigma, Communication plan, Company culture, Reinforcement and control, Introduction to softwares for Six Sigma, Understanding Minitab, Graphical analysis of Minitab plots. **08**

Text Books:

1. Henderson, G. R, Six Sigma Quality Improvement with MINITAB, Wiley
2. Thomas Pyzdek& Paul Keller, The Six Sigma Handbook, McGrawHill

References Books:

1. N A Siddiqui, Abhishek Dwivedi, Introduction to Six Sigma, New Age International Private Limited
2. William Truscott, Six Sigmaby Routledge.

ME –6054
INDUSTRIAL ERGONOMICS

COURSE OUTCOMES (COs)

1. Ability to increase awareness of the need for and role of ergonomics in occupational health
2. Ability to obtain basic knowledge in the application of ergonomic principles to design of industrial workplaces and the prevention of occupational injuries.
3. Ability to understand the breadth and scope of occupational ergonomics.
4. Ability to recognize ergonomic risk factors related to musculoskeletal disorders.
5. Ability to conduct an ergonomic worksite analysis, and evaluate and rank hazards

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UNIT I

Introduction: Importance applications and principles of occupational ergonomics. Physiological Principles: Muscular work, Nervous control of movements, Improving working efficiency. Optimal use of muscle strength. /Guidelines for work layout. Skilled work: Acquiring skill, control of skilled movements. Design of tools and equipments for skilled work. **08**

UNIT II

Heavy work: Energy consumption, Efficiency, Heart rate as a measure of workload. Work-station Design: Anthropometric data, Reach and clearance dimensions. Percentiles to be accommodated. **07**

UNIT III

Working Heights: Comfortable working postures. Room to grasp or move things, and operate controls.Sedentary work.Its advantages, disadvantages and limitation.Sedentary workplace design.Design ofVDT workstations, Design of Key board. Handling Lads: The Human spine, back troubles associated with industrial work, Inter-vertebral disc, disc pressure, slip of disc, Bio-mechanical models of lower back.

Recommendations for handling loads. Man-Machine System: Display equipment, Controls, Relation between control and display instruments, Mental activity, Fatigue, Occupational stress, Job design inmonotonous task. **09**

UNIT IV

Human Visual System: Accommodation, Aperture of the pupil, Adaptation of reline, eye movements Visual capacity, Visual strain, Physiology of reading. Ergonomic Principles of Lighting: Light sources, measurement, physiological requirements of artificial lighting, arrangement of light. Light for fine work and for VDT offices. **08**

UNIT V

Noise and Work Environment : Sound perception, Noise load, damage to hearing, physiological and psychological effects of noise. Protection against noise, Vibrations and their effect on performance. Working Environment: Thermo-regulation in human body, comfort indoors, Air quality and its dryness, Air pollution and ventilation. Heat in industry Recommendations for comfort indoors. Daylight, colours and music for pleasant work environment. **08**

Text Books :

1. E. Grandjean, Fitting The Task to the Man: A Textbook of Occupational Ergonomics, Taylor and Francis.
2. Helander, M., A guide to the Ergonomics of Manufacturing, CRC Press LLC.
3. Sanders, M.S., and McCormik, E.J.,Human Factor in Engineering and Design, McGraw.Hill

References Books:

1. Babur Mustafa Pulat&David C. Alexander, Industrial Ergonomics: Case Studies, Inst of Industrial Engineers.
2. GavrielSalvendy, Handbook of Human Factors and Ergonomics, Wiley.
3. Pamela McCauley-Bush, Ergonomics: Foundational Principles, Applications, and Technologies (Ergonomics Design & Mgmt. Theory & Applications), CRC Press

ME – 6055
ROBOTICS AND AUTOMATION

COURSE OUTCOMES (COs)

1. The anatomy of the automobile in general.
2. The functioning of the engine and its accessories, gear box, clutch, brakes, steering, axles and wheels.
3. Equipped with the knowledge automation and brief history of robot and applications.
4. Equipped with the principles of various Sensors and their applications in robots.
5. Gain knowledge about robot end effectors and their design concepts.

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UNIT I

Automation: History of Automation, Reasons for automation, Disadvantages of automation, Automation systems, Types of automation – Fixed, Programmable and Flexible automation, Automation strategies. Automated Manufacturing Systems: Components, classification and overview of manufacturing Systems, Flexible Manufacturing Systems (FMS), Types of FMS, Applications and benefits of FMS. **08**

UNIT II

Robotics: Definition of Robot, History of robotics, Robotics market and the future prospects, Robot Anatomy, Robot configurations: Polar, Cartesian, cylindrical and Jointed-arm configuration.

Robot motions, Joints, Work volume, Robot drive systems, Precision of movement – Spatial resolution, Accuracy, Repeatability, End effectors – Tools and grippers. **08**

UNIT III

Controllers and Actuators: Basic Control System concepts and Models, Transfer functions, Block diagrams, characteristic equation, Types of Controllers: on-off, Proportional, Integral, Differential, P-I, P-D, P-I-D controllers. Control system and analysis. Robot actuation and feedback components, Position sensors – Potentiometers, resolvers, encoders, velocity sensors.Actuators - Pneumatic and Hydraulic Actuators, Electric Motors, Stepper motors, Servomotors, Power Transmission systems. **08**

UNIT IV

Robot Sensors and Machine vision system: Sensors in Robotics - Tactile sensors, Proximity and Range sensors, use of sensors in robotics.

Machine Vision System: Introduction to Machine vision, the sensing and digitizing function in Machine vision, Image processing and analysis, Training and Vision systems. **08**

UNIT V

Robots Technology of the future: Robot Intelligence, Advanced Sensor capabilities, Telepresence and related technologies, Mechanical design features, Mobility, locomotion and navigation, the universal hand, system integration and networking.

Artificial Intelligence: Goals of AI research, AI techniques – Knowledge representation, Problem representation and problem solving, LISP programming, AI and Robotics, LISP in the factory. **08**

Text Books

1. M.P. Groover, Automation, Production Systems and Computer Integrated Manufacturing Prentice Hall
2. M.P. Groover, Weiss &Nagel, Industrial Robotics, Technology, Programming and Applications, McGraw Hill.
3. Appu Kuttan K. K., Robotics, I. K. International Pvt Ltd

Reference Books

1. Fu, Lee and Gonzalez, Robotics, Control Vision and Intelligence, McGraw Hill International.
2. Klafter, Chmielewski and Negin, Robotic Engineering - An Integrated approach, Prentice Hall.

ME-701
REFRIGERATION & AIR CONDITIONING

COURSE OUTCOMES (COs):

1. Understand the basics concepts of Refrigeration & Air-Conditioning and its future prospects.
2. Explain the construction and working of various components in Refrigeration & Air-Conditioning systems.
3. Understand the different types of RAC systems with their respective applications.
4. Apply the basic laws to the thermodynamic analysis of different processes involved in Refrigeration and Air-Conditioning.
5. Apply the basic concepts to calculate the COP and other performance parameters for different RAC systems

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UNIT-I **08**

Refrigeration: Introduction to refrigeration system, Methods of refrigeration, Carnot refrigeration cycle, Unit of refrigeration, Refrigeration effect & C.O.P.

Air Refrigeration cycle: Open and closed air refrigeration cycles, Reversed Carnot cycle, Bell Colemanor Reversed Joule air refrigeration cycle, Aircraft refrigeration system, Classification of aircraft refrigeration system. Boot strap refrigeration, Regenerative, Reduced ambient, Dry air rated temperature(DART).

UNIT-II **08**

Vapour Compression System: Single stage system, Analysis of vapour compression cycle, Use of T-Sand P-H charts, Effect of change in suction and discharge pressures on C.O.P,Effect of sub cooling ofcondensate& superheating of refrigerant vapour on C.O.P of the cycle, Actual vapour compressionrefrigeration cycle, Multistage vapour compression system requirement, Removal of flash gas,Intercooling, Different configuration of multistage system, Cascade system.

UNIT-III **08**

Vapour Absorption system: Working Principal of vapour absorption refrigeration system,Comparison between absorption & compression systems, Elementary idea of refrigerant absorbentmixtures, Temperature – concentration diagram & Enthalpy – concentration diagram, Adiabatic mixing oftwo streams, Ammonia – Water vapour absorption system, Lithium-Bromide water vapour absorptionsystem, Comparison.

Refrigerants: Classification of refrigerants, Nomenclature, Desirable properties of refrigerants, Commonrefrigerants, Secondary refrigerants and CFC free refrigerants.

UNIT-IV **08**

Air Conditioning: Introduction to air conditioning, Psychometric properties and their definitions,Psychometric chart, Different Psychometric processes, Thermal analysis of human body, Effectivetemperature and comfort chart, Cooling and heating load calculations, Selection of inside & outside designconditions, Heat transfer through walls & roofs, Infiltration & ventilation, Internal heat gain, Sensible heatfactor (SHF), By pass factor, Grand Sensible heat factor (GSHF), Apparatus dew point(ADP).

UNIT-V **08**

Refrigeration Equipment & Application: Elementary knowledge of refrigeration & air conditioningequipmente.g. compressors, condensers, evaporators & expansion devices, Air washers, Cooling, towers& humidifying efficiency, Food preservation, Cold storage,Refrigerates Freezers, Ice plant, Water coolers,Elementary knowledge of transmission and distribution of air through ducts and fans, Basic differencebetween comfort and industrial air conditioning.

Text Books

1. ManoharPrasad ,Refrigeration and Air conditioning, New Age International (P) Ltd.Pub.
2. C.P Arora.,Refrigeration and Air conditioning , McGrawhHill
3.R.K. Rajpoot ,Refrigeration& Air conditioning, S. Chand

Reference Books

1. Arora&Domkundwar,Refrigeration and Air conditioning.,McGrawhHill
2. stoecker& Jones, Refrigeration and Air conditioningMcGrawhHill.
3. Roy J. Dossat, Refrigeration and Air conditioning CECSA publication.
4. P.L. Baloney, Refrigeration and Air conditioning .Khanna Publication
5. Kuhen, Ramsey &Thelked, Thermal Environment Engg., Pearson publication

ME-702
COMPUTER AIDED DESIGN

COURSE OUTCOMES (COs):

1. To understand & apply co-ordinate system, different transformations and geometric modeling techniques.
2. To evaluate computer graphics, mesh generation for finite elements modeling, fully automatic methods & modeling software's like PRO-E, CATIA etc.
3. To understand complete design process.
4. To understand about Robotic, Computer aided process planning & advanced manufacturing planning.
5. To understand Rapid Prototyping & Flexible manufacturing cells.

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UNIT-I **08**

Introduction: Introduction to CAD/CAED/CAE, Elements of CAD, Essential requirements of CAD, Concepts of integrated CAD/CAM, Necessity & its importance, Engineering Applications Computer Graphics-I CAD/CAM systems, Graphics Input devices-cursor control Devices, Digitizers, Keyboard terminals, Image scanner, Speech control devices and Touch, panels, Graphics display devices-Cathode Ray Tube, Random & Raster scan display, Colour CRT monitors, Direct View Storage Tubes, Flat Panel display, Hard copy printers and plotters.

UNIT-II **08**

Computer Graphics-II Graphics standards, Graphics Software, Software Configuration, Graphics Functions, Output primitives- Bresenham's line drawing algorithm and Bresenham's circle generating algorithm

Geometric Transformations: World/device Coordinate Representation, Windowing and clipping, 2 D Geometric transformations-Translation, Scaling, Shearing, Rotation & Reflection Matrix representation, Composite transformation, 3 D transformations, multiple transformation.

UNIT-III **08**

Curves: Curves representation, Properties of curve design and representation, Interpolation vs approximation, Parametric representation of analytic curves, Parametric continuity conditions, Parametric representation of synthetic curves-Hermite cubic splines-Blending function formulation and its properties, Bezier curves-Blending function formulation and its properties, Composite Bezier curves, B-spline curves and its properties, Periodic and non-periodic B-spline curves.

UNIT-IV **07**

3D Graphics: Polygon surfaces-Polygon mesh representations, Quadric and Superquadric surfaces and blobby objects; Solid modelling-Solid entities, Fundamentals of Solid modelling-Set theory, regularized set operations; Half spaces, Boundary representation, Constructive solid geometry, Sweep representation, Color models Application commands for AutoCAD &Pro-E software.

UNIT-V **09**

Numerical Methods: Introduction, Errors in numbers, Binary representation of numbers, Root findingBisection method, Newton Raphson method, Curve fitting-Least square method,

Numerical differentiation-Newton's interpolation, Numerical Integration-Trapezoidal and Simpson method Finite Element Method: Introduction, Principles of Finite elements modelling, Stiffness matrix/displacement matrix, Stiffness matrix for spring system, bar & beam elements, bar elements in 2D space (truss element).

Text Books

1. Hearn & Baker, Computer Graphics, Prentice Hall of India
2. Anupam Saxena & B. Sahay, Computer Aided Engineering Design, Anamaya Publishers
3. Groover & EW Zimmers, Jr. Prentice, CAD/CAM, HP Hall India Ltd. 40

Reference Books

1. Ibrahim Zeid& R Sivasubramaniam, CAD/CAM Theory and Practice, McGraw Hill
2. RK Srivastava,Computer Aided Design, Umesh Publications
3. DF Rogers & JA Adams, Mathematical Elements for Computer Graphics,McGraw Hill
4. SS Rao, Finite Element Method, Wesley Publication
5. CS Krishnamoorthy, FE Analysis Theory and Programming,Tata McGraw Hill
6. MK Jain, SRK Iyenger& RK Jain,Numerical Method for Engg Computation,Wiley Eastern Limited

ME-703
COMPUTER AIDED MANUFACTURING

COURSE OUTCOMES (COs):

1. Understand the basic concepts of automation, computer numeric control machining.
2. Understand the algorithms of line generation, circle generation, transformation, curve, surface modeling and solid modeling.
3. Understand information system and material handling in CIM environment, rapid prototyping
4. Apply the algorithms of line & circle generation and geometric transformations.
5. Develop CNC program for simple operations.

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UNIT-I **08**

Automation Introduction to CAM; Automated Manufacturing system; Need of automation, Basic elements of automation, Levels of automation, Automation Strategies, Advantages & disadvantages of automation, Historical development and future trends.

Features of NC machinesfundamental of numerical control, elements of NC machine tools, classification of NC machine tools, Advantages, suitability and limitations of NC machine tools, Application of NC system, Methods for improving Accuracy considering the factors such as tool deflection and chatter and Productivity.

UNIT-II **08**

NC Part Programming-

(a) Manual (word address format) programming. Examples Drilling, Turning and Milling; Canned cycles, Subroutine, and Macro.

(b) APT programming. Geometry, Motion and Additional statements, Macro- statement.

UNIT-III **10**

System Devices Introduction to DC motors, stepping motors, feedback devices such as encoder, counting devices, digital to analog converter and vice versa. 3 Interpolators Digital differential Integrator-Principle of operation, exponential decelarion; DDA Hardware Interpolator- Linear, Circular; DDA Software Interpolator.

Control of NC systems open and closed loops. Control of point to point systems- Incremental open loop control, Incremental close loop, Absolute close loop; Control loop in contouring systems; Adaptive control.

UNIT-IV **07**

Computer Integrated Manufacturing system Group Technology, Flexible Manufacturing System, CIM, CAD/CAM, Computer aided process planning-Retrieval and Generative, Concept of Mechatronics, Computer aided Inspection.

UNIT-V **07**

Robotics Types and generations of Robots, Structure and operation of Robot, Robot applications.Economics, Robot programming methods.VAL and AML with examples.Intelligent Manufacturing Introduction to Artificial Intelligence for Intelligent manufacturing.

Text Books References:

1. Mikell P. Groover, Automation, Production Systems and Computer Integrated Manufacturing,Pearson

2. Kundra and Rao,Computer Aided Manufacturing ,McGrawHILL
3. Koren, Computer control of Manufacturing systems,McGrawHILL

References Books

1. S.J. Martin, NC Machine Tools,London: Hodder& Stoughton
2. Koren, NC Machines,Lotus Press
3. Groover, CAD/CAM, Pearson
4. P.N Rao, CAM,McGrawHILL
5. James L.Navins ,Concurrent design of products and processes

ME-7041
NON-DESTRUCTIVE TESTING

COURSE OUTCOMES (COs):

1. Understand the concept of destructive and Non-destructive testing methods.
2. Explain the working principle and application of die penetrates test and magnetic particle inspection.
3. Understand the working principle of eddy current inspection.
4. Apply radiographic techniques for testing.
5. Apply the principle of Ultrasonic testing and applications in medical and engineering areas.

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UNIT-I **07**

Introduction Scope and advantages of NDT.Comparison of NDT with DT.Some common NDT methods used since ages, Terminology.Flaws and Defects, Visual inspection, Equipment used for visual inspection. Ringing test chalk test (oil whitening test). Attractive uses of above tests in detecting surface cracks, bond strength & surface defects.

UNIT-II **10**

Common NDT methods Die penetrate test (liquid penetrate inspection), Principle, scope. Equipment & techniques, Tests stations, Advantages, types of penetrant and developers.Illustrative examples – Heavy castings of large size, frame of jet engine, porosity testing of nickel alloys, leak testing.Zyglo test 6 Magnetic particle Inspection – Scope , principle, Ferro Magnetic and Non-ferro magnetic materials, equipment & testing. Advantages, limitations Interpretation of results.DC & AC magnetization, Skin Effect, use of dye & wet powders for magna glow testing, different methods to generate magnetic fields, Applications.

UNIT-III **10**

Radiographic methods X-ray radiography principle, equipment & methodology. Applicability, types of radiations, limitations. Interpretation of Radiographs, limitations of γ-ray radiography – principle, equipment.Attenuation of electromagnetic radiations, source of radioactive materials & technique. Photo electric effect, Rayleigh's scattering (coherent scattering), Compton's scattering (Incoherent scattering). Pair production, Beam geometry, Scattering factor. Advantages of γ-ray radiography over X-ray radiography Precautions against radiation hazards.Case Study ─ X-ray of human body.

UNIT-IV **07**

Ultrasonic testing methods Introduction, Principle of operation, Piezoelectricity. Ultrasonic probes, CRO techniques, advantages, Limitation & typical applications. Applications in inspection of castings, forgings, Extruded steel parts, bars, pipes, rails and dimensions measurements. Case Study – Ultrasonography of human body.

UNIT-V **06**

Eddy Current Inspection Principle, Methods, Advantages, Scope and limitations. Types of Probes.Case Studies**.**

Text Books :

1. Prasad ,Non-Destructive Testing and Evaluation of Materials, McGraw Hill Edu.
2. Baldev Raj, T. Jayakumar, M. Thavasimuthu, Practical Non-destructive Testing, WoodheadPublishing.
3. Ravi Prakash, Non-Destructive Testing Techniques, New Age International.

Reference books :

1. Robert C. McMaster, Nondestructive Testing Handbook, American Society for Nondestructive.
2. Barry Hull and Vernon John, NDT,Springer
3. BuldevRaj,PracticalNon destructive Testing.,Narosa Publication
4. LariKumar,NDT,S.K. Kataria& Sons

ME-7042
FINITE ELEMENT METHOD

COURSE OUTCOMES (COs):

1. Understand the basic concepts of FEM and its applications.
2. Apply the procedure involved to solve a problem using Finite Element Methods.
3. Develop the element stiffness matrices using different approach.
4. Analyze 1D and 2D problem using different methods.
5. Analyze the complex geometric problems through FEM software packages.

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UNIT-I **10**

Introduction to finite difference method and finite elements method, Advantages and limitations, Mathematical formulation of FEM, Different approaches in Finite Element Method - Direct Stiffness approach, simple examples, Variational approach, Elements of variational calculus - Euler Lagrange equation, Rayliegh Ritz method, Weighted Residual methods, Point Collocation method, Galarkin method - Steps involved in FEM.

UNIT-II **08**

Types of Elements Used Interpolation Polynomials - Linear elements Shape function - Analysis of simply supported beam - Element and Global matrices - Two-dimensional elements, triangular and rectangular elements - Local and Natural Co-ordinate systems.

UNIT-III **08**

Finite Element Formulation of Field Problems 1-D and 2-D heat transfer, fluid flow (incompressible and non viscous fluid) in ducts, Simple electrical and magnetic field problems. Simple Numerical examples.

UNIT-IV **07**

Finite Element Formulation of Solid Mechanics Problems 1-D problem of shaft; Truss element analysis of pinned truss, Plane stress/strain problems, Axi-symmetric problems, thin plate problems; Vibration of shafts & beams.

UNIT-V **07**

Numerical Methods in FEM Evaluation of shape functions - One dimensional & triangular elements, Quadrilateral elements, Isoperimetric elements - Numerical Integration, Gauss Legendre quadrature - Solution of finite element equations – Gauss Elimination Method, Cholesky decomposition.

Text Books :

1. O.C. Zienkiewicz and R.L, The Finite Element Method, Taylor McGraw Hill
2. J. N. Reddy, An Introduction to Finite Element Method,McGraw Hill
3. K.J. Bathe, Finite Element Procedure in Engineering Analysis,McGraw Hill

References Books:

1. C.S. Krishnamoorthy,Finite Element Analysis,Tata McGraw Hill
2. R.D. Cook, D.S. Malcus and M.E. Plesha John, Concepts and Application of Finite Element Analysis,Wiley

3. T.R Chandragupta and A.D. Belegundu, Introduction to Finite Elements in Engineering, Prentice Hall India
4. E Balagurusamy, Numerical Methods,Tata McGraw Hill

ME-7043
MECHANICAL VIBRATIONS

COURSE OUTCOMES (COs):

1. Understand fundamentals of mechanical vibrations along with their classification.
2. Differentiate among single, two and multiple degree of freedom (DOF) systems.
3. Analyze, predict and measure the performance of systems undergoing single, two and multiple DOF.
4. Design systems with optimized vibration absorption capabilities.
5. Apply the fundamentals to the real life problems like whirling of shaft.
6. Solve complicated mathematical models using Numerical methods and software applications.

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UNIT – I **10**

Introduction, Classification of Vibration Systems, Harmonic motion, Vector representation of harmonic motion, Natural frequency & response, Effects of vibration, superposition of simple harmonic motions, beats, Fourier analysis-analytical and numerical methods.

Single Degree Freedom System, Equation of motion, Newton's method, D'Alembert's principle, Energy method etc., Free vibration, Natural frequency, Equivalent systems, Displacement, Velocity and acceleration, Response to an initial disturbance, Torsional vibrations, Damped vibrations, Vibrations of systems with viscous damping, Logarithmic decrement, Energy dissipation in viscous damping.

UNIT – II **08**

Single Degree Freedom: Forced Vibration Forced vibration, Harmonic excitation with viscous damping, steady state vibrations, Forced vibrations with rotating and reciprocating unbalance, Support excitation, Vibration isolation, Transmissibility, Vibration measuring instruments, Displacement, velocity and acceleration measuring instruments.

UNIT- III **08**

Two Degree Freedom systems Introduction, Principal modes, Double pendulum, Torsional system with damping, Coupled system, Principle of vibration absorber, Undamped dynamic vibration absorbers, Torsional vibration absorber, Centrifugal pendulum absorbers, Vibration isolators and Dampers.

UNIT- IV **07**

Multi-degree Freedom system: Exact Analysis, Undamped free and forced vibrations of multi-degree freedom systems, influence coefficients, Reciprocal theorem, Torsional vibration of multi-degree rotor system, Vibration of gear system, Principal coordinates, Continuous systems-Longitudinal vibrations of bars, Torsional vibrations of circular shafts.

UNIT- V **07**

Multi Degree Freedom system: Numerical Analysis by Rayleigh's method, Dunkerely's, Holzer's and Stodola methods, Rayleigh-Ritz method.

Critical speed of shafts, Whirling of uniform shaft, Shaft with one disc with and without damping, Multi-disc shafts, Secondary critical speed.

Text Books:

1. G. K. Groover, Jain Brothers, Mechanical Vibrations, Roorkee.
2. S Bhave, Mechanical Vibrations-Theory & Practice, Pearson Education.
3. Singhal, Mechanical Vibrations-Theory & Applications, Katson Books.

References Books:

1. Thomson&Dahleh, Theory of Vibrations with Applications, Pearson Education.
2. L Meirovitch, Elements of Vibration Analysis, McGraw-Hill Education.
3. Tse, Mechanical Vibrations , Morse & Hinkle
4. V. Rama Murthy,Mechanical Vibrations, Narosa Publications
5. D. Nag,MechanicalVibrations, Wiley

ME-7044
MECHANICAL SYSTEM DESIGN

COURSE OUTCOMES (COs)

1. Able to design machine tool gear boxes using standard procedure and modify them for enhanced efficiency.
2. Able to assess the data by using concepts statistical and provide correct interpretation.
3. Identify different conveyors, categorize them for respective material handling systems and design them using related concepts.
4. Outline objectives of optimum design and develop ability to apply optimum design principles for design for manufacturing, assembly & safety.
5. Ability to analyse the path problems and network flow problems.

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UNIT-I **09**

Engineering process and System Approach Basic concepts of systems, Attributes characterizing a system, system types, Application of system concepts in Engineering, Advantages of system approach, Problems concerning systems, Concurrent engineering, A case study-Viscous lubrication system in wire drawing.

Problem Formulation Nature of engineering problems, Need statement, hierarchical nature of systems, hierarchical nature of problem environment, problem scope and constraint, A case study: heating duct insulation system, high speed belt drive system.

UNIT-II **08**

System Theories System Analysis, Black box approach, state theory approach, component integration approach, Decision process approach, A case study- automobile instrumentation panel system. System modelling Need of modelling, Model types and purpose, linear systems, mathematical modelling, concepts, A case study compound bar system.

UNIT-III **08**

Graph Modelling and Analysis Graph Modelling and analysis process, path problem, Network flow problem, A case study: Material handling system.

Optimization Concepts Optimization processes, Selection of goals and objectives-criteria, methods of optimization, analytical, combinational, subjective. A case study: aluminium extrusion system.

UNIT-IV **08**

System Evaluation Feasibility assessment, planning horizon, time value of money, Financial analysis, A case study: Manufacture of maize starch system. Calculus Method for Optimization Model with one decision variable, model with two decision variables, model with equality constraints, model with inequality constraints, A case study: Optimization of an insulation system.

UNIT-V **09**

Decision Analysis Elements of a decision problem, decision making, under certainty, uncertainty risk and conflict probability, density function, Expected monetary value, Utility value, Baye's theorem, A case study: Installation of machinery. System Simulation Simulation concepts, simulation models, computer application in simulation, spread sheet simulation, Simulation process, problem definition, input model construction and solution, limitation of simulation approach, A case study: Inventory control in production plant.

Text Books:

1. DD Reredith, KV Wong, RW Woodhead, and RR Worthman, Design and Planning of Engineering systems, Prentice Hall Inc., Eaglewood Cliffs, New Jerse
2. K U Siddiqui, Manoj Kumar singh, Mechanical System Design , New age publication
3. JR Dixon, Design Engineering, TMH, New Delhi

References Books:

1. Robert Matousck, Engineering Design, Blackie and son ltd. Glasgow
2. Devid I Cleland, William R King,SystemAnalysis and Project Management, McGraw Hill.
3. V Gupta and PN Murthy, An Introduction to Engineering Design Method, TMH, New Delhi

ME-7045
REVERSE ENGINEERING AND RAPID PROTOTYPING

COURSE OUTCOMES (COs):

1. To know about the main opportunities provided by Reverse Engineering and Rapid Prototyping tools.
2. To understand the main differences, pros and cons of the alternative technologies to carry out design tasks supported by 3D-printing devices.
3. To know about some important Additive Manufacturing processes used for the fabrication of prototypes and components.
4. To be able to identify the advantages and limitations of Reverse Engineering and Additive Manufacturing processes.
5. To learn how to conduct detailed product design by benefitting from cutting-edge technologies.

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UNIT-I **07**

CAD Designing: Introduction, Model preparation, Slicing, Support structures and machine instructions. CAD-CAM and its integration, Development of CAD CAM., The importance of being Rapid, The nature of RP/T, The state of RP/T industry. Rapid Prototyping Defined. Time compression Technologies, Product development and its relationship with rapid prototyping.

UNIT-II **10**

STL Files & RP Software's: Process overviews, STL interface Specification, STL data generation, STL data Manipulation, Advantages and limitations of STL file format. STL file Generation, File Verification & Repair, Build File Creation, and Part Construction, Part Cleaning and finishing, Process Strength & limitations. Open files. Repair of STL files. Alternative RP interfaces. STL file generation, Defects in STL files and repairing algorithms. Tool Path, Part Orientation, Support Generation, Editing and Slicing. RP Software's: Magic or Mimic's, Axure RP Pro, Solid View/Pro RP.

UNIT-III **08**

Rapid Tooling : Introduction, Comparison between Conventional Tooling and Rapid Tooling, Soft Tooling Bridge Tooling, Rapid Injection Molding, Metal Filled Epoxy Tooling, Powdered Metal Tooling, One Piece Mould Approach, Two Piece Mould Approach, Advantages, limitations Applications.

UNIT-IV **07**

Reverse Engineering, Integration of RP and RE: History of Reverse Engineering, Scope and tasks of RE, Preserving and preparation for the four-stage process, Evaluation and Verification-Technical Data Generation, Data Verification, Project Implementation, Equipment Involved in the Reverse Engineering technique.

UNIT-V **08**

Domain analysis- process of duplicating Applications and case studies. Cognitive approach to program understated, integrating formal and structured methods in reverse engineering, Integrating reverse engineering, reuse and specification tool environments to Rapid Prototyping, Interdisciplinary Application of RP and RE.

Text Books:

1. T J Bigger staff,Design Recovery for Maintenance and Reuse, IEEE Corpn. July 1991
2. S. Rugaban,White paper on RE, Technical Report, Georgia Instt. of Technology, 1994
3. Katheryn, Reverse Engineering, A. Ingle, McGraw-Hill, 1994

References books:

1. Aiken, Peter, Data Reverse Engineering, McGraw-Hill, 1996
2. Linda Wills, Reverse Engineering, Kluiver Academic Publishers, 1996
3. Bjorke, Layer Manufacturing, Tapir Publisher. 1992.
4. EldadEilam, Reversing Secret of Reverse engineering, John Wiley & Sons.

AS–701

ENGINEERING ECONOMICS

COURSE OUTCOMES (COs):

Students will be able to:

1. Understand key economic analytical principles for decision-making among alternative courses of action in engineering
2. Learn about the nature of economics and demand analysis.
3. Understand about concept of supply, cost analysis and demand forecasting.
4. Learn about market structure.
5. Learn about nature and characteristics of Indian economy
6. Using analytical techniques including benefit-cost ratio and breakeven analysis, solve economic problems involving comparison and selection of alternatives

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UNIT-I **08**

Introduction of Engineering Economics and Demand Analysis: Meaning and nature of economics, relation between science, engineering, technology and economics; Meaning of demand, determinants of demand, shifts in demand, law of demand, price elasticity of demand &types, income elasticity, cross price elasticity, determinants of elasticity and uses and importance of elasticity.

UNIT-II **08**

Concept of Supply: Law of supply, factors affecting supply, and elasticity of supply. Demand forecasting: introduction, meaning and forecasting, methods or techniques of demand forecasting, criteria for good demand forecasting and demand forecasting for a new product.

UNIT-III **08**

Cost Analysis: Introduction, types of costs, cost-output relationship: cost function, cost-output relationships in the short run, and cost-output relationships in the long run; Short run and long run, break- even analysis; Production functions: laws of variable proportions, law of returns and economies of scale: internal and external.

UNIT-IV **08**

Market Structure: Market structure perfect competition, imperfect competition – monopolistic, oligopoly and duopoly sorbent features of price determination and various market conditions.

UNIT-V **08**

Nature and characteristics of Indian economy: Concepts of LPG, elementary concepts of national income, inflation and business cycles ,concept of N.I and measurement, meaning of inflation, types and causes and phases of business cycle investment decisions for boosting economy(national income and per capital income).

Text Books:

1. PremvirKapoor, "Sociology and Economics for Engineers", Khanna Publishing.
2. Salvatore D, “Principles of Microeconomics”, Oxford University Press.
3. Koutsoyiannis A, “Modern Microeconomic”, Macmillan Education Ltd.

Reference Books:

1. Dwivedi DN, “Principles of Microeconomics”, Pearson Education.
2. Cowell, FA, “Microeconomic Principles and Analysis”, Oxford University Press.
3. Riggs J L, “Engineering Economics”, McGraw Hills.

AS–702
INDUSTRIAL MANAGEMENT

COURSE OUTCOMES (COs)

1. To understand the basic concept of Industrial management and its types and ownership.
2. To know the functions of management with the help of scientific theory and human resource management.
3. Able to know the objective and measurement in work study and use the different model of inventory control.
4. To design the control chart for variable and attributes in statistical quality control and implementing sampling plan.
5. Able to analyse the project management scheme in project network analysis

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UNIT-I **08**

Introduction: Concept and scope of industrial management. **Productivity:** definition, measurement, productivity index, types of production system and industrial ownership.

UNIT-II **08**

Functions of Management: Taylor's scientific management theory, Fayol's principles of management, social responsibilities of management, introduction to human resources management: nature of HRM, functions and importance of HRM.

UNIT-III **08**

Work Study: Introduction, definition, objectives, steps in work study; **Method study:**Definition, objectives, steps of method study; **Work measurement:** Purpose, types of study: Stop watch methods steps: Allowances,standard time calculations, work sampling, production planning and control inventory control: inventory, cost, models of inventory control: EOQ, ABC, VED.

UNIT-IV **08**

Quality Control: Statistical quality control, control charts for variables and attributes, acceptance sampling: single sampling- double sampling plans and introduction to TQM.

UNIT-V **08**

Project Management: Project network analysis, CPM, PERT and project crashing and resource leveling.

Text Books:

1. Gideon Halevi, "Industrial Management- Control and Profit: A Technical Approach" Springer.
2. A.P. Verma and N. Mohan "A Textbook of Industrial Management" S.K. Kataria& Sons.
3. S. K. Sharma, Savita Sharma "Industrial Engineering and Organization Management", Kataria and Sons.

Reference Books:

1. S.C. Sharma & T.R. Banga,"Engineering Management" (Industrial Engineering & Management), Khanna Book Publishing Co.
2. P. Khanna, "Industrial Engineering and Management", Dhanpatrai publications Ltd.
3. PaneerSelvam, "Production & Operation Management", PHI.

ME-8011
ADVANCED WELDING

COURSE OUTCOMES (COs):

1. Understand the physics of arc welding process and various operating characteristics of welding power source.
2. Analyse various welding processes and their applications.
3. Apply the knowledge of welding for repair & maintenance, along with the weldability of different materials.
4. Apply the concept of quality control and testing of weldments in industrial environment.
5. Evaluate heat flow in welding and physical metallurgy of weldments.

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UNIT-I **09**

Introduction: Welding as compared with other fabrication processes, Importance andapplicationofwelding, classification of welding processes, Health & safety measures inwelding. Welding Power Sources: Physics of welding Arc, Basic characteristics of power sources forvarious arc welding processes, Transformer, rectifier and generators.

Physics of Welding Arc: Welding arc, arc initiation, voltage distribution along the arc, arccharacteristics, arc efficiency, heat generation at cathode and anode, Effect of shielding gas onarc, isotherms of arcs and arc blow.

Metal Transfer: Mechanism and types of metal transfer in various arc welding processes.

UNIT-II **09**

Welding Processes: Manual Metal Arc Welding (MMAW), TIG, MIG, Plasma Arc,Submerged Arc Welding, Electro gas and Electroslag, Flux Cored Arc Welding, Resistancewelding, Friction welding, Brazing, Soldering and Braze welding processes, Laser beamwelding, Electron beam welding, Ultrasonic welding, Explosive welding, Friction Stir Welding,Underwater welding & Microwave welding.

UNIT-III **07**

Heat Flow Welding: Calculation of peak temperature; Width of Heat Affected Zone (HAZ);cooling rate and solidification rates; weld thermal cycles; residual stresses and theirmeasurement; weld distortion and its prevention.

UNIT-IV **07**

Repair & Maintenance Welding: Hardfacing, Cladding, Surfacing, Metalizing processes andReclamation welding.

Weldability: Effects of alloying elements on weld ability, welding of plain carbon steel, CastIron and Aluminium. Micro & Macro structures in welding.

UNIT-V **08**

Weld Design: Types of welds & joints, Joint Design, Welding Symbols, weld defects,Inspection/testing of welds, Introduction to Welding Procedure Specification & ProcedureQualification Record.

Text Books:

1. Welding and Welding Technology, by- Richard L. Little, McGraw Hill Education.
2. Welding Principals and Practices, by- Edwars R. Bohnart, McGraw Hill Education.

3. Welding technology , O.P khanna , DhanpatRai

References Books;

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1. R. S. Parmar, Welding Engineering and Technology, KhannaPublishsers.
2. N K Srinivasan , Welding Technology,KHANNA PUBLISHERS
3. R S Parmar, Welding Engineering and Technology.KHANNA PUBLISHER
4. William. A. Bowditch, Welding Technology Fundamentals, Goodheart-Willcox
5. Baldev Raj, Welding Technology for engineers, ASM International

ME-8012
ENERGY CONSERVATION ANDMANAGEMENT

COURSE OUTCOMES (COs):

1. Obtain knowledge about energy conservation policy regulations and business practices.
2. Analyse energy systems from a supply and demand perspective.
3. Recognize opportunities for enabling rational use of energy.
4. Apply knowledge of Energy Conservation Opportunities in a range of contexts.
5. Develop innovative energy efficiency solutions and demand management strategies.

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UNIT –I **08**

Introduction to energy & power scenario of world, National Energy consumption data,environmentalaspects associated with energy utilization; Energy Auditing- need, types,methodology and barriers, role of energy managers, instruments of energy auditing.

UNIT –II **08**

Components of EB billing, HT and LT supply, transformers, cable sizing; Concept ofcapacitors, power factor improvement, harmonics; Electric motors- motor efficiencycomputation, energy efficient motors; Illumination- Lux, Lumens, types of lighting, efficacy,LED lighting and scope of energy conservation in lighting.

UNIT –III **08**

Thermal systems, Boilers, Furnaces and Thermic Fluid heaters- efficiency computation andenergy conservation measures; Steam distribution and usage, steam traps, condensaterecovery, flash steam utilization; Insulation & Refractories.

UNIT –IV **08**

Energy conservation in major utilities; pumps, fans, blowers, compressed air systems,Refrigeration& Air Conditioning systems, Cooling Towers, DG sets.

UNIT-V **08**

Energy Economics- discount period, payback period, internal rate of return, net present value;Life Cycle costing- ESCO concept.

Text Books:

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.

Reference Books:

1. K V Sharma and P Venkataseshaiah, Energy Management and Conservation.
2. Frank Kreith and D Yogi Goswami, Energy Management and Conservation Handbook (Mechanical and Aerospace Engineering Series)
3. Giovanni Petrecca, Energy Conversion and Management.
4. Dr. Subhash L.Gadhave, Energy ConsevAation and management, Technical Publication
5. KV Sharma, EnergyConsevAation and management.

ME-8013
TOTAL QUALITY MANAGEMENT

COURSE OUTCOMES (COs):

1.Evaluate the principles of quality management and to explain how these principles can be applied within quality management systems.

2.Identify the key aspects of the quality improvementcycle and to select and use appropriate tools and techniques for controlling, improving andmeasuring quality.

3.Critically appraise the organisational, communication and teamwork requirements for effective quality management

4.Critically analyse the strategic issues in quality management, including current issues and developments, and to devise and evaluate quality implementation plans

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UNIT-I **08**

Quality Concepts Evolution of Quality control, concept change, TQM Modern concept, Quality concept in design, Review off design, Evolution of proto type. Control on Purchased Product Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure. Manufacturing Quality Methods and Techniques for manufacture, Inspection and control of product, Quality in sales and services, Guarantee, analysis of claims**.**

UNIT-II **09**

Quality Management Organization structure and design, Quality function, decentralization, Designing and fitting organization for different types products and company, Economics of quality value and contribution, Quality cost, optimizing quality cost, seduction programme. Human Factor in Quality Attitude of top management, co-operation, of groups, operators attitude, responsibility, causes of operators error and corrective methods.

UNIT-III **08**

Control Charts Theory of control charts, measurement range, construction and analysis of R charts, process capability study, use of control charts. Attributes of Control Charts Defects, construction and analysis off-chart, improvement by control chart, variable sample size, construction and analysis of C-chart.

UNIT-IV **08**

Defects Diagnosis and Prevention Defect study, identification and analysis of defects, corrective measure, factors affecting reliability, MTTF, calculation of reliability, Building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality circle.

UNIT-V **07**

IS0-9000 and its concept of Quality Management: ISO 9000 series, Taguchi method, JIT in some details.

Text Books:

1. Proff. V.Vijayan, Total Quality Management, S.Chand Publication
2. Greg Bounds. “Beyond Total Quality Management”. McGraw Hill, 1994.
3. Menon, H.G, "TQM in New Product manufacturing", McGraw Hill 1992

References Books:

1. Poornima M. Charantimath, Total Quality Management, Pearson Education
2. Besterfield Dale H, Total Quality Management, Pearson Education India
3. Lt. Gen. H.LaI, "Total Quality management", Wiley Eastern Limited, 1990
4. Total Quality Management By ByMukheerji, PHI Publication

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ME-8014

THEORY OF ELASTICITY

COURSE OUTCOMES (COs):

1. To be able to execute the stress state and stresses analysis.
2. To be able to solve a problem of strain analysis.
3. To be able to analyze the stresses and strains in 3 D bodies.
4. To be able to use the numerical methods for the problem of the theory of elasticity in practice.
5. To be able to use theory for solution of practice problem of stress and strain analysis.

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UNIT I **08**

Basic Equations of Elasticity: Definition of Stress and Strain: Stress – Strain Relationships – Equations of Equilibrium, Compatibility Equations, Boundary Conditions, Saint Venant'sprinciple – Principal Stresses, Stress Ellipsoid – Stress Invariants.

UNIT II **08**

Plane Stress and Plane Strain Problems: Airy's Stress Function, Bi-Harmonic Equations, Polynomial Solutions, Simple Two-Dimensional Problems in Cartesian Coordinates Like Bending of Cantilever and Simply Supported Beams.

UNIT III **08**

Polar Coordinates: Equations of Equilibrium, Strain – Displacement Relations, Stress – Strain Relations, Airy's Stress Function, Axis – Symmetric Problems, Introduction toDunder's Table, Curved Beam Analysis, Lame's, Kirsch, Michell's And Boussinesque Problems – Rotating Discs.

UNIT IV **08**

Torsion: Navier's Theory, St. Venant's Theory, Prandtl's Theory on Torsion, Semi- Inverse Method and Applications to Shafts of Circular, Elliptical, Equilateral Triangular and Rectangular Sections. Membrane Analogy.

UNIT V **08**

Introduction to Theory of Plates and Shells: Classical Plate Theory – Assumptions – Governing Equations – Boundary conditions – Navier's Method of Solution for Simply Supported Rectangular Plates Levy's Method of Solution forRectangular Plates Under Different Boundary Conditions.

Text Books:

1. Wang, C. T., Applied Elasticity, McGraw – Hill Co., New York, 1993.
2. Sokolnikoff, I. S., Mathematical Theory of Elasticity, McGraw – Hill, New York, 1978.
3. Volterra& J.H. Caines, Advanced Strength of Materials, Prentice Hall, New Jersey, 1991.

Reference Books:

1. Barber, J. R., Elasticity, Kluwer Academic Publishers, 2004.
2. S.Timoshenko, Theory of elasticity.
3. H Jane Helena, Theory of elasticity.
4. Ukadgaonkar Vijay G, Theory of elasticity and Fracture Mechanism.

ME-8015

ADVANCED PRODUCTION ENGINEERING

COURSE OUTCOMES (COs):

1. To be able to categorize different material removal, joining processes as per the requirements of material being used to manufacture end product.
2. To be able to select material processing technique with the aim of cost reduction, reducing material wastage & machining time.
3. To be able to identify the process parameters affecting the product quality in various advanced machining of metals/ non-metals, ceramics and composites.
4. To be able to combine & develop novel hybrid techniques from the state of art techniques available.
5. To be able to perform process analysis taking into account the various responses considered in a process.

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UNIT-I **08**

Metal Cutting Theory: Geometry of cutting tools, metal machining, chip formation, types of chips, force analysis, velocity relationship, stress and strain analysis, power and energy relationships, thermal aspects, dynamometers for turning and drilling. Evaluation of machinability, tool wear and tool life, cutting forces, surface finish, economies of metal machining and cutting fluids.

UNIT-II **09**

Machine Tools System: Design analysis of machine tools, elements, structure, slideways and guides, spindle unit drives in machine tools, layout of gear box, stepped regulators, stepless regulators, and hydraulic regulators. Tool Design of CNC machines Tooling principles and tool layouts for turrets, automates, operation planning considerations, designing of cams. Tooling for CNC machines, Design of single point cutting tools, rigidity, design of chip breakers, dynamic chip breaking, design of press dies, component of die, cutting action in a die, clearance, cutting forces, shear, centre of pressure,

UNIT-III **06**

Jigs and fixture: Usefulness of jigs and fixtures, principles of design, locating and clamping, diamond pin locator, jig bushes, drill jigs, milling, turning, boring and broaching fixtures, assembly fixtures, welding fixtures, indexing devices, materials for jigs and fixtures, economics of jigs and fixtures.

UNIT-IV **09**

Unconventional Machining Processes: Mechanical Processes: Ultrasonic Machining, Elements of USM, Acoustic Head and Design etc., Abrasive Jet Machining, Variables effecting AJM, Water Jet Machining, Equipment and process details, Electrochemical Processes: elements of process, electrolytes & their properties, chemistry of process, metal removal rate. Thermal aspect, temperature rise & pressure-flow rate, tool design, accuracy & surface finish, advantages, application & limitations of the process.

UNIT-V **08**

Thermal processes: Electrical discharge machining, mechanism of metal removal, accuracy and surface finish, application & future trends, Plasma Arc Machining, mechanism of metal removal,

accuracy and surface finish, economics and application of plasma jets, Electro/Laser Beam Machining: Electro beam machining: generation and control of electron beam, process capability and limitations. Laser beam machining: Principles of working, thermal aspect, material removal, cutting speed and accuracy, advantages & limitations.

Text Books:

1. R.K. Jain, Production Technology, Khanna Publishers
2. Ghosh Amitabh, Manufacturing Processes, PEARSON India
3. Dr. P.C Sharma, Production Engineering., S Chand

References Books.

1. Bhattacharya, Metal Cutting Principles, New Central Book Agency
2. PN Rao, Manufacturing technology, McGrawHill
3. Martend T Telsang, Industrial Engineering and production Management, S Chand

ME-802
AUTOMOBILE ENGINEERING

COURSE OUTCOMES (COs):

1. Explain the working principle, performance parameters and testing of IC Engine.
2. Understand the phenomena of combustion and its application in SI and CI engines.
3. Understand the essential systems of IC engine.
4. Understand the effect of engine emissions on environment and human health and methods of reducing it.
5. Apply the concepts of thermodynamics to air standard cycle in IC Engines.

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UNIT-I **06**

Introduction: Basic concepts of Automobile Engineering and general configuration of an automobile, PowerandTorque characteristics.Rolling, air and gradient resistance.Tractive effort. Gear Box. Gearratiodetermination.

UNIT-II **08**

Transmission System: Requirements. Clutches.Toque converters.Over Drive and free wheel, Universal joint.DifferentialGearMechanism of Rear Axle. Automatic transmission, Steering and Front Axle.Castor Angle, wheel camber& Toe-in, Toe-out etc... Steering geometry. Ackerman mechanism,Understeer and Oversteer. Hotchkissdrive and Torque tube drive.

UNIT-III **10**

Braking System: General requirements, Road, tyre adhesion, weight transfer, Braking ratio. Mechanical brakes,Hydraulicbrakes. Vacuum and air brakes.Thermal aspects.Antilock braking system(ABS), electronic brake forcedistribution (EBD) and traction control.

Chassis and Suspension System: Loads on the frame, Strength and stiffness, Independent front & rear suspension, Perpendiculararm type,Parallel arm type, Dead axle suspension system, Live axis suspension system,Airsuspension& shockabsorbers.

UNIT-IV **07**

Electrical System: Types of starting motors, generator & regulators, lighting system, Ignition system, Horn, Batteryetc.

Fuel Supply System: Diesel& Petrol vehicle system such as Fuel Injection Pump, Injector & Fuel Pump, Carburettoretc.

UNIT-V **09**

Emission standards and pollution control: Indian standards for automotive vehicles-Bharat I and II, Euro-I and Euro-II norms, fuelqualitystandards, environmental management systems for automotive vehicles, engine emissioncontrolby 3-way catalytic converter system, fueladditives and modern trends in automotive engine efficiencyand emission control.

Alternative Energy Sources: Alternative energy sources, natural gas, LPG, biodiesel, bio-ethanol, gasohol and hydrogenfuelsinautomobiles, modifications needed, performance, combustion &emissioncharacteristics of alternativefuels in SI and CI engines, Electric and Hybrid vehicles,application of Fuel Cells. Preventionmaintenance and overhauling.

Text Books:

1. Hietner, Automotive Engineering,CBS
2. Narang, Automobile Engineering,KHANNA PUBLISHERS
3. TTTI, Automobile Engineering, Pearson Indi,McGraw Hill Education

References Books:.

1. Newton and Steeds, Automobile Engineering,Society of Automotive Engineers
2. Ramakrishna, Automobile Engineering, PHI, India.
3. Kripal Singh, Automobile Engineering., Standard
4. Kirpal Singh, Automobile Engineering, 7th ed., Standard Publishers, New Delhi, 199

AS–801

ENGINEERING ECONOMICS

COURSE OUTCOMES (COs):

Students will be able to:

1. Understand key economic analytical principles for decision-making among alternative courses of action in engineering
2. Learn about the nature of economics and demand analysis.
3. Understand about concept of supply, cost analysis and demand forecasting.
4. Learn about market structure.
5. Learn about nature and characteristics of Indian economy
6. Using analytical techniques including benefit-cost ratio and breakeven analysis, solve economic problems involving comparison and selection of alternatives

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UNIT-I **08**

Introduction of Engineering Economics and Demand Analysis: Meaning and nature of economics, relation between science, engineering, technology and economics; Meaning of demand, determinants of demand, shifts in demand, law of demand, price elasticity of demand &types, income elasticity, cross price elasticity, determinants of elasticity and uses and importance of elasticity.

UNIT-II **08**

Concept of Supply: Law of supply, factors affecting supply, and elasticity of supply. Demand forecasting: introduction, meaning and forecasting, methods or techniques of demand forecasting, criteria for good demand forecasting and demand forecasting for a new product.

UNIT-III **08**

Cost Analysis: Introduction, types of costs, cost-output relationship: cost function, cost-output relationships in the short run, and cost-output relationships in the long run; Short run and long run, break- even analysis; Production functions: laws of variable proportions, law of returns and economies of scale: internal and external.

UNIT-IV **08**

Market Structure: Market structure perfect competition, imperfect competition – monopolistic, oligopoly and duopoly sorbent features of price determination and various market conditions.

UNIT-V **08**

Nature and characteristics of Indian economy: Concepts of LPG, elementary concepts of national income, inflation and business cycles ,concept of N.I and measurement, meaning of inflation, types and causes and phases of business cycle investment decisions for boosting economy(national income and per capital income).

Text Books:

1. PremvirKapoor, "Sociology and Economics for Engineers", Khanna Publishing.
2. Salvatore D, “Principles of Microeconomics”, Oxford University Press.
3. Koutsoyiannis A, “Modern Microeconomic”, Macmillan Education Ltd.

Reference Books:

1. Dwivedi DN, “Principles of Microeconomics”, Pearson Education.
2. Cowell, FA, “Microeconomic Principles and Analysis”, Oxford UniversityPress.
3. Riggs J L, “Engineering Economics”, McGraw Hills.

AS–802
INDUSTRIAL MANAGEMENT

COURSE OUTCOMES (COs)

1. To understand the basic concept of Industrial management and its types and ownership.
2. To know the functions of management with the help of scientific theory and human resource management.
3. Able to know the objective and measurement in work study and use the different model of inventory control.
4. To design the control chart for variable and attributes in statistical quality control and implementing sampling plan.
5. Able to analyse the project management scheme in project network analysis

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UNIT-I **08**

Introduction: Concept and scope of industrial management. **Productivity:** definition, measurement, productivity index, types of production system and industrial ownership.

UNIT-II **08**

Functions of Management: Taylor's scientific management theory, Fayol's principles of management, social responsibilities of management, introduction to human resources management: nature of HRM, functions and importance of HRM.

UNIT-III **08**

Work Study: Introduction, definition, objectives, steps in work study; **Method study:**Definition, objectives, steps of method study; **Work measurement:** Purpose, types of study: Stop watch methods steps: Allowances,standard time calculations, work sampling, production planning and control inventory control: inventory, cost, models of inventory control: EOQ, ABC, VED.

UNIT-IV **08**

Quality Control: Statistical quality control, control charts for variables and attributes, acceptance sampling: single sampling- double sampling plans and introduction to TQM.

UNIT-V **08**

Project Management: Project network analysis, CPM, PERT and project crashing and resource leveling.

Text Books:

1 Gideon Halevi, "Industrial Management- Control and Profit: A Technical Approach" Springer.
2 A.P. Verma and N. Mohan "A Textbook of Industrial Management" S.K. Kataria& Sons.
3 S. K. Sharma, Savita Sharma "Industrial Engineering and Organization Management", Kataria and Sons.

Reference Books:

1 S.C. Sharma & T.R. Banga,"Engineering Management" (Industrial Engineering & Management), Khanna Book Publishing Co.
2 P. Khanna, "Industrial Engineering and Management", Dhanpatrai publications Ltd.
3 PaneerSelvam, "Production & Operation Management", PHI.

APPENDIX

List of Open Electives

Note: Students may opt any one subject from the following list of open electives with restriction in some subjects as mentioned-

S.No.	Subject Code	Subject Name	Subject Offered by Department of	Remark
1.	OE-8011	Fuzzy logic and Neural Network	Computer Science &Engg.	--
2.	OE -8012	Mobile Application development	Computer Science &Engg.	--
3.	OE -8013	Automation & Robotics	Computer Science &Engg.	--
4.	OE -8014	Mobile Computing	Computer Science &Engg.	--
5.	OE -8015	Internet-of-Things	Computer Science &Engg.	--
6.	OE -8016	Cyber Law and Ethics	Computer Science &Engg.	--
7.	OE -8017	Data Analytics	Electrical Engg.	--
8.	OE -8018	Non-Conventional Energy Resources	Electrical Engg.	--
9.	OE -8019	Applied Operations Research	Mechanical Engg.	Not to be opted by students of Mechanical Engg.
10.	OE -8020	Six Sigma Methods & Application	Mechanical Engg.	--
11.	OE -8021	Mechatronics	Mechanical Engg.	--
12.	OE -8022	Biomedical Electronics	Electronics & Comm. Engg.	Not to be opted by students of Electronics & Comm. Engg.
13.	OE -8023	Embedded System	Electronics & Comm. Engg.	Not to be opted by students of Electronics & Comm. Engg.
14.	OE -8024	Advances in Polymer Science Technology	Applied Science& Humanities	--
15.	OE -8025	Mathematical Modeling and Simulation	Applied Science&Humanities	--
16.	OE -8026	Nanoscience and Quantum Computing	Applied Science& Humanities	--
17.	OE -8027	Entrepreneurship Development	Applied Science& Humanities	--
18.	OE -8028	Critical And Logical Thinking	Applied Science& Humanities	--
19.	OE -8029	Town Planning	Civil Engg.	--

20.	OE -8030	Disaster Management	Civil Engg.	--
21.	OE -8031	Environmental Pollution & Management	Civil Engg.	--

OE -8011
FUZZY LOGIC AND NEURAL NETWORK

COURSE OUTCOMES (COs)

After completion of the course student will be able to

1. Understand basic knowledge of fuzzy sets and fuzzy logic.
2. Apply basic fuzzy inference and approximate reasoning.
3. Understand principles of neural networks.
4. Apply basic fuzzy system modelling methods.

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Unit-1 **08**

Introduction to Neural Networks: Introduction, humans and computers, organization of the brain, biological neuron, biological and artificial neuron models, Hodgkin-Huxley neuron model, integrate-and-fire neuron model, spiking neuron model, characteristics of ANN, Mcculloch-Pitts model, historical developments, and potential applications of ANN.

Unit-2 **08**

Essentials of Artificial Neural Networks: Artificial neuron model, operations of artificial neuron, types of neuron activation function, ANN architectures, classification taxonomy of ANN –connectivity, neural dynamics (activation and synaptic), learning strategy (supervised, unsupervised, reinforcement), learning rules, and types of application.

Unit-3 **08**

Single Layer Feed Forward Neural Networks: Introduction, **Perceptron models:** discrete, continuous and multi-category; **Training algorithms:** discrete and continuous perceptron networks, perceptron convergence theorem, limitations of the perceptron model, and applications.

Unit-4 **08**

Classical & Fuzzy Sets: Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, and membership functions.

Unit-5 **08**

Fuzzy Logic System Components: Fuzzification, membership value assignment, development of rule base and decision making system, defuzzification to crisp sets, and defuzzification methods.

Text Books:

1. Rajasekharan and Rai., "Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications", PHI Publication.
2. Bart Kosko, "Neural Networks and Fuzzy Logic System", PHI Publications.
3. S.N.Sivanandam, S.Sumathi, S.N.Deepa, "Introduction to Neural Networks using MATLAB 6.0", TMH.

Reference Books:

1. James A Freeman and Davis Skapura, “Neural Networks”, Pearson Education.
2. Simon Hakins, “Neural Networks”, Pearson Education.
3. C.Eliasmith and CH.Anderson, ”Neural Engineering”, PHI.

OE-8012
Mobile Application Development

COURSE OUTCOMES (COs)

After completion of the course student will be able to

1. Ability to apply general programming knowledge in the field of developing mobile applications.
2. Understanding of the specific requirements, possibilities and challenges when developing for a mobile context.
3. Understanding of the interactions between user interface and underlying application infrastructure.

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Unit-1 **08**

Introduction: What is android, android versions and its feature to set the various android devices on the market, the android market application store, android development environment - system requirements, android SDK, installing java, and ADT bundle - eclipse integrated development environment (IDE), creating android virtual devices (AVDs), android architecture overview and creating an example. **Android Application:** The android software stack, the linux kernel and android runtime - Dalvik virtual machine

Unit-2 **08**

Android Software Development Platform: Understanding java SE and the Dalvik virtual machine, the directory structure of an android project, common default resources folders, the values folder, leveraging android XML, screen sizes. **Launching your application:** The android manifest.xml file, creating your first android application, android framework overview and android application components.

Unit-3 **10**

Understanding Android Views: View groups and layouts, designing for different android devices, views and view groups, android layout managers, the view hierarchy, designing an android user interface using the graphical layout tool. Graphical user interface screen with views, displaying text with text view, retrieving data from users, using buttons, check boxes and audio groups. Getting dates and times from users, using indicators to display data to users, adjusting progress with seek bar and working with menus using views.

Unit-4 **07**

Displaying Pictures: Gallery, image switcher, grid view, and image view, views to display images, creating animation files, content providers, and databases, saving and loading files, SQLite databases and android database design.

Unit-5 **07**

Intents and Intent Filters: Intent overview, implicit intents, creating the implicit intent example project, explicit intents, creating the explicit intent example application, intents with activities and intents with broadcast receivers. A basic overview of android threads and thread handlers.

Text Books:

1. S. Sydhani Begum, “Mobile App Development”, Notion press.
2. Pradeep Kothari, “Android Application Development”, Dream Tech press.
3. Bill Phillips, Chris Stewart and Kristin Marsicano, ”Android Programming”, Big Nerd Ranch.

Reference Books:

1. Jonathan McCallister, “Mobile Apps”, Create Space Independent Publishing platform.
2. Dan Hermes , “Xamarin Mobile Application Development”, Apress.
3. Dawn Griffiths, ”Head First Android Development”, O’Reilly.

OE-8013
AUTOMATION AND ROBOTICS

COURSE OUTCOMES (COs)

After completion of the course student will be able to

1. Understand robotics and automation terminology.
2. Evaluate and plan robotic path.
3. Know various end effectors along with selection criterion.
4. Analyze robot matching with workplace.
5. Understand industrial environment for robotics system.
6. Explain the fundamentals of robotics and its components
7. Illustrate the Dynamics of robotics.
8. Explain sensors and instrumentation in robotics.

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Unit-1 **08**

Introduction to Robotics: Types and components of a robot, classification of robots, closed-loop and open-loop control systems. Kinematics systems: Definition of mechanisms and manipulators, social issues and safety.

Unit-2 **09**

Robot Kinematics and Dynamics: Kinematic Modelling: Translation and rotation representation, co-ordinate transformation, DH parameters, Jacobian, singularity and statics, dynamic modelling, Equations of motion: Euler-Lagrange formulation.

Unit-3 **09**

Sensors and Vision System: Sensor: Contact and proximity, position, velocity, force and tactile etc., Introduction to Cameras: Camera calibration, geometry of image formation, Euclidean/similarity/affine/projective transformations and vision applications in robotics.

Unit-4 **08**

Robot Control: Basics of control: Transfer functions, control laws: P, PD, PID, non-linear and advanced controls, robot actuation systems: actuators: electric, hydraulic and pneumatic. Transmission: Gears, timing belts and bearings and parameters for selection of actuators.

Unit-5 **06**

Control Hardware and Interfacing: Embedded systems: Architecture and integration with sensors, actuators, components and programming for robot applications

Text Books:

1. Mittal R.K., NagrathI.J., “Robotics and Control”, Tata McGraw Hill.
2. Mukherjee S., “Robotics and Automation”, Khanna Publishing House, Delhi.
3. Craig, J.J., “Introduction to Robotics: Mechanics and Control”, Pearson, New Delhi,

Reference Books:

1. Saha, S.K., “Introduction to Robotics”, McGraw-Hill Higher Education”, NewDelhi.
2. Ghosal, A., “Robotics”, Oxford, New Delhi.
3. Niku Saeed B., “Introduction to Robotics: Analysis, Systems, Applications”, PHI, New Delhi.

OE-8014
MOBILE COMPUTING

COURSE OUTCOMES (COs)

After completion of the course student will be able to

1. Explain the principles and theories of mobile computing technologies.
2. Describe infrastructures and technologies of mobile computing technologies.
3. List applications in different domains that mobile computing offers to the public, employees, and businesses.

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Unit -1: **08**

Introduction: Challenges in mobile computing, coping with uncertainties, resource poorness and bandwidth, etc. cellular architecture, co-channel interference, frequency reuse and capacity increase by cell splitting. **Evolution of mobile system**: CDMA, FDMA, TDMA, and GSM.

Unit -2: **08**

Mobility Management: Cellular architecture, co-channel interference. **Mobility:** handoff, types of handoffs, location management, HLR-VLR scheme, hierarchical scheme, predictive location management schemes, Mobile IP and cellular IP.

Unit -3: **09**

Publishing & Accessing Data in Air: Pull and push based data delivery models, data dissemination by broadcast, broadcast disks, directory service in air and energy efficient indexing scheme for push based data delivery. **File System Support for Mobility**: Distributed file sharing for mobility support, CODA and other storage manager for mobility support.

Unit -4: **08**

Ad-hoc Network Routing Protocols: Ad-hoc network routing protocols, destination sequenced distance vector algorithm, cluster based gateway switch routing, global state routing, fish-eye state routing, dynamic source routing, ad-hoc on-demand routing, location aided routing and zonal routing algorithm.

Unit -5: **07**

Mobile Transaction and Commerce: Models for mobile transaction, Kangaroo and Joey transactions and team transaction, recovery model for mobile transactions, electronic payment and protocols for mobile commerce.

Text Books:

1. J. schiller , “Mobile Communication”, Addison Wesley.
2. Charlsperkins, “Ad-hoc Networks”, Addison Wesley.
3. Charlsperkins, “Mobile IP”, Addison Wesley.

Reference Books:

1. Willam Stallings, “Wireless Communications and Networking “, Pearson Education.
2. Sandeep Ks Gupta, “Fundamentals of Mobile & Pervasive Computing”, Frank Adelstein.
3. A. Mehrotra, “GSM System Engineering” Artech House.

OE- 8015
INTERNET OF THINGS

COURSE OUTCOMES (COs)

After completion of the course student will be able to

1. Understand the application areas of IOT.
2. Understand building blocks of Internet of Things and characteristics.

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Unit-1 **08**

Introduction: Internet of thing, history of IoT, about IoT, overview and motivations, examples of applications, internet of things definitions and frameworks: IoT definitions, IoT architecture, general observations, ITU-T views, working definition, IoT frameworks and basic nodal capabilities.

Unit-2 **08**

Fundamentals of IoT Mechanisms and Key Technologies: Identification of IoT objects and services, structural aspects of the IoT, environment characteristics, traffic characteristics, scalability, interoperability, security and privacy, open architecture, key IoT technologies, device intelligence, communication capabilities, mobility support, device power, sensor technology, RFID technology and satellite technology.

Unit-3 **08**

Radio Frequency Identification Technology: RFID introduction, principle of RFID, components of an RFID system, Issues EPC global architecture framework- EPCIS & ONS, design issues, technological challenges, security challenges, IP for IoT, and web of things. **Wireless Sensor Networks:** History and context, WSN architecture, the node, connecting nodes, networking nodes, securing communication WSN specific IoT applications, challenges- security, QoS, configuration, various integration approaches, data link layer protocols, routing protocols and infrastructure establishment.

Unit-4 **08**

Resource Management in the Internet of Things: Clustering, software agents, clustering principles in an internet of things, architecture, design guidelines, and software agents for object representation, data synchronization, identity portrayal, identity management, various identity management models- local, network, federated and global web identity, user-centric identity management, device centric identity management and hybrid-identity management, identity and trust.

Unit-5 **08**

Internet of Things Privacy, Security and Governance: Vulnerabilities of IoT, security requirements, threat analysis, use cases and misuse cases, IoT security tomography and layered attacker model, identity establishment, access control, message integrity, non-repudiation, availability and security model for IoT.

Text Books:

1. A. Bahga and Vijay Madisetti, “Internet of Things - A Hands-on Approach”, Universities Press.
2. Matt Richardson, S. Wallace, “Getting Started with Raspberry Pi”, O'Reilly (SPD).

3. Olivier Hersent, D. Boswarthick, O.Elloumi, “The Internet of Things: Key Applications and Protocols”, 2nd Edition, Willy Publications.

Reference Books:

1. D. Uckelmann, M. Harrison, Michahelles, Florian , “Architecting the Internet of Things”, Springer.
2. Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press.
3. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier.

OE-8016
CYBER LAW AND ETHICS

COURSE OUTCOMES (COs)

After completion of the course student will be able to

1. Identify and analyse statutory, regulatory, constitutional, and organizational laws that affect the information technology professional.
2. Locate and apply case law and common law to current legal dilemmas in the technology field.

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Unit-1 **08**

Fundamentals of Cyber Law: Jurisprudence of cyber law, object and scope of the IT Act2000, introduction to Indian cyber law, uncitral model law, ISP guideline. Intellectual property issues and cyber space, Indian perspective, overview of intellectual property related legislation in India, patent, copy right, trademark law, law related to semiconductor layout and design.

Unit-2 **08**

E-commerce Security: Security threats to e-commerce, virtual organization, business transactions on web, e-governance and EDI, concepts in electronic payment systems, e-cash, credit/debit cards, e-agreement, legal recognition of electronic and digital records, e-commerce issues of privacy, wireless computing-security challenges in mobile devices. **Digital Signatures** -Technical issues, legal issues, electronic records, digital contracts, and requirements of digital signature system.

Unit-3 **08**

Security Policies: Development of policies, www policies, email security policies, policy review process-corporate policies-sample security policies, publishing and notification requirement of the policies, **Evolving technology security:** mobile, cloud, outsourcing and SCM.

Unit-4 **09**

Internet Security Threats: Information systems and its importance, role of security in internet and web services, classification of threats and attacks, security challenges, security implication for organizations, security services-authentication, confidentiality, integrity, availability and other terms in information security, Introduction to cryptography, firewalls, basic concepts of network security, perimeters of network protection & network attack, need of intrusion monitoring and detection, hacking, cracking, sneaking, viruses, trojan horse, malicious code & logic bombs, Introduction to biometric security, its challenges, and finger prints.

Unit-5 **07**

Investigation and Ethics: Cyber-crime, cyber jurisdiction, cyber-crime and evidence act, treatment of different countries of cyber-crime, ethical issues in data and software privacy, plagiarism, pornography, tampering computer documents, data privacy and protection, domain name system, software piracy, issues in ethical hacking. **Cyber-crime forensic:** Case study in cyber-crime.

Text Books:

1. Charles P. Pfleeger, Shari Lawerance Pfleeger, "Analyzing Computer Security", Pearson Education India.

2. Harish Chander, “Cyber Law and IT Protection”, PHI Publication, New Delhi.
3. Sarika Gupta & Gaurav Gupta, Information Security and Cyber Laws, Khanna Publishing House.

Reference Books:

1. Schou, Shoemaker, “Information Assurance for the Enterprise”, Tata McGraw Hill.
2. Anshul Kaushik, “Cyber Security”, Khanna Publishing House.
3. V.K. Jain, “Cryptography and Network Security”, Khanna Publishing House, Delhi.

OE-8017
DATA ANALYTICS

COURSE OUTCOMES (COs)

After completion of the course student will be able to

1. Identify appropriate data mining algorithms to solve real world problems.
2. Compare and evaluate different data mining techniques like classification, prediction, clustering and association rule mining.
3. Describe complex data types with respect to spatial and web mining.

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UNIT-I **10**

Introduction: Sources, modes of availability, inaccuracies and uses of data; Data Objects and Attributes; Descriptive Statistics: Visualization, Data Similarity and Dissimilarity, Pre-processing of Data: Cleaning for Missing and Noisy Data; Data Reduction: Discrete Wavelet Transform, Principal Component Analysis, Partial Least Square Method, Attribute Subset Selection, Data Transformation and Discretization.

UNIT-II **08**

Inferential Statistics: Probability density functions; Inferential statistics through hypothesis tests. **Business Analytics:** Predictive Analysis (Regression and Correlation, Logistic Regression, In-Sample and Out-of-Sample Predictions), Prescriptive Analytics (Optimization and Simulation with Multiple Objectives);

UNIT-III **08**

Mining Frequent Patterns: Concepts of support and confidence; Frequent Item sets Mining Methods; Pattern Evaluation. Classification: Decision Trees – Attribute Selection Measures and Tree Pruning; Bayesian and Rule-based Classification; Model Evaluation and Selection; Cross-Validation; Classification Accuracy; Bayesian Belief Networks; Classification by Back-propagation and Support Vector Machine.

UNIT-IV **06**

Clustering: Partitioning Methods – k-means Hierarchical Methods and Hierarchical Clustering using Feature Trees; Probabilistic Hierarchical Clustering; Introduction to Density, Grid and Fuzzy and Probabilistic Model-based Clustering Methods; and Evaluation of Clustering Methods.

UNIT-V08

Machine Learning: Introduction and Concepts: Ridge Regression; Lasso Regression; and *k*-Nearest Neighbours, Regression and Classification;

Supervised Learning with Regression and Classification Techniques: Bias-Variance Dichotomy, Linear and Quadratic Discriminant Analysis, Classification and Regression Trees; Ensemble Methods: Random Forest, Neural Networks, Deep Learning.

Text Books:

1. G. Shmueli, N. R. Patel, and P. C. Bruce, "Data Mining for Business Intelligence", John Wiley & Sons, New York.
2. V. Kumar, and P.N. T. M. Steinbach, "Introduction to Data Mining", Pearson.

Reference Books:

1. J. Han, M. Kamber and J. Pei, "Data Mining: Concepts and Techniques, Morgan Kaufmann.
2. G. James, D. Witten, T. Hastie, and R. Tibshirani, "An Introduction to Statistical learning with Applications in R", Springer, New York.
3. C. M. Bishop, "Pattern Recognition and Machine Learning", Springer.

OE-8018
NON-CONVENTIONAL ENERGY RESOURCES

COURSE OUTCOMES(COs)

After completion of the course student will be able to

1. Identify renewable energy sources and their utilization.
2. Understand basic concepts of solar radiation and analyze solar thermal systems for its utilization.
3. Understand working of solar cells and its modern manufacturing technologies.
4. Understand concepts of Fuel cells and their applications
5. Compare energy utilization from wind energy, geothermal energy, biomass, biogas and hydrogen

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UNIT-I **09**

Introduction: Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits; Solar Energy: Solar Radiation and its measurement, modes of utilization of solar energy; Solar Photovoltaic Technology: Theory of solar cells. Solar cell materials, voltage developed by solar cell, Solar cell performance, solar PV power plant.

UNIT-II **06**

Solar Thermal Energy: Flat plate collectors: materials used, applications and performance; Focusing type collectors: materials used, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling systems, limitations.

UNIT-III **10**

Geothermal Energy: Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations; Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations; Fuel Cells: Principle of working of various types of fuel cells and their working, performance and limitations.

UNIT-IV **07**

Thermo-electric and Thermionic conversions: Principle of working, performance and limitations; Wind Energy: Wind power, site selection criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics, performance and limitations of energy conversion systems.

UNIT-V **08**

Bio-mass: Availability of bio-mass and its conversion theory; Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle, performance and limitations; Wave energy and Tidal energy: Working principle, performance, limitations; waste recycling plants; Grid integration of RES.

Text Books:

1. M. V. R. Koteswara Rao, "Energy Resources: Conventional & Non-Conventional", BS Publications.
2. D.S. Chauhan,"Non-conventional Energy Resources" New Age International.

3. C.S. Solanki, “Renewable Energy Technologies: A Practical Guide for Beginners” PHI Learning.
4. G.D. Rai, “Non-Conventional Energy Sources”, Khanna Publishers.
5. R. D. Begamudre, “Energy Conversion Systems”, New Age International Publishers.

Reference Books:

1. Peter Auer, “Advances in Energy Systems and Technology”, Vol. 1 & II Edited by Academic Press.
2. Godfrey Boyle, “Renewable Energy Power for A Sustainable Future”, Oxford University Press.

OE-8019
APPLIED OPERATIONS RESEARCH

COURSE OUTCOMES (COs)

After completion of the course student will be able to

1. To be able to understand the application of OR and frame a LP Problem with solution–graphical and through solver add in excel (software).
2. To be able to build and solve Transportation and Assignment problems using appropriate method.
3. To be able to design and solve simple models of CPM and queuing to improve decision making and develop critical thinking and objective analysis of decision problems.
4. To be able to solve simple problems of replacement and implement practical cases of decision making under different business environments.
5. Enables to take best course of action out of several alternative courses for the purpose of achieving objectives by applying game theory and sequencing models.

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UNIT-I **10**

Introduction: Definition and scope of OR, Techniques and tools, model formulation, general methods for solution, Classification of Optimization problems, Optimization techniques.

Linear Optimization Models: Complex and revised Simplex algorithms, Degeneracy and duality, Post-optimum and Sensitivity analysis, Assignment, transportation and transhipment models, Travelling salesmanproblem, Integer and parametric programming.

UNIT-II **08**

Game Problems: Minimax criterion and optimal strategy, two persons zero sum game, Games by Simplex dominance rules.

UNIT-III **07**

Waiting Line Problems: Classification of queuing problems, M/M/1 & M/M/1/N queuing systems, Steady state analysis of M/M/m queues, Discrete and continuous time Markov models, Chapman-Kolmogorov equation, Birth & death processes in manufacturing, Open and Closed queuing networks.

UNIT-IV **07**

Inventory Management: ABC analysis, deterministic and Probabilistic models.

UNIT-V **08**

Dynamic Programming: Characteristics of dynamic programming problems, Bellman's principle of optimality, Problems with finite number of stages.

Stochastic Programming: Basic concepts of Probability theory, Stochastic linear programming.

Text Books:

1. L.Saaty, Elements of Queuing Theory,Dover Pubns, New Ed edition
2. HadleyAddison&Wesley, Nonlinear and Dynamic Programming, Pearson Education(US)

3. Ackoff&Sasieni, Fundamentals of Operations Research,Wiley & Sons Inc.

References Books:

1. Wagner, Principles of OR with Applications to ManagerialDecisions, Prentice Hall
2. Taha, OperationsResearch, Pearson Education India
3. R PanneerselvamPrentice, OperationsResearch, Hall ofIndia
4. A P VermaS.K, OperationsResearch, Kataria&Sons
5. Hillier and Lieberman, Introduction to Operations Research, Prentice Hall

OE-8020
SIX SIGMA METHODS & APPLICATION

COURSE OUTCOMES (COs)

After completion of the course student will be able to

1. Understand the concepts, implementation and objectives of six sigma.
2. Use a structural approach to process improvement.
3. Develop a skill to predict, prevent and control defects in a process.
4. Achieve quality improvement through process improvement.
5. Understand the tools of process discovery.

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UNIT I **08**

Quality Perception; Quality in Manufacturing, Quality in Service Sector; Differences between Conventional and Six Sigma concept of quality; Six Sigma success stories. Statistical foundation and methods of quality improvement. Descriptive statistics: Data Type, Mean, Median, Mode, Range, Variation, Standard Deviation, Skewness, Kurtosis. Probability Distribution: Normal, Binomial, Poisson Distribution.

UNIT II **08**

Basics of Six Sigma: Concept of Six Sigma, Defects, DPMO, DPU, Attacks on X'S,Customer focus, Six Sigma for manufacturing, Six Sigma for service. Z score,Understanding Six Sigma organization, Leadership council, Project sponsors and champions, Master Black Belt, Black Belt, Green Belts.

UNIT III **08**

Methodology of Six Sigma, DMAIC, DFSS, Models of Implementation of Six Sigma, Selection of Six Sigma Projects.

UNIT IV **08**

Six Sigma Tools: Project Charter, Process mapping, Measurement system analysis, Hypothesis Testing, Quality Function deployment, Failure mode effect analysis, Design of Experiments.

UNIT V **08**

Sustenance of Six Sigma, Communication plan, Company culture, Reinforcement and control, Introduction to software for Six Sigma, Understanding Minitab, Graphical analysis of Minitab plots.

Text Books :

1. Hillier and Lieberman,Six Sigma: SPC and TQM in manufacturing and service, Geoff Tennant, Gower PublishingCo.
2. Greg Brue, Six Sigma for managers, McGraw-Hill
3. Pete Pande, What is Six Sigma, McGraw-Hill

References Books:

1. Peter S. Pande, The Six Sigma Way, McGraw-Hill education
2. Peter S. Pande, The Six Sigma way, McGraw-Hill

3. Adam Vardy, Lean Six Sigma, Create space Independent Publishing Platform
4. Thomas Pyzdek and Paul Keller, Six Sigma,McGraw-Hill

OE-8021
MECHATRONICS

COURSE OUTCOMES(COs)

After completion of the course student will be able to

1. Identify key elements of mechatronics and its representation by block diagram.
2. Understand the concept of sensors and use of interfacing systems.
3. Understand the concept and applications of different actuators.
4. Illustrate various applications of mechatronic systems.
5. Develop PLC ladder programming and implementation in real life problem.

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UNIT-I **08**

Introduction: Introduction to mechatronics, systems, measurement systems, control systems, microprocessor basedcontrollers, The mechatronics approach, Problems.

Review of Transducers: Sensors and transducers, performance terminology, Displacement position and proximity, velocity& motion, Force, Fluid pressure, Liquid flow, liquid level, Temperature, Light sensors, Selection of sensors, Inputting data by switches.

UNIT-II **09**

Signal Conditioning: Signal conditioning, The operational amplifier, Protection, Filtering, Wheatstone bridge, Digital signals, Multiplexers, Data acquisition, Digital signal processing, Pulse - modulation, Problems.

Data Presentation Systems: Displays, Data presentation elements, Magnetic recording, Displays, Data acquisition systems, Measurement systems, Measurement systems, Testing and calibration.

UNIT-III **09**

Pneumatic and Hydraulic Systems: Actuation systems, Pneumatic and hydraulic systems, Directional control valves, Pressure-control valves, Cylinders, Process control valves, rotary actuators, Problems.

Mechanical Actuation Systems: Mechanical systems, Types of motion, Kinematics chains, Cams, Gear trains, Ratchet and pawl, Belt and chain drives, Bearings, Mechanical aspects of motor selection problems.

UNIT-IV **07**

Electrical Actuation Systems: Electrical systems, Mechanical Switches, Solid-state switches, Solenoids, DC motors, AC motors, Stepper motors.

UNIT-V **07**

Basic System Models: Mathematical models, mechanical system building blocks, Electrical system building blocks, Thermal system building blocks.

Text Books :

1. W. Bolton, Mechatronics,. Addison Wesley Longman, Pub, 1999 (Delhi)
2. K.P Ramachandra, Mechatronics, Wiley Publication.
3. Dr. Rajesh Purohit, Industrial Engineering robotics and Mechatronics, Made Easy Publication

References Books:

1. William Bolton, Mechatronics, Pearson Education.
2. M.D.Singh and J.G Joshi, Mehatronics, PHI Publication
3. Richard A.Kolk, Mechatronics System design. Cengage Learning, Inc
4. AppuKuttan K.K, Introduction To Mechatronics, Oxford University Press

OE-8022
BIOMEDICAL ELECTRONICS

COURSE OUTCOMES (COs)

After completion of the course student will be able to

1. To have a basic understanding of medical terminology, relevant for biomedical instrumentation
2. To understand and describe the physical and medical principles used as a basis for biomedical instrumentation
3. Understand the elements of risk for different instrumentation methods and basic electrical safety
4. Understand the position of biomedical instrumentation in modern hospital care.

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Unit I **08**

Introduction: The age of Biomedical Engineering, Development of Biomedical Instrumentation, Man–Instrumentation system, Components, Physiological system of the body, Problem encountered in measuring a living system.

Transducers: The Transducers & Transduction principles, Active transducers, Passive Transducers, Transducer for Biomedical Applications.

Unit II **08**

Sources of Bioelectric potentials: Resting & Action potentials, propagation of active potential, The Bioelectric potentials-ECG, EEG, EMG, and Invoked responses.

Electrodes: Electrode theory, Biopotential Electrodes–Microelectrodes Body surface electrodes, Needle Electrodes, Biochemical Transducers, Reference electrodes, PH electrodes, Blood Gas electrodes.

Unit III **08**

Cardiovascular Measurements: Electrocardiography – ECG amplifiers, Electrodes & leads, ECG recorders - Three channel, Vector Cardiographs, ECG system for stress testing, Continuous ECG recording (Holter recording), Blood pressure measurement, Blood flow measurement, Heart sound measurements.

Patient Care & Monitoring - Elements of Intensive Care monitoring, patient monitoring displays, Diagnosis, Calibration & Repairability of patient monitoring equipment, pacemakers & Defibrillators.

Unit IV **08**

Measurements in Respiratory system: Physiology of respiratory system Measurement of breathing mechanics - Spiro meter, Respiratory Therapy equipments: Inhalators ventilators & Respirators, Humidifiers, Nebulizers & Aspirators.

Diagnostic Techniques: Ultrasonic Diagnosis Echocardiography, Echo Encephalography, Ophthalmic scans, X-Ray & Radio-isotope Instrumentation, Computerized Axial Tomography Scanners.

Unit V **08**

Introduction to Bio-Medical Signals:
Classification, Acquisition and Difficulties during Acquisition, Electroencephalography, Electromyography, & electro-retinography, Role of Computers in the Analysis, Processing, Monitoring & Control and image reconstruction in bio-medical field.
Bio Telemetry: The components of Biotelemetry system Implantable units, Telemetry for ECG measurements during exercise, for Emergency patient monitoring. Physiological Effects of Electric Current Safety of Medical Electronic Equipments, Shock hazards from Electrical equipment and prevention against them.

Text Books:

1. Leslie Cromwell, Fred J. Welbell and Erich A. Pfeiffer, "Biomedical Instrumentation and Measurements", Prentice Hall (India).

Reference Books:

1. R. S. Khandpur, "Biomedical Instrumentation", Tata McGraw-Hill.
2. Willis J. Tompkins, "Biomedical DSP: C Language Examples and Laboratory Experiments
   for the IBM PC", Prentice Hall (India).
3. D. C. Reddy, "Biomedical Signal Processing", McGraw-Hill

OE-8023
EMBEDDED SYSTEMS

COURSE OUTCOMES (COs)

After completion of the course student will be able to

1. Gain knowledge of embedded systems.
2. Understand the concept, classification, characteristics, quality attributes and applications of Embedded Systems.
3. Understand the architecture of embedded system and basics of real-time operating system. ¬ Write simple programs based on 8051 μC.
4. Design simple applications using 8051 μC kit

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Unit I **08**

Introduction to Embedded system, Embedded System Project Management, ESD and Codesign issues in System development Process, Design cycle in the development phase for an embedded system, Use of target system or its emulator and In-circuit emulator, Use of software tools for development of an ES.

Unit II **08**

8051 Microcontroller: Microprocessor V/s Micro-controller, 8051 Microcontroller: General architecture; Memory organization; I/O pins, ports & circuits; Counters and Timers; Serial data input/output; Interrupts. 8051 Instructions: Addressing Modes, Instruction set: Data Move Operations, Logical Operations, Arithmetic Operations, Jump and Call Subroutine, Advanced Instructions. 8051 Interfacing and Applications: Interfacing External Memory, Keyboard and Display Devices: LED, 7-segment LED display, LCD.

Unit III **08**

Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

Unit IV **08**

Brief general architecture of AVR, PIC and ARM microcontrollers, JTAG: Concept and Boundary Scan Architecture. Organization of FPGAs, FPGA Programming Technologies, Programmable Logic Block Architectures, Programmable Interconnects, Programmable I/O blocks in FPGAs, Dedicated Specialized Components of FPGAs, Applications of FPGAs.

Unit V **08**

Advanced Processor: (only architectures) 80386, 80486 and ARM (References)

RTOS: Tasks, states, Data, Semaphores and shared data, Operating system, services, Message queues, Mailboxes.

Communication basics: Microprocessor Interfacing, I/O Addressing, Direct memory access, Arbitration, multilevel bus architecture, Serial protocols, Parallel Protocols and wireless protocols.

Real world Interfacing: LCD, Stepping Motor, ADC, DAC, LED, Push Buttons, Keyboard, Latch Interconnection, PPI.

Text Books:

1. K. V. Shibu, “Introduction to Embedded Systems”, McGraw Hill.
2. E. Mazadi, “The 8051 Microcontroller And Embedded Systems Using Assembly And C”, Pearson Education India, 2007

Reference Books:

1. Kenneth Hintz and Daniel Tabak, “Microcontrollers (Architecture, Implementation and Programming)”, TMH 2005.
2. Raj Kamal, “Embedded Systems”, TMH, 2006.
3. K. Ayala, “The 8051 Microcontroller”, 3rd Ed., Thomson Delmar Learning, 2007.
4. Frank Vahid and Tony Givargis, “Embedded System Design”, John Wiley.

OE-8024
ADVANCES IN POLYMER SCIENCE TECHNOLOGY

COURSE OUTCOMES (COs)

After completion of the course student will be able to

1. Get knowledge of calculation of molecular weight of polymers.
2. Get know about rate of different polymerization reactions
3. Get know about morphology and deformation causes in polymers.
4. Get know the use of composites and conducting in technology
5. Get knowledge about various processing techniques of polymers like plastic, fibres and elastomers.

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UNIT 1: **08**

Characteristics and Analysis of Polymers

Basic concept of Polymer Science, Measurement of molecular weight and size, Polymer degradation, Analysis and testing of polymers.

UNIT 2: **0**8

Mechanism and Kinetics of Polymerisation

Free radical, Cationic,Anionic, Coordination polymerization and their kinetics. Step Growth polymerization and their kinetics, Ring opening polymerization.

UNIT 3: **08**

Structure and Properties of Polymers

Morphology in crystalline polymers, Calculation of crystallinity, Polymer structure and physical properties, Deformation, flow and melt characteristics, Rheology and mechanical properties of polymers.

UNIT 4: **0**8

Composites, Conducting Polymers

Definition, types of composites, preparation methods, testing of composites, Applications of composites in technology. Conducting polymers- Definition, Synthesis and application in technology.

UNIT 5: **0**8

Processing of Polymers- Plastics, Fibers and Elastomers

Plastics-extrusion, injection molding, blow molding, compression and transfer molding; Spinning of fibers. Elastomers: Utility of Vulcanization and Reinforcement in Engineering.

Text Books:

- F.W. Billmeyer, "Text Book of Polymer Science", 3rd Edn., Wiley Inter Science.

- V. R. Gowarikar, N. V. Viswanathan, Jayadev Sreedhar, “Polymer Science” 3rd Edition, New Age International Publishers.

Reference Books:

- F. Rodriguez, "Principles of polymer systems",4th Edn., Taylor and Francis, Washington.
- Fried, J.R., “Polymer Science and Technology”, Prentice Hall, Inc.

OE-8025
Mathematical Modeling and Simulation

COURSE OUTCOMES (COs)

After completion of the course student will be able to

1. Define, describe and apply basic concepts related to modeling and simulation.
2. Importance of simulation, how to simulate real world problems.
3. Simulation of real world problems like water reservoir, autopilot, servo system.
4. Develop mathematical model for real world problems.
5. Model and simulate mechanical and electrical systems using the computer tools Simulink.

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UNIT I **08**

Introduction to Modeling and Simulation: System definition and components, stochastic activities, continuous and discrete systems, system modeling, types of models, static and dynamic physical models, static and dynamic mathematical models, full corporate model, types of system study. Introduction to Simulation, appropriate and not appropriate, advantages and disadvantage, application areas, history of simulation software, MATLAB as a Simulation tool.

UNIT II **08**

System simulation, why& when to simulate, nature and techniques of simulation, comparison of simulation and analytical methods, types of system simulation, real time simulation, hybrid simulation, simulation of pure-pursuit problem, single-server queuing system and an inventory problem, Monte-Carlo simulation, Distributed Lag models, Cobweb model.

UNIT III **08**

Simulation of continuous systems, analog vs. digital Simulation, Simulation of water reservoir system, Simulation of a servo system, simulation of an autopilot, Discrete system simulation, fixed time-step vs. even to even model, generation of random numbers, test for randomness, Monte-Carlo computation vs. stochastic simulation.

Unit IV **08**

System dynamics,exponential growth models, exponential decay models, modified exponential growth models, logistic curves, generalization of growth models, system dynamic diagrams.

Introduction to SIMSCRIPT: Program, system concepts, origination, and statements, defining the telephone system model.

UNIT V **08**

Simulation of PERT Networks, critical path computation, uncertainties in activity duration, resource allocation and consideration.Simulation languages and software, continuous and discrete simulation languages, expression based languages, object oriented simulation, general purpose vs. application - oriented simulation packages, CSMP-III, MODSIM-III.

Text Books:

1. Geoftrey Gordon, " System Simulation", PHI
2. Narsingh Deo, "System Simulation with digital computer"PHI

Reference Books

1.Jerry Banks, John S. C Barry L. Nelson David M. Nicol, "Discrete Event System Simulation", Pearson Education

2. V P Singh, "System Modeling and simulation", New Age International.

3. Averill M. Law, W. David Kelton, "System Modeling and simulation and Analysis", TMH

OE-8026
Nanoscience and Quantum Computing

COURSE OUTCOMES (COs)

After completion of the course student will be able to

1. To apply engineering and physics concepts to the nano-scale and non-continuum domain. Identify and compare state-of-the-art nanofabrication methods and perform a critical analysis of the research literature. Design processing conditions to engineer functional nanomaterials.
2. To explain the fundamental science and quantum mechanics behind nanoelectronics. Explain the concepts of a quantum well, quantum transport and tunnelling effects. Differentiate between microelectronics and nanoelectronics and to understand basic and advanced concepts of nanoelectronic devices, sensors
3. Understand the general concepts of photon trapping and plasmons in nanooptics, nano-photonics etc and to explain the basic functions, properties and different methods of Nanoholes and photons, solar energy, solar cells, optically used nanomaterials, Photoniccrystals.
4. To impart knowledge on *Nanomaterials* for *biomedical* applications such as Proteins and applications, Drug delivery systems and to explain fabrication of nanoporous and nanofluidic devices and itsapplications.
5. To provide a brief idea about quantum information and quantum Computing, Superposition, Measurement and working principle of quantum computers.

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UNIT - I: Nanomaterials and Nano-structures **08**

Brief review of nanomaterials: Fullerenes, Nanotubes, Nanowires, Quantum Dots, Dendrites, Synthesis- Top Down, Bottom Up, Plasma arcing, Chemical vapour Deposition, sol-gelmethods, Characterization using Electron Microscopy Techniques: Scanning Electron Microscopy, Transmission Electron Microscopy, Scanning Tunneling Microscopy, Atomic Force Microscopy, Scanning Probe Microscopy, X ray methods, Fluorescence, Properties of nanomaterials.

UNIT –II: Nanoelectronics **08**

Introduction – micro, and nano fabrication: Optical lithography, Electron beam lithography, Atomic lithography, Molecular beam epitaxy, Quantum electronic devices: High electron mobility transistors, Quantum interference Transistor, Single electron Transistor, MEMS, NEMS

UNIT - III: Nanotechnology in Optics **08**

Properties of light – interaction of light and nanomaterials: Photon trapping and Plasmons, Dielectric Constant and Polarisation, Refractive index, Nanoholes and photons, solar energy, solar cells, optically used nanomaterials, Photoniccrystals

UNIT – IV: Nanotechnology in Biomedicine **08**

Self assembled monolayers, Bio molecular motors: Function of Motor Proteins and applications, Drug delivery systems, Nanofluidics: Fluids at micro andNanometer scale, fabrication of nanoporous and nanofluidic devices and itsapplications.

UNIT – V: Quantum Computers **08**

Brief idea about quantum information and quantum Computing: Superposition, Measurement, Unitary evolution, qubits-single and multiple qubits, quantum memory, Elementary gates-quantum teleportation, working principle of quantum computers.

Text Books:

1. Nanotechnology- Basic Science and Emerging Technologies, Mick Wilson, Kamali Kannangara Geoff Smith, Michelle Simmons and Burkhard Raguse, I Edition – Overseas Press,2005
2. Introduction to Nanoscale Science & Technology, Ed. By Massimilano DiVentra – I Edition, Kluwer Academic - 2004
3. Nanotechnology, Gregory Timp – I Edition, Springer International –2005

Reference Books:

1. Nanotechnology, Michael Kohler – I Edition, Wiley VCH –2004
2. Nano-Engineering in Science & Technology, Michael Rieth – I Edition, World Scientific –2004
3. Nano, The Nwext Revoliution, Mohan Sundara Rajan – I Edition, National Book Trust – 2004
4. Nanotechnology, Gregory Timp-I Edition, Springer International - 2005

OE-8027
ENTREPRENEURSHIP DEVELOPMENT

COURSE OUTCOMES(COs)

After completion of the course student will be able to

1. Define, describe and apply basic concepts related to entrepreneurship.
2. Understand the systematic process to analyze and evaluate project, prepare project report.
3. Prepare balance sheet, financial report.
4. Interpret their own business plan.
5. Consider the legal and financial conditions for starting a business venture.

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UNIT-I **08**

Entrepreneurship- definition. growth of small scale industries in developingcountries and their positions vis-a-vis large industries; role of small scale industries in the national economy; characteristics and types of small scale industries; demand based and resources based ancillaries and sub-control types.Government policy for small scale industry; stages in starting a small scale industry.

UNIT-II **08**

Project identification- assessment of viability, formulation, evaluation, financing, field-study and collection of information, preparation of project report, demand analysis, material balance and output methods, benefit cost analysis, discounted cash flow, internal rate of return and net present value methods.

UNIT-III **08**

Accountancy- Preparation of balance sheets and assessment of economic viability, decision making, expected costs, planning and production control, quality control, marketing, industrial relations, sales and purchases, advertisement, wages and incentive, inventory control, preparation of financial reports, accounts and stores studies.

UNIT-IV **08**

Project Planning and control: The financial functions cost of capital approach in project planning and control. Economic evaluation, risk analysis, capital expenditures, policies and practices in public enterprises. Profit planning and programming, planning cash flow, capital expenditure and operations. control of financial flows, control and communication.

UNIT-V **08**

Laws concerning entrepreneur viz, partnership laws, business ownership, sales and income taxes and workman compensation act. Role of various national and state agencies which render assistance to small scale industries.

Text Books:

1.Khana.S.S., "Entrepreneurial Development" S.Chand &Co.Ltd.,Ram Nagar,New Delhi,2013.

2. Donald F Kuratko, "Entrepreneurship-Theory, Process and Practice",9th Edition, Cengage Learning 2014.

Reference Books:

1. Forbat, John, "Entrepreneurship" New Age International.

2. Havinal, Veerbhadrappa, "Management and Entrepreneurship" New Age International

3. Joseph, L. Massod, "Essential of Management", Prentice Hall of India

OE-8028

CRITICAL AND LOGICAL THINKING

COURSE OUTCOMES (COs)
After completion of the course student will be able to

1. Analyzing, reasoning, evaluating, decision-making and problem-solving attributes to play a vital role in organizational growth.
2. Understand and comprehend the complexity of the professional domain and implement Interpersonal Skills.
3. Negotiate with the odds and provide best opinions to the higher officials.
4. Logical leadership with critical bent to produce positive results in unfavourable situations.

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Unit I: Fundamentals of Critical Thinking **08**

Introduction to Critical Thinking, Recognizing Arguments, Key Concepts – Thinking Reflection and Creativity; Rhetorical Language; Principles of Interpretations; Process of Elimination; The Parts of an Argument – Claims and Propositions, Evidence, Reasoning; Argument and Critical thought; Communicating Arguments; Co-orientational, Cultural and Ethical View of Arguments

Unit II: Critical Thinking and Logical Communication **07**

Language and Critical Thinking; Citing and listing references – How to refer appropriately to the work of others; Putting your thinking into words; Writing about reflection - How to structure and report your thoughts; Editing and presenting your assignment – How to review your own work and follow academic conventions; Preparing for employment – How to transfer your thinking skills to a career.

Unit III: Logical Concepts and Philosophy of Science **08**

Truth and Validity; Hypothesis; Methods of Experimental Enquiry; Logic: Inductive and Deductive;Syllogism and Fallacies; Aristotle's conception of Virtue and Well-being; Kant's conception of Good Will, Duty and Categorical Imperative; Joseph Butler's Theory of Conscience and Self Love; J. S. Mill's Utiliterianism, Freedom and Responsibility, Chankya's Arthsashtra

Unit IV: Select School of Thought and Criticism **08**

Structuralism (Ferdinand de Saussure), Post Structuralism, Deconstruction (Jacques Derrida), Reader Response Theory (Roland Barthes), Gender Studies, Cultural Studies (Raymond Williams).

Unit V: Select School of Thought and Criticism **08**

1) *******Hind Swaraj***by Mahatma Gandhi

2) ***Tradition and Individual Talent*** by T.S. Eliot
3) ***"***Phenomenal Woman"*** by *Maya* Angelou
4) **Heart of Darkness** by Joseph Conrad

Note: (*) denotes texts for detailed study.

Text Books:

1 Rangarajan, L.N. *Kautilya The Arthashashtra*. Penguin Classics, New Delhi, 2000.
2 Gandhi, M. K. *Hindi Swaraj*. Delhi Open Books, New Delhi, 2019.
3 Eliot, T. S. *Tradition and the Individual Talent*, The Sacred Wood, New York, 1921.
4 Conrad, Joseph. *Heart of Darkness*. Signet Classic Publishers, New York, 1997.
5 Angelou, Maya. *Phenomenal Woman: Four Poems Celebrating Women*. New York: Random House, 1994.
6 *Critical Thinking: A Student's Introduction* by Gregory Bassham and William Irwin and Henry Nardone and James Wallace, McGraw-Hill, Noida, 2019.
7 *How to Improve your Critical Thinking & Reflective Skills* by Jonathan Weyers, Pearson Education, New York, 2011.

Reference Books:

1 *Critical Thinking* by Brooke Noel Moore and Richard Parker, McGraw-Hill, Noida, 2019.
2 *Critical Thinking and Communication* by Edward S Inch, Pearson Education, New York, 2011.
3 *A glossary of literary terms* by M H Abrams& Geoffrey Galt Harpham, Cengage Learning, San Francisco, 1957.
4 *English Literary Criticism and Theory* by M.S. Nagarajan, Orient BlackSwan, Hyderabad, 2006.
5 *The Penguin Dictionary of Philosophy* by Thomas Mautner, Penguin Reference, New Delhi, 1997.
6 *Western Philosophy: An Anthology* by John Cottingham, Wiley-Blackwell, New Jersey, 1996.

CE-8029
TOWN PLANNING

COURSE OUTCOMES (COs)

After completion of the course student will be able to

1. To understand the concept of balanced town by ensuring that new and existing facilities are complimentary to each other.
2. To provide sustainable buildings by considering the environmental, social and economic conditions.
3. To provide diversity of accommodation.
4. To provide leisure and cultural facilities for the town.
5. To create awareness about the traffic management within the town.

L	T	P
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UNIT-1 **08**

Introduction to Town Planning: Definitions of town planning, form of planning, Elements and planning principal of city plan, Shapes of plan in accordance to road networks.

UNIT-2 **08**

Planning Concepts and Evolution: Planning concepts related to City beautiful movement (Chicago, Chandigarh), Urban Utopia (Broadacre), Garden city (Letchworth), Radburn Theory (Radburn) and Neighbourhood planning.

UNIT-3 **08**

Planning Process & Standards: Understanding of planning process, Relevance of standards in planning as per URDPFI guidelines prepared by TCPO.

UNIT-4 **08**

Roads and traffic studies: Awareness of concepts related to various traffic problems in India, Understanding of PCU, Traffic volume, Road capacities, Road types; their sections and intersections, Traffic calming as per IRC guidelines.

UNIT-5 **08**

Modern Transportation systems: New concepts in mass and rapid transportation systems e.g. BRT, LRT and Metro rail. **Modern approach in Planning:** Introduction, Benefits and Planning components of Green City (e.g. Vancouver), Compact City (e.g. Sky city, China) and Smart City (e.g. Malta)

Text Books:

1 John Ratcliffe, "An Introduction to Town and Country Planning", Hutchinson 1981.
2 Arthur B. Gallion and Simon Eisner, "The Urban Pattern – City planning and Design", Van Nostrand Reinhold company.
3 Rangwala, "Town Planning", Charotar publishing house.
4 G.K.Hiraskar, "Town Planning".

Reference Books:

1 Rame Gowda, " Urban and Regional planning".
2 S.K. Khanna, C.E.G. Jhusto, "Highway Engineering", Nemchand & Bros. Roorkee 1997.
3 N.V.Modak, V.N. Ambedkar, "Town and country planning and Housing", orient longman, 1971.
4 URDPFI Guidelines for Planning by TCPO.
5 IRC Guidelines.

CE-8030

DISASTER MANAGEMENT

COURSE OUTCOMES (COs)

After completion of the course student will be able to

1. Capacity to integrate knowledge and to analyse, evaluate and manage the different public health aspects of disaster events at a local and global levels, even when limited information is available.
2. Capacity to describe, analyse and evaluate the environmental, social, cultural, economic, legal and organisational aspects influencing vulnerabilities and capacities to face disasters.
3. Capacity to work theoretically and practically in the processes of disaster management (disaster risk reduction, response, and recovery) and relate their interconnections, particularly in the field of the Public Health aspects of the disasters.
4. Capacity to manage the Public Health aspects of the disasters.
5. Capacity to obtain, analyse, and communicate information on risks, relief needs and lessons learned from earlier disasters in order to formulate strategies for mitigation in future scenarios with the ability to clearly present and discuss their conclusions and the knowledge and arguments behind them.
6. Capacity to design and perform research on the different aspects of the emergencies and disaster events while demonstrating insight into the potential and limitations of science, its role in society and people's responsibility for how it is used.
7. Capacity to analyse and evaluate research work on the field of emergencies and disaster while demonstrating insight into the potential and limitations of science, its role in society and people's responsibility for how it is used.

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UNIT-1 **08**

Introduction: Reasons, classifications-natural, based on violence, deterioration of environment and health and failures of industrial society; disaster risk, elements of risk Goals of disaster management, Assessment of disasters magnitude**.**

UNIT-2 **08**

Natural disasters: Earthquake, floods, cyclone, landslide, volcano, Tsunami, drought.

UNIT-3 **08**

Man-made disasters: Reasons, types, assessment methodologies, mitigation; community-based participation; government intervention.

UNIT-4 **08**

Phases / Elements of disaster management: Mitigation, Preparedness, response, recovery, Structural and non-structural measures for flood disasters, earthquake, cyclone, landslides

UNIT-5 **08**

Community based disaster preparedness, new paradigm for risk reduction, Government of India's initiatives, International bodies, Case studies of recent major disasters in India and Abroad.

Text Books:

1 R.B. Singh (Ed.), "Disaster management", Rawat publications, New Delhi.
2 "National Disaster Response Plan", A Document prepared by Department of Agriculture and Cooperation.

Reference Books:

1. Concept of Trigger Mechanism, Govt. Of India, Ministry of Home Affairs, February 2001, Publication.
2. Water and Climate related Disasters, Govt. of India, Ministry of Home affairs, Publication.

CE-8031
ENVIRONMENTAL POLLUTION AND MANAGEMENT

COURSE OUTCOMES (COs)

After completion of the course student will be able to

1. Understand the relation, impact and dependency of human being on environment.
2. Identify the sources of different types of pollutants, methods of reduction of these pollutants.
3. Identify sources and effects of air, water and land pollution.
4. Demonstrate the use of different uses and effectiveness of government policies related to reduction of pollution.

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UNIT-1 **08**

Impact of man on environment, Consequence of population growth, Energy problem, Pollution of air, water & land, Global environmental issues

UNIT-2 **08**

Water pollution: Sources and classification of water pollutants, wastewater treatment, control strategies, Eutrophication of lakes, self purification capacity of streams,
Thermal pollution: Sources, effects and control measures.

UNIT-3 **08**

Air pollution: Sources and effects, meteorological aspects, control methods and equipments, Land pollution: Types of land pollution, solid waste management-generation, storage, collection, transport, processing and disposal
Noise pollution: Sources, effects, preventive and control measures.

UNIT-4 **08**

EIA: Planning and management of environmental impact studies;
Impact evaluation methodologies: baseline studies, screening, scooping, checklist, overlays, Environmental Impact Assessment of water resources and environmental projects, Case study of power plant.
EA: Meaning, audit items, audit procedure, safety audit.

UNIT-5 **08**

Contemporary issues: Emission trading, discharge permits, international resource sharing issues, climate change, international environmental treaties and protocol, Environmental legislation: Introduction to various legislations related to water, air, biodiversity, ozone depletion etc at National and International level; Institutions for governance.

Text Books:

1 C. Manoharachary and P. Jayarama Reddy, “Principles of environmental studies (Ecology, economics, management and law)”, B.S. Publications.
2 P.V. Rao, “Text of Environmental Engineering”, Prentice Hall Pvt ltd., Delhi.

Reference Books:

1 Y. Ananayulu and C.A. Sastry, "Environmental impact assessment methodologies", B.S. Publications, Hyderabad.