ANNAMALAI UNIVERSITY

Annamalainagar

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL ENGINEERING

B.E. Mechanical Engineering (Part - Time)

Choice Based Credit System

HAND BOOK

2017

ANNAMALAI UNIVERSITY

FACULTY OF ENGINEERING AND TECHNOLOGY

B.E. (3½ year PART TIME) DEGREE PROGRAMME
Choice Based Credit System (CBCS)

REGULATIONS

1. Condition for Admission

Candidates for admission to First year of the **3½ year** B.E. Degree Programme by part-time shall be required to have passed the Diploma examination in the appropriate branch conducted by state Board of Technical Education of Tamil Nadu or its equivalent Examination accepted by the Syndicate of this University. They shall satisfy the conditions regarding eligibility norms as may be prescribed by the Syndicate of the Annamalai University from time to time.

A Pass in anyone of the Diploma Programmes (listed in Annexure-I) conducted by the State Board of Technical Education of Tamil Nadu or its equivalent examination with **2 years** professional experience in a recognized industry or organization after passing the Diploma Examination.

The admission is restricted to those working or residing within a radius of **90 km** from Annamalainagar. The application should be sent through their employers.

However the advance copy with all documents complete in all respects should be received before the prescribed last date. The application through proper channel to be received before entrance test.

2. Courses of study and Scheme of Examinations

The courses of study with respective syllabi and scheme of examinations are given separately.

3. Choice Based Credit System (CBCS)

The curriculum includes six components namely Humanities/Social Sciences/Management, Basic Sciences, Engineering Sciences, Professional Core, Professional Electives and Open Electives in addition to Project work. Each semester curriculum shall normally have a blend of theory and practical courses. The total credits for the entire degree Programme is 101.

4. Eligibility for the Degree

A candidate shall be eligible for the degree of Bachelor of Engineering if the candidate has satisfactorily undergone the prescribed courses of study for a period of **3½ years** and has passed the prescribed examinations of all the courses of study. For the award of the degree, a student has to earn a minimum of 101 credits.

5. Assignment of Credits for Courses

Each course is normally assigned one credit per hour of lecture / tutorial per week and one credit for two hours or part thereof for laboratory or practical or drawing per week.

6. Duration of the programme

A student is normally expected to complete the B.E. programme in 3½ years but in any case not more than **eight years** from the time of admission.

7. Registration for courses

A newly admitted student will automatically be registered for all the courses prescribed for the first semester without any option.

Every other student shall enroll for the courses intended to be credited in the succeeding semester in the current semester itself by completing the registration form indicating the list of courses. This registration will be done a week before the last working day of the current semester.

A student is required to earn 101 credits in order to be eligible for obtaining the degree.

8. Project Work

The student typically registers for project at the end of sixth semester and completes it at the end of the seventh semester along with the courses prescribed for study in the seventh semester. After completing his / her project work, submit the project report and appear for viva-voce examination at the end of seventh semester.

9. Electives

The elective courses fall under two categories: Professional Electives and Open Electives**.** The Professional Elective courses are offered in the concerned branch of specialization and a student can choose the Professional Elective courses with the approval of the Head of the

Department concerned. Apart from the various Professional elective courses, a student can choose the open electives from any specialization offered in any Department in the Faculty of Engineering and Technology during the entire period of study, with the approval of the Head of the Department and the Head of the Department offering the course.

10. Assessment

The break-up of continuous assessment and examination marks for theory courses is as follows:

First assessment (Mid-Semester Test-I)	: 10 marks
Second assessment (Mid-Semester Test-II)	: 10 marks
Third Assessment	: 5 marks
End Semester Examination	: 75 marks

The break-up of continuous assessment and examination marks for Practical courses is as follows:

First assessment (Test-I)	: 15 marks
Second assessment (Test-II)	: 15 marks
Maintenance of record book	: 10 marks
End Semester Examination	: 60 marks

The continuous assessment marks for the project work will be 40 and to be assessed by a review committee consisting of the project guide and a minimum of two members nominated by the Head of the Department. One of the committee members will be nominated as the Chairman by the Head of the Department. The Head of the Department may be a member or the Chairman. At least two reviews should be conducted during the seventh semester by the review committee. The student shall make presentation on the progress made before the committee. 60 marks are allotted for the project work and viva voce examination at the end of the semester.

11. Substitute Assessment

A student who has missed, for genuine reasons accepted by the Head of the Department, one or more of the assessments of a course other than the final examination, may take a substitute assessment for any one of the missed assessments. The substitute assessment must be completed before the date of the third meeting of the respective class committees.

A student who wishes to have a substitute assessment for a missed assessment must apply to the Head of the Department within a week from the date of the missed assessment.

12. Student Counsellors (Mentors)

To help the students in planning their course of study and for general advice on the academic programme, the Head of the Department will attach a certain number of students to a member of the faculty who shall function as student counsellor for those students throughout their period of study. Such student counsellors shall advise the students, give preliminary approval for the courses to be taken by the students during each semester and obtain the final approval of the Head of the Department.

13. Class Committee

For each of the semesters, separate class committees will be constituted by the respective Head of the Departments. The composition of the class committees from first to seventh semester will be as follows:

- Teachers of the individual courses.
- A project coordinator (for seventh semester only) shall be appointed by the Head of the Department from among the project supervisors.
- One Professor or Associate Professor, preferably not teaching the concerned class, appointed as Chairman by the Head of the Department.
- The Head of the Department may opt to be a member or the Chairman.

The class committee shall meet two times during the semester. The first meeting will be held within a week after the completion of the first assessment to review the performance and for follow-up action like test, assignment etc. for the third assessment and the dates of completion of the assessments will also be decided.

The second meeting will be held after all the assessments but at least one week before the commencement of the University examinations. During this meeting the assessment for a maximum of 25 marks for theory / 40 marks for practical courses and project work will be finalized for every student and tabulated and submitted to the Head of the Department for approval and transmission to the Controller of Examinations.

14. Attendance requirements

The students with 75% attendance and above are permitted to appear for the University examinations. However, the Vice Chancellor may give a rebate / concession not exceeding 10% in attendance for exceptional cases only on Medical Grounds.

15. Temporary break of study

A student is permitted to go on break of study for a maximum period of one year either as two breaks of one semester each or a single break of one year.

The student applies for break of study, the student shall apply to the Dean in advance, in any case, not later than the last date of the first assessment period. The application duly filled by the student shall be submitted through the Head of the Department.

However, the student must complete the entire programme within the maximum period of **eight** years.

16. Procedure for withdrawing from the Examinations

A student can withdraw from all the examinations of the semester only once during the entire programme on valid grounds accepted by the University. Such withdrawal from the examinations of a semester will be permitted only if the candidate applies for withdrawal at least 24 hours before the commencement of the last examination. The letter **grade 'W'** appears in the mark sheet for such candidates.

17. Passing and Declaration of Examination Results

All assessments of all the courses on an absolute marks basis will be considered and passed by the respective results passing boards in accordance with the rules of the University. Thereafter, the Controller of examinations shall convert the marks for each course to the corresponding letter grade as follows, compute the Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA), and prepare the mark sheets.

90 to 100 marks	:	Grade 'S'
80 to 89 marks	:	Grade 'A'
70 to 79 marks	:	Grade 'B'
60 to 69 marks	:	Grade 'C'
55 to 59 marks	:	Grade 'D'
50 to 54 marks	:	Grade 'E'

Less than 50 marks	:	Grade 'RA'
Withdrawn from the examination	:	Grade 'W'

A student who obtains less than 30 / 24 marks out of 75 / 60 in the theory / practical examinations respectively or is absent for the examination will be awarded grade RA.

A student who earns a grade of S,A,B,C,D or E for a course is declared to have successfully completed that course. Such a course cannot be repeated by the student.

A student who is detained for lack of attendance must re-register for and repeat the courses in the respective semester.

A student who obtains letter grade RA / W in the mark sheet must reappear for the examination of the courses.

The following grade points are associated with each letter grade for calculating the grade point average and cumulative grade point average.

S - 10; A - 9; B - 8; C - 7; D - 6; E - 5; RA - 0

Courses with grade RA / W are not considered for calculation of grade point average or cumulative grade point average.

A student can apply for re-totaling of one or more of his examination answer papers within a week from the date of issue of mark sheet to the student on payment of the prescribed fee per paper. The application must be made to the Controller of Examinations with the recommendation of the Head of the Department.

After the results are declared, mark sheets will be issued to the students. The mark sheet will contain the list of courses registered during the semester, the grades scored and the grade point average for the semester.

GPA is the sum of the products of the number of credits of a course with the grade point scored in that course, taken over all the courses for the semester, divided by the sum of the number of credits for all courses taken in that semester.

CGPA is similarly calculated considering all the courses taken from the time of admission.

18. Awarding degree

After successful completion of the programme, the degree will be awarded with the following classification based on CGPA.

- For **First Class with Distinction**, the student must earn a minimum of 101–credits within **3½** years from the time of admission , pass all the courses in the first attempt and obtain a CGPA of 8.25 or above for all the courses from I Semester to VII Semester.

- For **First Class**, the student must earn a minimum of 101 credits within four and half years from the time of admission and obtain a CGPA of 6.75 or above for all the courses from I Semester to VII Semester .
- For **Second Class**, the student must earn a minimum of 101 credits within eight years from the time of admission.

19. Ranking of Candidates

The candidates who are eligible to get the B.E. degree in the First Class with Distinction will be ranked together on the basis of CGPA for all the courses of study from I Semester to VII Semester .

The Candidates passing with First Class will be ranked next after those with distinction on the basis of CGPA for all the courses of study from I Semester to VII Semester.

The ranking of candidates will be done separately for each branch of study.

20. Transitory Regulations

The University shall have powers to revise or change or amend the regulations, the scheme of examinations, the courses of study and the syllabi from time to time.

Wherever there had been change of syllabi, examinations based on the existing syllabi will be conducted for three consecutive times after implementation of the new syllabi in order to enable the students to clear the arrears. Beyond that the students will have to take up their examinations in equivalent courses, as per the new syllabi, on the recommendations of the Head of the Department concerned.

Annexure-I

Diploma Programmes Eligible for the B.E (Part Time) Programmes offered in FEAT (from 2017-2018)

Sl.No.	Branches of Study	Eligible Diploma Programme (FT / PT / SW)
1	**Civil Engineering**	Civil Engineering
		Civil Engineering(Architecture)
2	**Civil and Structural Engineering.**	Environmental Engineering and Pollution Control(Full Time)
		Architectural Assistantship
		Civil Engineering (Rural Tech.)
		Civil and Rural Engineering
3	**Mechanical Engineering**	Mechanical Engineering
		Mechanical and Rural Engineering
4	**Mechanical Engineering (Manufacturing Engineering)**	Mechanical Design and Drafting
		Production Engineering
		Production Technology
		Automobile Engineering
		Automobile Technology
		Metallurgy
		Mechatronics Engineering
		Machine Tool Maintenance and Repairs
		Tool and Die making
		Tool Engineering
		Tool Design
		Foundry Technology
		Refrigeration and Air Conditioning
		Agricultural Engineering
		Agricultural Technology
		Marine Engineering
		Mechanical Engineering (Production)
		Mechanical Engineering (Tool &Die)
		Automobile Technology
		Mechanical Engineering (Foundry)
		Mechanical Engineering(R & A.C.)
		Electronics (Robotics)
		Mining Engineering
		Agricultural Engineering and Farm
		Equipment Technology

5	**Electrical and Electronics Engineering**	Electrical and Electronics Engineering
6	**Electronics and Instrumentation Engineering**	Electronics and Communication Engg.
		Electronics and Instrumentation Engg
		Electronics Engineering (Instrumentation)
		Instrument Technology
		Instrumentation and Control Engineering
		Electrical Engineering (Instruments and Control)
		Electrical Engineering
		Instrumentation Technology
		Electronics (Robotics)
		Mechatronics Engineering
7	**Chemical Engineering**	Petrochemical Engineering
		Chemical Engineering
		Environmental Engineering and Pollution Control
		Leather Technology (Footwear)
		Leather Technology
		Plastic Technology
		Polymer Technology
		Sugar Technology
		Textile Technology
		Chemical Technology
		Ceramic Technology
		Petro Chemical Technology
		Pulp & Paper Technology
		Petroleum Engineering
8	**Computer Science and Engineering**	Electronics and Communication Engineering
9	**Information Technology**	Computer Technology
		Computer Science and Engineering
10	**Electronics and Communication Engineering**	Information Technology
		Computer Engineering
		Computer Networking
		Electronics (Robotics)
		Mechatronics Engineering

FT- Full Time; PT-Part Time; SW- Sandwich

DEPARTMENT OF MECHANICAL ENGINEERING

VISION

The Mechanical Engineering Department endeavors to be recognized globally for outstanding education and research leading to well qualified engineers, who are innovative, entrepreneurial and successful in advanced fields of mechanical engineering to cater the ever changing industrial demands and social needs.

MISSION

The Mechanical Engineering program makes available a high quality, relevant engineering education. The Program dedicates itself to providing students with a set of skills, knowledge and attitudes that will permit its graduates to succeed and thrive as engineers and leaders. The Program strives to:

- Prepare its graduates to pursue life-long learning, serve the profession and meet intellectual, ethical and career challenges
- Maintain a vital, state-of-the-art research enterprise to provide its students and faculty with opportunities to create, interpret, apply and disseminate knowledge.

Program Educational Objectives (PEOs)

PEO 1: To prepare the graduates with a solid foundation in engineering, Science and Technology for a successful career in Mechanical Engineering.

PEO 2: To train the students to solve problems in mechanical engineering and related areas by thorough training in methods of engineering analysis, computation and experimentation, including understanding basic mathematical and scientific principles.

PEO 3: To inculcate students with professional and ethical attitude, effective communication skills, team work skills and multidisciplinary approach.

PEO 4: To train the students to adapt to the rapidly changing environment in the areas of mechanical engineering and scale new heights in their profession through lifelong learning.

Programme Outcomes (POs)

1. Graduates will be able to apply knowledge of mathematics, science and engineering for the solution of mechanical engineering problems.
2. Graduates will be able to formulate and analyze complex mechanical engineering problems.
3. Graduates will be able to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, and public health.
4. Graduates will be able to design and conduct experiments, and to analyze and interpret data.
5. Graduates will be able to use the techniques, skills, and modern engineering tools necessary for mechanical engineering practice.
6. Graduates will be able to include social, cultural, ethical issues with engineering solutions.
7. Graduates will be able to function effectively on multidisciplinary teams.
8. Graduates will be able to communicate effectively.
9. Graduates will be able to adopt technological changes and promotes life-long learning.

Mapping PO with PEO				
POs	**PEO1**	**PEO2**	**PEO3**	**PEO4**
PO1	✓	✓		
PO2	✓	✓		
PO3	✓	✓		
PO4		✓		
PO5		✓		
PO6			✓	✓
PO7	✓		✓	✓
PO8	✓		✓	✓
PO9	✓			✓

Proposed Curriculum for B.E. (Part-Time) in Mechanical Engineering
(For the Batch joining in 2017-2018)

Data Summary

Semester	No. of Courses		HS	BS	ES	PC	PE	OE	Proj.	Total Credit
	T+P	Total								
I	4+1	**5**	-	4 1	3 1	8 2+1	-	-	-	15
II	4+1	**5**	-	4 1	-	11 3+1	-	-	-	15
III	4+1	**5**	-	-	-	11 3+1	3 1	-	-	14
IV	4+1	**5**	-	-	-	11 3+1	3 1	-	-	14
V	4+1	**5**	3 1	-	-	5 1+1	6 2	-	-	14
VI	4+1	**5**	-	-	-	5 1+1	6 2	3 1	-	14
VII	3+1	**4**	3 1	-	-	-	3 1	3 1	6 1	15
Total Courses	27+7	**34**	**2**	**2**	**1**	**13+6**	**7**	**2**	**0+1**	**-**
Total credits →			**6**	**7**	**3**	**52**	**21**	**6**	**6**	**101**
			6 Practical Courses can be Professional Core or Professional Elective Labs.							

Legend:

HS - Humanities / Social Sciences / Management
BS - Basic Science
ES - Engineering Science
PC - Professional Core
PE - Professional Elective
OE - Open Elective
Proj. - Project
T - Theory
P - Practical/Proj

Code	Details	Code	Details
00	Common course for the faculty	06	Electronics and Instrumentation Engg. course
01	Civil Engg. course	07	Chemical Engg. course
02	Civil and Structural Engg. course	08	Computer Science and Engg. course
03	Mechanical Engg. course	09	Information Technology course
04	Mechanical(Manufacturing) Engg. course	10	Electronics and Communication Engg. course
05	Electrical and Electronics Engg. course	XX	Code of the programme concerned (01 to 10)

Course Nos. **105,205, 305,405,505,605** are all Practical Courses that can be Professional Core Labs or Professional Elective Labs.

If a Practical Course is Professional Core Lab then the Course Code is **P06CP105**

If a Practical Course is Professional Elective Lab then the Course Code is **P06EP105**

Course Code in the 2nd Column represents the Part-Time course whereas the last column is the corresponding course code in the full time programme which can be from any semester

Code	Details	Code	Details
HS	Humanities Theory	PE	Professional Elective Theory
BS	Basic Science Theory	EP	Professional Elective Lab
ES	Engineering Science Theory	OE	Open Elective Theory
PC	Professional Core Theory	PV	Project and Viva-voce
CP	Professional Core Lab		

SEMESTER – I

Sl. No.	Category	Course Code	Course	L	T	P	Exam	CA	Total	Credits	Equivalent Course Code in B.E. Full Time
1	BS	P00BS101	Mathematics I	4	-	-	75	25	100	4	—
2	ES	P03ES102	Thermodynamics	4	-	-	75	25	100	3	00ES304
3	PC	P03PC103	Engineering Mechanics	4	-	-	75	25	100	3	03ES303
4	PC	P03PC104	Electrical and Electronics Engineering	4	-	-	75	25	100	3	03PC306
5	CP	P03CP105	Mechanical Lab-I	-	-	3	60	40	100	2	03CP308
Total →				**16**	**-**	**3**	**360**	**140**	**500**	**15**	**-**

SEMESTER – II

Sl. No.	Category	Course Code	Course	L	T	P	Exam	CA	Total	Credits	Equivalent Course Code in B.E. Full Time
1	BS	P00BS201	Probability Random Process and Numerical Methods	4	-	-	75	25	100	4	03BS401
2	PC	P03PC202	Strength of Materials	4	-	-	75	25	100	3	03PC 403
3	PC	P03PC203	Thermal Engineering	4	-	-	75	25	100	3	03 PC 404
4	PC	P03PC204	Mechanical Measurements and Control	4	-	-	75	25	100	3	03 PC 305
5	CP	P03CP205	Machine Drawing	-	-	3	60	40	100	2	03CP 307
Total →				**16**	**-**	**3**	**360**	**140**	**500**	**15**	**-**

SEMESTER – III

Sl. No.	Category	Course Code	Course	L	T	P	Exam	CA	Total	Credits	Equivalent Course Code in B.E. Full Time
1	PC	P03PC301	Machine Design	4	-	-	75	25	100	3	03PC 406
2	PC	P03PC302	Mechanics of Machines	4	-	-	75	25	100	3	03PC501
3	PC	P03PC303	Fluid mechanics and Hydraulic Machinery	4	-	-	75	25	100	3	-
4	PE	P03PE304	Professional Elective -I	4	-	-	75	25	100	3	-
5	CP	P03CP305	Programming Lab	-	-	3	60	40	100	2	03 EP 509
Total →				**16**	**-**	**3**	**360**	**140**	**500**	**14**	**-**

SEMESTER – IV

Sl. No.	Category	Course Code	Course	L	T	P	Exam	CA	Total	Credits	Equivalent Course Code in B.E. Full Time
1	PC	P03PC401	Design of Transmission Systems	4	-	-	75	25	100	3	03PC 504
2	PC	P03PC402	Manufacturing Technology	4	-	-	75	25	100	3	03PC 502
3	PC	P03PC403	Power Plant Engineering	4	-	-	75	25	100	3	03PC 601
4	PE	P03PE404	Professional Elective -II	4	-	-	75	25	100	3	-
5	CP	P03CP405	Mechanical Lab-II	-	-	3	60	40	100	2	03 CP 608
Total →				**16**	**-**	**3**	**360**	**140**	**500**	**14**	**-**

SEMESTER – V

Sl. No.	Category	Course Code	Course	L	T	P	Exam	CA	Total	Credits	Equivalent Course Code in B.E. Full Time
1	HS	P00HS501	Environmental Studies	4	-	-	75	25	100	3	00HS301
2	PC	P03PC502	Heat and Mass Transfer	4	-	-	75	25	100	3	03PC 702
3	PE	P03PE503	Professional Elective -III	4	-	-	75	25	100	3	-
4	PE	P03PE504	Professional Elective -IV	4	-	-	75	25	100	3	-
5	CP	P03CP505	Mechanical Lab-III	-	-	3	60	40	100	2	03 EP 609
Total →				**16**	**-**	**3**	**360**	**140**	**500**	**14**	**-**

SEMESTER – VI

Sl. No.	Category	Course Code	Course	L	T	P	Exam	CA	Total	Credits	Equivalent Course Code in B.E. Full Time
1	PC	P03PC601	Refrigeration and Air conditioning	4	-	-	75	25	100	3	03PC602
2	PE	P03PE602	Professional Elective –V	4	-	-	75	25	100	3	-
3	PE	P03PE603	Professional Elective -VI	4	-	-	75	25	100	3	-
4	OE	P03OE604	Open Elective -I	4	-	-	75	25	100	3	-
5	CP	P03CP605	Mechanical Lab-IV	-	-	3	60	40	100	2	03CP 706
Total →				**16**	**-**	**3**	**360**	**140**	**500**	**14**	**-**

.

SEMESTER – VII

Sl. No.	Category	Course Code	Course	L	T	P	Exam	CA	Total	Credits	Equivalent Course Code in B.E. Full Time
1	HS	P00HS701	Engineering Ethics	4	-	-	75	25	100	3	00HS 701
2	PE	P03PE702	Professional Elective -VII	4	-	-	75	25	100	3	-
3	OE	P03OE703	Open Elective-II	4	-	-	75	25	100	3	-
4	Project	P03PV704	Project Work and Viva-voce		-	8	60	40	100	6	-
Total →				**12**	**-**	**8**	**285**	**115**	**400**	**15**	**-**

PROFESSIONAL ELECTIVES

1. Applied Thermal Engineering
2. Automotive Engineering
3. Applied Mechanics of Machine
4. Industrial Relations and Organizational Development
5. Industrial Engineering and Management
6. Plant layout and Materials Handling
7. Renewable Energy Sources
8. Fuels and Combustion
9. Engine Pollution and Control
10. Operations Research
11. Computer oriented numerical analysis
12. Finite Element Methods
13. Applied Manufacturing Technologies
14. Computational Fluid Dynamics

OPEN ELECTIVES

1. Biology For Engineers
2. Human Rights
3. Entrepreneurship
4. National Service Scheme
5. Disaster Management
6. Turbo Machinery
7. Vibration and Noise Control
8. Total Quality Management
9. Mechatronics
10. Microprocessor Technology
11. Organizational Behavior
12. Quality Assurance and Reliability
13. CAD/CAM/CIM
14. Computer Integrated Manufacturing System
15. Artificial Intelligence and Robotics
16. Maintenance and Safety Engineering
17. Production and Operation Management

P00BS101	MATHEMATICS - I	L	T	P
		4	0	0

Course Objectives:

- To acquaint the student with the concepts in matrices, ordinary differential equations, partial differential equations, Laplace transforms and Fourier series, which are most important in connection with practical engineering problems.

Unit I: Matrices

Characteristic equation – Eigen values and eigen vectors of a real matrix – Properties – Cayley-Hamilton theorem – Orthogonal transformation of a real symmetric matrix to diagonal form – Quadratic form – Reduction of quadratic form to canonical form by orthogonal transformation.

Unit II: Ordinary Differential Equations

Second order linear differential equations with constant coefficients, Second order linear differential equations with variable coefficients (Euler and Legendre's linear equations), Variation of parameters.

Unit-III: Partial Differential Equations

Formation of partial differential equations by eliminating arbitrary constants and arbitrary functions - Solution of standard type of first order partial differential equations - Lagrange's linear equation - Linear partial differential equations of second order with constant coefficients.

Unit IV: Laplace Transform

Definition, Transform of elementary functions, Properties, Derivatives and integrals of transforms, Transforms of derivatives, Inverse Laplace transform, Application to solution of linear ordinary differential equations of second order with constant coefficients.

Unit-V: Fourier Series

Dirichle's conditions - General Fourier series - Odd and Even functions - Half range sine series - Half range cosine series - Complex form of Fourier series – Parseval's identity.

(In all units, proof of theorems are not included)

Text Books:

Venkataraman M K, Engineering Mathematics, Volumes I (2008) and II (2009), The National Publishing Company, Chennai.

Veerarajan T, Engineering Mathematics, Second Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2011.

References:

1. Grewal B S, Higher Engineering Mathematics, Khanna Publishers, Delhi, 40th Edition, 2007.
2. Erwin Kreysig, Advenced Engineering Mathematics, John Wiley & Sons, 8th Edition, 2002. Kandasamy.P , Tilagavathy.K and Gunavathy.K, Engineering Mathematics ,6th ed., (Vol-I & II) S.Chand & Co Ltd. 2006, New Delhi.

Course Outcomes:

Students acquire basic understanding of the most common partial differential equations, Fourier series, Fourier transform and Z-transform and to learn some methods of solving them. The students should be able to solve some boundary value problems.

Mapping with Programme Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO6**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							

P03ES102	**THERMODYNAMICS**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

- To understand the principles of Thermodynamics and analysis of energy systems in Mechanical Engineering

Unit–I : Basic Concepts and First Law

Fundamental concepts and definitions- continuum, Microscopic and Macroscopic approaches. Path and point functions. Intensive and extensive properties, total and specific quantities. System, surrounding, boundary and their types. Thermodynamic Equilibrium. State, path and process. Quasi-static, reversible and irreversible processes. Heat and work transfer - definition and comparison, sign convention. Displacement work, P-V diagram and other modes of work. Zeroth law - concept of temperature and thermal equilibrium. First law (concept of energy)- application to closed and open systems - steady and unsteady flow processes.

Unit–II : Second Law of Thermodynamics

Heat Reservoir - source and sink. Heat Engine, Refrigerator, Heat pump. Statements of second law and its corollaries. Carnot cycle, Reversed Carnot cycle, Performance. Clausius inequality. Concept of entropy, T-s diagram, Tds Equations - entropy change for a pure substance, ideal gases undergoing different processes, principle of increase in entropy. Applications of II Law. High and low grade energy. Availability and Irreversibility analysis for open and closed systems, I and II law Efficiency.

Unit–III : Pure Substances and Steam Power Cycle

Properties of pure substance- formation of Steam and its thermodynamic properties - p-v, p-T, T-v, T-s, h-s diagrams. PVT surface. Determination of dryness fraction. Calculation of work done and heat transfer in non-flow and flow processes using Steam Table and Mollier Chart. Rankine cycles- cycle efficiency-reheat cycle-regenerative cycle (concept only)

Unit–IV : Ideal and Real Gases Thermodynamic Relations

Properties of Ideal gas, real gas, and their comparison. Equations of state for ideal and real gases. Van der Waal's relation, Reduced properties, Compressibility factor, Principle of Corresponding states. Generalised Compressibility Chart and its

use. Maxwell relations, Tds Equations, heat capacities relations, Energy equation, Joule-Thomson experiment, Phase Change Processes, Clausius-Clapeyron equation. Simple Calculations.

Unit–V : Gas Mixtures and Psychrometry

Gas and gas-vapour mixtures - Dalton's and Amagat's laws, properties of ideal gas mixtures. Psychrometric properties - Property calculations using Psychrometric chart and expressions. Psychrometric processes - adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing.

(Use of Steam tables, Mollier chart and Psychrometric chart are permitted)

TEXT BOOKS

1) Nag, P.K., "Engineering Thermodynamics", 5th Edition, Tata McGraw Hill (2013), New Delhi
2) Ballaney, P.L., Thermal Engineering, Khanna Publishers, New Delhi, 24th ed., 2003.

REFERENCES

1) Natarajan, E., "Engineering Thermodynamics: Fundamentals and Applications", 2nd Edition (2014). Anuragam Publications, Chennai.
2) Dr. C.G. Saravanan & M.P. Ashok, Thermodynamics, Scitech Publications, 2008.
3) Cengel, Y. and M. Boles, Thermodynamics - An Engineering Approach, Tata McGraw Hill, 7th Edition, 2011.
4) Chattopadhyay, P., "Engineering Thermodynamics", 2nd Ed. Oxford University Press, 2014.
5) E. Rathakrishnan, "Fundamentals of Engineering Thermodynamics", 2nd Edition, Prentice Hall of India Pvt. Ltd., 2006.

COURSE OUTCOMES

Upon completion of this course, the students will be able to understand:

1) Fundamental concepts and definitions, Thermodynamic principles to Engineering applications.
2) The fundamentals properties of steam, gas and gas mixtures.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO6**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							✓
CO2	✓		✓						

P03PC103	**ENGINEERING MECHANICS**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

- To introduce the fundamentals of forces and their effects with their governing laws.
- To understand the definitions of particle, body forces and their equilibrium conditions.

- To understand and predict the forces and its related motions.

Unit–I : Statics of Particles

Introduction-Units and Dimensions-Laws of Mechanics-Lami's Theorem-Parallelogram, Triangular and Polygon Law of Forces-Classification of Forces-Vectorial Representation of Forces-Coplanar Forces-Resolution of Forces.

Equilibrium of Particle-Vector representation of Space Force-Equilibrium of Particle in Space-Equivalent System of Forces-Principle of Transmissibility.

Unit–II : Equilibrium of Rigid Bodies

Free Body Diagram-Types of Supports- Types of loads- Types of beams-Action and Reaction of Forces- -Moments and Couples-Moment of a Force-Vectorial Representation of Moments and Couples.

Varignon's Theorem- Stable Equilibrium-Single Equivalent Force-Equilibrium of Rigid Bodies in Two Dimensions and Three Dimensions.

Unit–III : Geometrical Properties of Surfaces and Solids

Centroid and Centre of Gravity-Determination of Centroid of Sections of Different Geometry- Centre of Gravity of a Body-Area Moment of Inertia-Parallel Axis Theorem-Perpendicular Axis Theorem-Determination of Moment of Inertia of Rectangular, Triangular, Circular and Semi-circular- Moment of Inertia of structural Steel Sections of Standard and Composite Sections.

Polar Moment of Inertia-Radius of Gyration-Principal Moment of Inertia-Mass Moment of Inertia- Determination of Mass Moment of Inertia of a Thin Rectangular Plate, Thin Circular Disc, Solid Cylinder, Prism, Sphere and Cone from first principles.

Unit–IV : Dynamics of Particles

Introduction-Kinematics and Kinetics-Displacements, Velocity and Acceleration-Equations of Motion-Types of Motion-Rectilinear Motion-Relative Motion-Curvilinear Motion-Projectiles.

Newton's Laws of Motion-Linear Momentum-Impulse and Momentum-D'Alembert's Principle-Dynamic Equilibrium- Work Energy Equations-Law of Conservation of Energy-Principle of Work and Energy.

Unit–V : Friction and Elements of Rigid Body Dynamics

Friction Force-Laws of Sliding Friction-Equilibrium Analysis of simple systems with Sliding Friction-Wedge Friction.

Rolling Resistance-Translation and Rotation of Rigid Bodies-Velocity and Acceleration-General Plane Motion of Simple Rigid Bodies such as Cylinder, Disc/Wheel and Sphere.

TEXT BOOKS

1) Palanichamy, M.S. and Nagan, S., (2010). Engineering Mechanics (Statics and Dynamics), Tata McGraw Hill Publishing Company, Ltd., New Delhi.
2) Beer, F.P. and Johnson, R., (2004). Vector Mechanics for Engineers (Statics), McGraw Hill Book company, New Delhi.

REFERENCES

1) Bhavikatti, S.S. and K.G. Rajasekarappa, (1999). Engineering Mechanics, New Agent International (P) Ltd.
2) Sadhu Singh, (2000). Engineering Mechanics, Oxford & IBH Publishing Co., New Delhi.

3) Irving H. Shames, (2006). Engineering Mechanics, prentice Hall of India ltd., New Delhi.
4) Hibbeller, R.C and Ashok Gupta, (2010) Engineering Mechanics: Statics and Dynamics, Edition, Pearson Education.
5) Vela Murali, Engineering mechanics

WEBSITES

1) http://www.vssut.ac.in/lecture_notes/lecture1423904717.pdf
2) https://www.civil.iitb.ac.in/~naresh/teaching/ce221/Emech_equilibrium_review_v1.pdf
3) http://nptel.ac.in/courses/Webcourse-contents/IIT KANPUR/engg_mechanics/ui/TableofContents.html
4) www.btechguru.com/Mobile-SD-Cards
5) www.solidmechanics.org/contents.htm

COURSE OUTCOMES

Students can able to

1) Understand the forces and its related laws of mechanics in static and dynamic conditions.
2) Analyse the forces and its motions on particles, rigid bodies and structures.
3) Solve the moment of inertia of any sections and masses for the structural members.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO6**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓	✓						
CO2	✓	✓	✓						
CO3	✓	✓	✓						

P03PC104	**ELECTRICAL AND ELECTRONICS ENGINEERING**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

- To explain the operating principle of DC motors, Transformers, AC induction and synchronous motors.
- To introduce the basic theory of various semiconductor devices and their applications.
- To illustrate the usage of transistorized circuits in different applications including amplifiers and oscillators.

Unit–I : DC Motors

DC motors – principle of operation – back emf – lap and wave windings – commentator – speed and torque equations – method of speed control – speed-torque characteristics of series, shunt and compound motors – efficiency – swinburne's test – applications of DC motors – starters – necessity and use – types of starters and connections.

Unit–II : Transformers

Transformer – working principle – phasor diagram for no load and loaded conditions – equivalent circuit – OC and SC tests – efficiency and voltage regulation

–auto transformer – three phase transformers – constructional features – connections – line voltage and current relations.

Unit–III : Induction and Synchronous Motors

Three phase induction motors – types – principle of operation – rotating magnetic field – synchronous speed and slip – equivalent circuit – torque-slip characteristics – starters – single phase induction motors – principle of operation – types – starting methods – applications.

Alternators – principle of operation and constructional features – salient and non-salient pole machines – voltage regulation – emf method – synchronous motors – phasor diagram – power factor control – applications.

Unit–IV : Electronic Devices

P-N junction – characteristics and uses of semi conductor devices: diode, photo diode, zener diode, BJT, FET, UJT and SCR – half wave, full wave and bridge rectifier circuits – filters – zener voltage regulators.

Unit–V : Amplifiers and Oscillators

Transistorized amplifiers and oscillators: classification and characteristics – voltage, current and power gain – frequency response – audio amplifier – principle of negative feedback – emitter follower – power amplifier – class A, B, C – applications – oscillators – RC phase shift – Hartley and UJT oscillators.

TEXT BOOKS

1) Theraja, B.L., "A Text Book of Electrical Technology", S. Chand & Co., New Delhi, 2005.
2) Premkumar, N., "Basic Electrical and Electronics Engineering", 4th Edition, Anuradha Publications, Kumbakonam, 2008.

REFERENCES

1) Rajput, R.K., "A text book of Electrical Machines", Lakshmi Publications, 2006.
2) Metha, V.K., "Principles of Electronics", S. Chand & Co., New Delhi, 2014.

COURSE OUTCOMES:

Upon completing this course, students should be able to:

1) Understand the DC and AC motor operation.
2) Explore the operation and application transformers.
3) Establish the working of semiconductor devices.
4) Suggest the applicability of transistors for amplifiers and oscillators.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1			✓				✓		
CO2				✓	✓				
CO3			✓						✓
CO4				✓	✓				

P03CP105	MECHANICAL LAB - 1	L	T	P
		0	0	3

COURSE OBJECTIVES

To inculcate the knowledge about the working of I.C engines and different types of dynamometers.

- To study the valve timing and port timing of an IC engine
- To make the students understand the working principle of various flow and pressure measuring devices.

LIST OF EXPERIMENTS

1. Study and valve timing on four stroke diesel engine.
2. Study and port-timing on two stroke petrol engine.
3. Dismantling and assembling of four stroke diesel engine.
4. Study of Carburettor
5. Study of fuel injection pump
6. Study of cooling system
7. Study of lubrication system
8. Study of air compressor
9. Measurement of temperature using resistance temperature detector
10. Determination of coefficient of discharge of orifice /Venturimeter
11. Measurement of displacement using LVDT
12. Experiments on DC Servo motor controller
13. Experiment on DC motor position control system

COURSE OUTCOMES

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

1) Understand the various types of engines and working principles of dynamometers.
2) Know the dismantling and assembling procedure of a four stroke CI engines.
3) Determine the coefficient of discharge of various flow measuring devices.
4) Understand the concept of proportional control action, integral control action and derivative control action in a control system.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓	✓				✓		
CO2		✓	✓				✓		
CO3					✓				
CO4				✓			✓		

SECOND SEMESTER

P00BS201	PROBABILITY RANDOM PROCESS AND NUMERICAL METHODS	L	T	P
		4	0	0

COURSE OBJECTIVES

- Be exposed to probability, random processes, and statistical methods designed to contribute to the process of making scientific judgments in the face of uncertainty and variation.
- To develop the skills of the students in numerical mathematics - using method of finite difference interpolation, finding numerical solution of algebraic and transcendental equations, and finding numerical solution of ordinary and partial differential equations.

Unit–I : Probability and Random Variables

Definition – Types of random variables - probability distribution function - probability density function – expectation and moments – moment generating functions –joint probability distribution -marginal probability distribution function – joint probability density function – marginal probability density function – conditional probability density function.

Unit–II : Random Processes

Classification of random processes – methods of description of a random process – special classes of random processes – Average values of random process - stationarity –Autocorrelation function and its properties - cross correlation function and its properties.

Unit–III : Test of Significance

Hypothesis, testing – Large sampling tests – small sampling test based on t, F and chi-square distributions – interval estimates of mean, standard deviation and proportion.

Unit–IV : Interpolation, Numerical Differentiation and Integration

Interpolation: Gregory Newton forward and backward interpolation formula; Stirling's central difference formula; Lagrange's interpolation formula for unequal interval.

Numerical differentiation: Using Newton's forward and backward interpolation formula.

Numerical integration: Trapezoidal rule, Simpson's one-third and three-eight rule.

Unit–V : Solution of Algebraic, Transcendental and ordinary Differential Equations

Solution of algebraic and transcendental equations: Bolzano's bisection method, Regula-falsi method, Newton–Raphson method.

Solution of simultaneous algebraic equation: Gauss elimination method, Crout's method, Gauss – Seidel iteration method.

Solution of ordinary differential equations: Taylor series method, Runge–Kutta fourth order method, Milne's - Predictor corrector method.

TEXT BOOKS

1) Kandasamy, P., Thilagavathy, K., and Gunavathy, K., Probability and Random Processes, S.Chand & Co. Ltd.
2) Veerarajan, T., Probability Theory and Random Process, Tata McGraw Hill Co., Ltd. New Delhi 2005.

REFERENCES

1) Venkataraman, M.K., Numerical Method in Science and Engineering, National Publishing Co., Chennai - 2003.
2) Lipschutz, S. and Schiller. J., Schaums' Outlines – Introduction to Probability and Statistics, McGraw Hill, New Delhi, 1998.
3) Kandasamy, P., Thilagavathy, K., and Gunavathy, K., Numerical Methods, S. Chand & Co. Ltd., New Delhi. 2004.

COURSE OUTCOMES

4) Acquire skills in handling situations involving random variables, random processes and to solve problems for engineers in using numerical methods.

Mapping with Programme Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓		✓					

P03PC202	**STRENGTH OF MATERIALS**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

- To gain knowledge of simple stresses, strains and deformation in components due to external loads.
- To assess stresses and deformations through mathematical models of beams, twisting bars or combinations of both.
- Effect of component dimensions and shape on stresses and deformations are to be understood.
- The study would provide knowledge for use in the design courses

Unit–I

Elementary ideas about stress and strain - Mechanical properties of Engineering materials - Hardness and impact tests - Classification of loads - static, dynamic and impact loading - Concepts of stress and strain - stress-strain diagrams for brittle and ductile materials - Luders lines - Hookes law – true stress-true strain - shear stress - shear strain – Poisson's ratio and elastic constants.

Unit–II

Principal stress and principal strain - triaxial stresses - strain energy and work done in tension and compression - stress in compound bars - temperature stresses - stress concentration.

Unit–III

Bending moments and shearing forces under dead loads - cantilevers - simply supported and overhanging beams with different types of loading - bending moment and shear force diagrams - maximum bending moment - maximum shear

force - Point of inflexion - Bending stress in beams - simple theory of bending stress in beams of varying sections - stresses in composite sections - moment of resistance - beams of uniform strength.

Unit–IV

Deflection of Determinate beams - Determination of elastic curve - Double integration method, Macaulay's method - Area moment methods - strain energy - The theorem of Castingliano.

Unit–V

Theory of columns- Eulers theory for long columns – Rankine's formula – Johnson's formula – Columns subjected to eccentric loading –Thin cylinders – Stresses in thin cylindrical shell due to internal pressure – circumferential and longitudinal stresses and deformation in thin cylinders - Threaded fasteners – Bolted joints – simple and eccentrically loaded bolted joints -

TEXT BOOKS

1) Junarkar, S.B. & Shah, H.J., Applied Mechanics, Charotar Pub. House, Anand, 1994.
2) Ramamirutham, S., Strength of Materials, Dhanpat Rai & Sons, New Delhi, 1995.

REFERENCES

1) Khurmi, R.S., Strength of Materials, S.Chand & Co., New Delhi, 23rd ed., 2005.
2) Timoshenko, S. & Young, D.H., Strength of Materials, East West Press, New Delhi, 1968.
3) Papov, Mechanics of Materials.
4) Etan, Mechanics of Materials

COURSE OUTCOMES

Upon completing this course, students should be able to:

1) Critically analyses components like beams and twisting bars
2) Understand theories on columns and springs
3) Employ the knowledge gained in designing machine components.

Mapping with Programme Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓			✓				
CO2	✓	✓							
CO3			✓		✓				✓

P03PC203	**THERMAL ENGINEERING**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

- To apply the thermodynamic concepts into various thermal application like internal combustion engines, Steam engines and Compressors.
- To get an insight on the working and performance of air compressors
- To understand the working of various auxiliary systems present in internal combustion engines.

Unit–I : Gas Power Cycles

Air Standard Cycles - Otto, Diesel, Dual, Brayton - Cycle Analysis, Performance and Comparison - Problems.

Unit–II : Reciprocating Air Compressor

Classification and comparison, working principle, work of compression - with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency. Multistage air compressor with Intercooling. Working principle and comparison of Rotary compressors with reciprocating air compressors.

Unit–III : Internal Combustion Engines

Reciprocating internal combustion engines - Classification, working, components and their functions. Ideal and actual: Valve and port timing diagrams, p-v diagrams- two stroke & four stroke, and SI & CI engines - comparison. Geometric, operating, and performance comparison of SI and CI engines. Desirable properties and qualities of fuels. Air-fuel ratio calculation - lean and rich mixtures. Combustion in SI & CI Engines - Knocking - phenomena and control.

Unit–IV : Internal Combustion Engine Performance and Systems

Performance parameters and calculations. Morse and Heat Balance tests. Multipoint Fuel Injection system and Common Rail Direct Injection systems. Ignition systems - Magneto, Battery and Electronic. Lubrication and Cooling systems. Concepts of Supercharging and Turbocharging - Emission Norms.

Unit–V : Steam Engines

Steam engines - cycle of operation - Piston valve and Mayer expansion valve - mechanical, thermal, Rankine and overall efficiencies - missing quantity - Willan's line - method of compounding – advantages.

TEXT BOOKS

1) Ballaney, P.L., "Thermal Engineering", Khanna Publishers, New Delhi, 24 th ed.2003.
2) Ganesan, V., "Internal Combustion Engines", 4th Edition, Tata McGraw Hill, 2012.

REFERENCES

1) Mahesh M. Rathore, "Thermal Engineering", 1st Edition, Tata McGraw Hill, 2010.
2) Mathur & Sharma, A Text Book on Internal Combustion Engine.
3) Khurmi, R.S., Thermal Engineering, S.Chand & Co., 14th ed., New Delhi, 2005.
4) Holman, J.P., "Thermodynamics", McGraw Hill, 1985.
5) Rajput, R.K., "Thermal Engineering", Laxmi, 8th Edition, 2013.

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1) Understand Basics of internal combustion engines and reciprocating compressors
2) Analyse the theory and performance of air-standard cycles
3) Understand functioning and performance of IC engines and its sub systems
4) Understand the working of steam engine their performance.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2	✓	✓							
CO3			✓		✓				✓
CO4	✓		✓		✓		✓		

P03PC204	**MECHANICAL MEASUREMENTS AND CONTROL**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

- To educate students on different measurement systems and on common types of errors.
- To introduce different types of sensors, transducers, strain gauges, thermocouples, thermometers and flow meters used for measurement.
- To introduce control equipments and combined modes of control systems.

Unit–I

Generalised measurement system - Basic standards of measurement - Errors - Classification. Measurements of displacement, force and torque. Dynamometers: Hydraulic, Absorption and Eddy current.

Unit–II

Measurement of strain - Bonded and unbounded strain gauges - Requirements of materials. Mechanical - Electrical - Opto mechanical strain gauges. Measurement of temperature - electrical and non-electrical methods - Bimetallic and pressure thermometer, thermocouples - requirements - Resistance thermometers - Pyrometry - Calibration methods.

Unit–III

Measurements of Pressure and flow - Measurements of high pressure and low pressure - Measurements of flow by obstruction meters - Velocity probes - Hot wire anemometer - Calibration of pressure gauges and flow meters - Time constant of pressure gauges.

Unit–IV

Elementary ideas of automatic control - Open and closed systems, on-off, proportional, and floating modes, reset and rate actions. Basic combined modes for pneumatic, hydraulic and electrical systems.

Unit–V

Transfer function - Stability - Routh's criterion - Analysis of second order systems – System response to step – step, pulse - ramp inputs. Introduction to computerized measurement and control systems (Description only)

TEXT BOOKS

1) Hollman, J.P., Experimental Methods for Engineers, Tata McGraw Hill.
2) Benjamin Kuo, Automotive Control Engineering, EEE Publications.

REFERENCES

1) D.S. Kumar, 'Mechanical Measurement & Control', Metropolitan Book Company.
2) Beckwith, T.C & Buck, N.L., Mechanical Measurements, Addison Wesley.
3) Nagarth and Gopal, Control Engineering, Wiley Eastern Ltd.

4) Control System by Nagoor Kani, RBA Publications.
5) Erenest O. Doebeling, 'Measurement Systems', McGraw Hill.

COURSE OUTCOMES

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

1) Work in Quality control and quality assurances divisions in industries
2) Design a sensors and transducers used for stress analysis.
3) Design and maintain measuring equipments for the measurement of temperature and flow.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓				✓				
CO2	✓		✓		✓				
CO3			✓	✓					

P03CP205	**MACHINE DRAWING**	**L**	**T**	**P**
		0	**0**	**3**

COURSE OBJECTIVES

- Students have an ability to apply knowledge of modeling, science & engineering.
- Student can modeled this drawing even in CAD/CAM software by applying the basic knowledge of machine drawing.
- Students will able to demonstrate an ability to design and conduct experiments, analyze and interpret data, assembly and disassembly drawings knowledge will be provided.

Unit–I : Free Hand Sketches

Fasteners: Different form of rivet heads – Single, double riveted lap and butt joints - Foundation bolts - Locking arrangements for nuts - lock nut, split pin, locking plate and spring washer - Stud Set screws – Different forms of machine screws - pan, countersunk, slotted and philip headed screws - Keys - sunk taper key, gib headed taper key, feather key, woodruff key, saddle key.

Unit–II : Orthographic and Assembly Drawings

To draw orthographic views from the given isometric views of simple objects. Detailed assembly drawing and additional views from the given drawing.

(a) Shaft coupling - Protected type and Pin type flexible coupling
(b) Bearings and Supports - Bushed bearing, Foot step bearing and Plummer Block
(c) Eccentric
(d) Steam engine stuffing box
(e) Screw jack.

TEXT BOOKS

1) Gopalakrishna, K.R., Machine Drawing, Subhas stores, Bangalore.
2) Bhatt, N.D., Machine Drawing, Charotar Publishing House.

REFERENCES

1) Parkinson, A.C. (Sinha), A First Year Engineering Drawing, Wheeler Publishers, New Delhi.

2) Parkinson, A.C., Intermediate Engineering Drawing.
3) Narayana, K.L., Kanniah, P. & Venkata Reddy, K., A Text Book on Production Drawing, Premier Publishing House, Hydrabad.
4) Narayana, K.L., Kanniah, P. & Venkata Reddy, K., Machine Drawing, New Age International (P) Limited, Publishers.
5) Lakshmi Narayanan, V. & Mathur, M.L., A Text Book of Machine Drawing, Jain Brothers Publishers.

COURSE OUTCOMES

Upon completing this course, students should be able to:

1) Understand and apply the knowledge of machine drawing as a system of communication in which ideas are expressed clearly and all information fully conveyed.
2) Understand the design of a system, component or process to meet desired needs within realistic constraints such as manufacturability, economic, environmental, safety & sustainability etc.., to represent a part drawing and assembly drawings.
3) Recognize the need and an ability to engage in self education and life-long learning.

Mapping with Programme Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓		✓					✓	
CO2			✓						✓
CO3					✓		✓		✓

THIRD SEMESTER

P03PC301	MACHINE DESIGN	L	T	P
		4	0	0

COURSE OBJECTIVES

- To familiarize the various steps involved in the Design Process.
- To understand the principles involved in evaluating the shape and dimensions of Component to satisfy functional and strength requirements.
- To learn to use standard practices and standard data To learn to use catalogues and standard machine components.

Unit–I

Introduction: Types of Design factors. Factor of safety, Theories of failure - Curved beam, Crane hook and C frames.

Design for fatigue strength: S-N diagram - Endurance limit modifying factors - Stress concentration - Fluctuation stress –Soderberg & Good Man equations.

Unit–II

Shafts - Material and design stresses - Calculation of equivalent bending moment and twisting moment - Design of shafts subjected to combined bending moment and twisting moment.

Unit–III

Theory of columns: Design of push rod, piston rod and I.C. Engine connecting rods sections.

Wire ropes - Stresses - selection Design procedure–leaf springs - construction equalized stresses in leaves - material and design. Open and closed coiled helical springs stress - Wahl's factor.

Unit–IV

Power screws - Thread forms Design consideration and materials - wear and shear - design procedure. Coupling - Types - Design and selection of coupling - Flange coupling, Bushed pin type, flexible coupling design and selection.

Unit–V

Design of Joints: Riveted Joints: Introduction - Types of riveted joints - failures of a riveted joint - strength and efficiency - Design of boiler joints.

Welded joints: Introduction - Strength of transverse and parallel fillet welded joints - Axially loaded unsymmetrical welded sections - Eccentrically loaded welded joints.

TEXT BOOKS

1) Khurmi R.S., Machine Design, S. Chand and Company Ltd., New Delhi, 14th edition, 2005.
2) Pandya and Sha, Machine Design, Charotar Pub. House, Anand, India.

REFERENCES

1) Richard Budynnas and J.E. Shigley's, Mechanical Engineering Design, McGraw Hill Book Company, 8th ed., 2008.
2) Prabhu, T.J., Fundamentals of Machine Design, 4th ed. 2000, Scitech Pub.
3) Sundararajamoorthy, T.V. & N. Shanmugam, Machine Design, Anuradha Agencies.2000.

COURSE OUTCOMES

Upon completing this course, students should be able to:

1) Appreciate the functions of various machine elements and assemblies
2) Design various machine components according to the requirement as per the prescribed standards
3) Apply the knowledge of materials and their properties
4) Use a standard design data book.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓			✓					
CO2		✓					✓		
CO3	✓			✓	✓				
CO4	✓							✓	

P03PC302	**MECHANICS OF MACHINES**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

- To study the motion of different parts of a machine through determination of velocity and acceleration at different moments using graphical and analytical methods.
- To study the motion and forces concerning different parts of a mechanism and to understand the concepts of theory of machines involved in the design of parts.
- To draw the displacement, velocity, acceleration and jerk diagrams for a given cam profile and analyse the special contour cams.
- To distinguish and study the phenomena involving frictional force as an advantage or disadvantage.
- To acquaint the basic concepts on gears and gear trains needed for the design of the same.

Unit–I : Basic Concepts and Mechanisms

Kinematics - links, pairs chain – mechanism – structure – Inversion of four bar chain – Inversion of single slider crank chain – Inversion of double crank chain – Grashof law – Degrees of freedom – Kutzbach criterion – Grubler's criterion.

Classification of mechanisms – Ratchet and Escapement mechanisms – Indexing mechanisms – 'Analysis of Hooke's joint – Double Hooke's joint – Pantograph – Straight line motion Mechanisms (Exact and Approximate) – Steering gear mechanisms.

Unit–II : Kinematics of Linkage Mechanisms

Displacement, velocity and acceleration analysis of mechanisms – Velocities and accelerations by relative velocity method – Velocities and accelerations by Analytical method – Coriolis Acceleration – Graphical methods for determination of velocity and acceleration of I.C engine mechanism.

Unit–III : Friction

Friction – clutches – single plate – multi plate – cone clutches.

Belt –Tension due to centrifugal force – Maximum power transmitted – rope drive – chain drive.

Hydrodynamic and hydrostatic bearing – frictional loss of power in journal – pivot – collar bearings.

Unit–IV : Kinematics of Cam Mechanisms

Cams – Layout of cam profile – Uniform velocity – Simple Harmonic – Cycloidal – Uniform acceleration and retardation – Reciprocating and oscillating followers – Knife edge, Roller and flat faced – Calculation of maximum velocity and acceleration of followers.

Unit–V : Gears and Gear Trains

Law of gearing – Spur Gear terminology and definitions - Involutes and cycloidal tooth profiles Gear tooth action - Contact ratio - Interference and undercutting - corrected and uncorrected gear teeth - Gear terminology and definitions -Helical, Bevel, Worm, Rack and Pinion gears.

Gear trains - Speed ratio, train value - Epicyclic Gear Trains - Differentials - Automobile gear box

TEXT BOOKS

1) Rattan, S.S., "Theory of Machines", 3rd Edition, Tata McGraw Hill, 2009.
2) Thomas Bevan, "Theory of Machines", 3rd Edition, CBS Publishers and Distributors, 2005.

REFERENCES

1) Dr. R. K. Bansal and Dr. J.S. Brar, "A Text Book of Theory of Machines (In S.I. Units)", 5th Edition(Revised), Laxmi Publications (P) Ltd., 2016.
2) Khurmi, R.S.," Theory of Machines", 14th Edition, S Chand Publications 2015.
3) Sadhu Singh, Theory of Machines, Pearson, 2013.
4) Rao, J.S. and Dukkipati, R.V., "Mechanisms and Machine Theory", Wiley-Eastern Ltd., New Delhi, 1992.
5) Ghosh, A. and Mallick, A.K., "Theory of Mechanisms and Machines", Affiliated East-West Pvt. Ltd., New Delhi, 1988.

COURSE OUTCOMES

Upon completing this course, students should be able to:

1) Provide a clear and thorough presentation of the theory of mechanics of machines.
2) Carryout analysis and synthesis of mechanisms.
3) Perform the velocity and acceleration analysis on various links which constitute a mechanism.
4) Understand the working principle of clutches, belt drives, bearings, cams and gears.
5) Develop the ability to use mathematics as a tool whereby the solution to a problem may be carried out in the most direct and effective manner.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓		✓						
CO2		✓							
CO3		✓		✓					
CO4	✓		✓			✓			
CO5	✓	✓			✓				

P03PC303	**FLUID MECHANICS AND HYDRAULIC MACHINERY**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES:

- To study the applications of the conservation laws to flow through pipes and hydraulic machines.
- To understand the importance of dimensional analysis.
- To understand the importance of various types of flow in pumps and turbines

Unit- I PROPERTIES OF FLUID

Introduction to fluid mechanics -Real and ideal fluids – Properties of fluid – Pressure in a fluid – Manometers –– compressible and incompressible fluids – Pressure measurements –– Hydrostatic forces on surfaces -Total pressure and Centre of pressure on different surfaces – Buoyancy and static stability – Metacentre.

Unit - II FLOW CHARACTERISTICS

Types of flows and flow pattern (stream lines, stream tube, Path lines and streak line)– one dimensional flow analysis – General continuity equation – steady flow equation of continuity – Euler's equation- Bernoulli's equation and its applications.(Orifice meter, Venturimeter and pitot tube).

Unit - III BOUNDARY LAYER CONCEPT, EVALUATION OF FRICTIONAL LOSSES IN PIPE AND DIMENSIONAL ANALYSIS

Boundary layer – laminar and turbulent flow separation – Transition- types of Boundary layer thickness – Flow through pipes- Weisbach equation and chezy's for friction loss in pipe- Major and minor losses – Buckingham $\prod$ theorem – non – dimensional numbers – Reynolds number – Froude numbers, Weber number, Euler's number and Mach number.

Unit - IV TURBINES

Pressure of a jet a stationary and moving curved blades – impulse and reaction turbines – Pelton wheel – velocity diagram for impulse turbine – hydraulic, mechanical and overall efficiency – reaction turbines – types – Francis and Kaplan turbine – velocity diagrams – draft tubes – specific speed – cavitation.

Unit - V PUMPS

Centrifugal pump – casing – velocity diagrams – manometric and hydraulic efficiency – minimum speed for starting a pump – specific speed. Reciprocating

pump – slip and co-efficient of discharge – velocity diagrams – effect of friction and velocity & acceleration on pipes – air vessels – hydraulic appliances.

TEXT BOOKS:

1. A Text Book of Fluid Mechanics and Hydraulic Machinery, Bansal R. K., Lakshmi Publications, Madras.
2. Hydraulics and Fluid Mechanics, Modi P.N., Seth S.M Standard Book House, NewDelhi, 1992.

REFERENCES:

1. Fluid Mechanics and Hydraulics Machinery, Khurmi R. S., S. Chand and Co. New Delhi,1991
2. Fluid Mechanics and Hydraulics Machines, JagdishLal, Metropolitan Book Co. Pvt.Ltd.,New Delhi, 1991.
3. Engineering Fluid Mechanics, Kumar K. L., Eurasia Publishing House(p) Ltd. New Delhi (2004)

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

1. Apply mathematical knowledge to predict the properties and characteristics of a fluid.
2. Critically analyse the performance of pumps and turbines.
3. Identify hydraulic component
4. Ability to design hydraulic circuits
5. Visualize how the hydraulic circuit will work to accomplish the function.

Mapping with Programme Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2	✓		✓			✓			✓
CO3	✓	✓							
CO4				✓					
CO5					✓				✓

P03CP305	PROGRAMMING LAB	L	T	P
		0	0	3

COURSE OBJECTIVES

- To understand the strength of OOPS (polymorphism & inheritance) using c++
- To impart programming skills in C++ programming.
- To provide hands-on experience in developing basic mechanical models and assembly drawing using AUTO CAD.
- To introduce the basics of MAT LAB.

LIST OF EXPERIMENTS

Preliminary Auto CAD 2 D drawing exercise

Auto CAD machine drawing

Knuckle Joint

Bushed bearing

C++, Programming,

Otto cycle efficiency

Compressor dimensions

Simple MATLAB Exercises

COURSE OUTCOMES

Upon completing this course, students should be able to:

1) Write and compile programmes in C++
2) Develop assembly drawings with different views using auto cad
3) Exchange file formats between AutoCAD & other analysis packages
4) Solve simple mathematical models using MATLAB.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓		✓	✓				
CO2		✓					✓	✓	
CO3							✓	✓	✓
CO4							✓	✓	✓

FOURTH SEMESTER

P03PC401	DESIGN OF TRANSMISSION SYSTEMS	L	T	P
		4	0	0

COURSE OBJECTIVES

- To gain knowledge on the principles and procedures for the design of power
- Transmission components.
- To understand the standard procedure available for Design of transmission systems
- To learn to use standard data and catalogues

Unit–I

Bearings: - Hydrodynamic Journals Bearings - Design procedure - Minimum film thickness - Selection of Antifriction bearings - Life of bearings - Equivalent load, Cubic mean load - load rating - Design Procedure..

Unit–II

Belt Drives of flat belts, V-Belts using manufacturer's table - Matched set of V-Belts, Chain drives for Power transmission design procedure.

Unit–III

Gear drives: Toothed gear - types of failure - Design analysis - Gear Materials - Design of spur and Helical gears based on surface strength and bending strength - Forces acting on toothed gears.

Unit–IV

Bevel and worm gears: Bevel gears classification - terminology - forces on bevel gear tooth - Design procedure - working gears - Design of worm gears - Terminology - centre distance - losses - design procedure.

Unit–V

Gear Box: Standard Step ratio - Speed diagram - Kinematics layout - Design of six speed, twelve speed, eighteen speed gear box - calculation of actual speed.

TEXT BOOKS

1) R.S. Khurmi, “Machine Design”, S. Chand company Ltd., 14th ed. 2005.
2) T.J. Prabhu, “Design of Transmission Elements”, 4th ed. 2000.

REFERENCES

1) Richard Bundya and Shigley, “Mechanical Engineering Design”, McGraw Hill Book Company.
2) T.V. Sundarajamoorthy, N.Shanmugham, “Machine Design”, Khanna Publishers.

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1) Develop knowledge on the functions of various transmission elements.
2) Understand prerequisite for design of various transmission components.
3) Implement the basic engineering knowledge.
4) Work in the design team analyzing difficulties.
5) Design and develop solutions of various elements.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1			✓		✓				
CO2		✓			✓				
CO3	✓	✓							
CO4							✓	✓	✓
CO5								✓	✓

P03PC402	**MANUFACTURING TECHNOLOGIES**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

To understand the theory of metal cutting, cutting tools and materials involved in the cutting operations.

- To explore the special purpose machines and understand their working operation
- To understand the abrasive processes and their grinding metrology
- To understand the basic concepts of jigs and fixtures and their design and manufacturing
- To introduce and understand the mechanisms of unconventional machining processes and their applications

Unit–I : Theory of Metal Cutting

Material removal processes: Cutting tool geometry, Tool signature, Theory of metal cutting: orthogonal and oblique cutting, chip formation, Power requirements for turning, Cutting tool materials, Tool wear, Tool life, Tool life equation, Cutting fluids.

Unit–II : Special Purpose Machines

Capstan and turret lathes –Comparison - Turret Indexing mechanism, Bar feed mechanism.

Automats and transfer machines: Single spindle and multiple spindle automatic lathes, transfer machines - Rotary indexing lathe and drum type transfer machines.

Gear cutting – forming and generation principle, gear hobbing and gear shaping processes –finishing of gears.

Unit–III : Abrasive Machining Processes

Types of grinding process: Cylindrical grinding, surface grinding, center less grinding and internal grinding- Typical applications.

Grinding wheel: specifications and selection, Wheel truing and dressing.

Micro finishing: Honing, Lapping, Super finishing: Buffing and Polishing.

Unit–IV : Jigs and Fixtures

Elements of jigs and fixtures - 3-2-1 principle - Locating devices and types - clamping devices and types - types of jigs: drill jigs - template jigs.

Elements of fixtures: Types of fixtures - milling fixtures - turning fixtures – Modular fixtures.

Unit–V : Unconventional Machining Processes

Basic principle and metal removal mechanism of Abrasive Jet Machining (AJM), Ultrasonic Machining (USM), ElectricDischarge Machining (EDM), Electro Chemical Machining (ECM), Laser Beam Machining (LBM) and Electron Beam Machining (EBM).

Basics of Rapid prototyping.

TEXT BOOKS

1) Hajara Chowdry, et al.: Elements of Workshop Technology Vol.I & Vol.II, Media Promoters & Pub., 1997.
2) Khanna, O.P. & Lal M., Production Technology, Vol.I & Vol.II, DhanpatRai & Sons, 2000.

REFERENCES

1) Chapman, W.AJ., Workshop Technology, Vol, II & III, CBS Pub., 2001.
2) Begeman, Manufacturing Processes.

COURSE OUTCOMES

Upon completion of the course students will be able to

1) Identify, formulate and solve technical problems
2) Work effectively on teams and within a diverse environment
3) Recognize the need for self-improvement through continuing education and the ability to engage in lifelong learning.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2					✓	✓			
CO3									✓

P03PC403	**POWER PLANT ENGINEERING**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

- Basic knowledge of different types of power plants, working cycle criteria of each one of them.
- Understanding of thermal power plant operation, different types of high pressure boilers including supercritical and supercharged boilers, fluidized bed combustion systems.
- Design of chimney in thermal power plants, knowledge of cooling tower operation, numerical on surface condenser design.
- Basic knowledge of different types of nuclear power plants, power plant economics, safety and environmental.

Unit–I

Introduction to types, layouts and working cycles - Layouts of diesel-electric, hydro-electric, nuclear, gas turbine, steam, cogeneration, MHD and other power plants - Site selection - Reheat and regenerative steam cycles - Binary vapour cycle - Combined cycle - Topping cycle - Power plant instrumentation and control - air flow, furnace pressure, steam temperature control system - Governing system - Steam turbine.

Unit–II

Fuels, combustion and burning methods - Fuel classification - Solid, liquid and gaseous - Compositions and heating values - Classification of coal - Combustion process, atmosphere and control - ESP Furnace construction - Stokers - suspension firing - pulverised fuel firing - oil and gas burners and systems - Fuel control - Burner management system - FSSS - Ash handling system.

Unit–III

Steam power plant - Steam generators - fire tube, water tube, forced circulation, once through, super charged, super critical, Lamont, Loeffler, Schmide, Hortmen and Velox boilers, Fluidised Bed & Circulated Fluidised Bed boilers - Natural, artificial, balanced and steam jet drafts - Simple problems - Functions of super heaters, economisers, air-heaters, deaerators, feed heaters, air ejectors - Feed pumps - Injectors - Feed water control- Condensers – Jet and surface type - Simple problems - Cooling towers.

Unit–IV

Nuclear power plant - Basics of nuclear fuels - Fission and chain reaction - Reactor classification - Boiling water, pressurised water, homogeneous, gas cooled breeding and metal cooled.

Unit–V

Economics and safety - Actual load curves - Fixed and operating costs - Tariff methods for electrical energy - Peak load and variable load operations - Selection of generation type and general equipment. Introduction to safety aspects in power plants - Environmental impacts - assessment for thermal power plant.

TEXT BOOKS

1) S. Domkundwar, A.V. Domkundwar, S.C. Arora A Course in Power Plant Engineering, Dhanpat Rai Publications. 2013
2) P.K. Nag, Power Plant Engineering, Tata McGraw Hill, Laxmi Publications Pvt. Ltd New Delhi, 5th Edition, 2014.

REFERENCES

1) R.K. Rajput. A Text of Power Plant Engineering, Laxmi publications, New Delhi 5th Edition, 2016.
2) G.R. Nagpal, Power Plant Engineering, Khanna Publications 1998.
3) Moarse, Power plant Engineering.
4) M.M. El-Wakil, Power plant Technology, Tata McGraw Hill, New Delhi 1984.
5) Vopat and Skrotzki, Power Plant Engineering, Tata McGraw Hill, New Delhi.

COURSE OUTCOMES:

Upon completing this course, students should be able to:

1) Select the suitability of site and calculate the performance of power plant.
2) Understand the suitable ash handling, coal-handling method in a thermal power plant.
3) Know the working principle of different types of power plant.

4) Calculate average load and peak load on a power plant and indicate environmental and safety aspects of power plants.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1		✓							
CO2			✓			✓			
CO3	✓								✓
CO4	✓	✓			✓				

P03CP405	**MECHANICAL LAB – II**	**L**	**T**	**P**
		0	**0**	**3**

COURSE OBJECTIVES

- To evaluate the performance and emission characteristics of an single cylinder diesel engine
- To conduct the load test, speed test of a single and double cylinder diesel engine
- To conduct performance test on double stage reciprocating air compressor
- To conduct the heat balance test on single and double cylinder diesel engine.
- To evaluate the performance of steam boiler, turbine and condenser.

LIST OF EXPERIMENTS

1) Load Test on Four Stroke Diesel Engine
2) Study and performance test on Air Compressor
3) Heat Balance Test on Four Stroke Diesel Engine
4) Speed test on Four Stroke Diesel Engine
5) Study and performance test on steam boilers
6) Study and performance test on Steam turbines
7) Study and performance test on Reader vertical steam engine.
8) Study and performance test on steam condenser.

COURSE OUTCOMES

Upon completion of this practical class, the students will be able to:

1) Learn about the different heat losses in the engine viz., cooling water, exhaust gas and un-accountable losses.
2) Understand the working principle of emission measuring instruments and calibration procedure.
3) Acquire the knowledge of emission standards and fuel modification in engines.
4) Experimentally determine the performance of a steam boiler, turbine and condenser.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1		✓	✓						✓
CO2					✓				
CO3		✓						✓	
CO4				✓		✓			✓

FIFTH SEMESTER

P00HS501	ENVIRONMENTAL STUDIES	L	T	P
		4	0	0

COURSE OBJECTIVES

- To study the nature and the facts about environment.
- To find and implement scientific, technological, economic and political solutions to environmental problems.
- To Study the dynamic processes and understand the features of the earth interior and surface.

Unit–I

Introduction - Multidisciplinary nature of environmental studies - Definition, scope and importance - Need for public awareness.

Natural resources - Forest resources: use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources.- Equitable use of resources for sustainable lifestyles.

Unit–II

Concept of an ecosystem - Structure and function of an ecosystem - Producers, consumers and decomposers - Energy flow in the ecosystem - Ecological succession - Food chains, food webs and ecological - pyramids - Introduction, types, characteristic features, structure and function of the following ecosystem - Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit–III

Introduction – Definition: genetic, species and ecosystem diversity - Bio geographical classification of India - Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, National and local levels - India as a mega-diversity nation - Hot-spots of biodiversity - Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts - Endangered and endemic species of India - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit–IV

Definition - Cause, effects and control measures of Air pollution - Water pollution - Soil pollution - Marine pollution- Noise pollution - Thermal pollution - Nuclear hazards- Solid waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution - Disaster management: floods, earthquake, cyclone and landslides.

Sustainable development - Urban problems related to energy - Water conservation, rain water harvesting, and watershed management - Resettlement and rehabilitation of people; its problems and concerns. - Environmental ethics: Issues and possible solutions - Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.

Wasteland reclamation - Consumerism and waste products - Environment Protection Act - Air (Prevention and Control of Pollution) Act - Water (Prevention and control of Pollution) Act - Wildlife Protection Act - Forest Conservation Act - Issues involved in enforcement of environmental legislation.

Unit–V

Population growth, variation among nations - Population explosion – Family Welfare Programme - Environment and human health - Human Rights - Value Education - HIV/AIDS - Women and Child Welfare - Role of Information Technology in Environment and human health -Case Studies.

Field Work

Visit to a local area to document environmental assets-river / forest / grassland / hill / mountain - Visit to a local polluted site-Urban/Rural/ Industrial/ Agricultural - Study of common plants, insects, birds - Study of simple ecosystems-pond, river, hill slopes, etc. **(Field work Equal to 5 lecture hours)**

TEXT BOOKS

1) Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
2) Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email:mapin@icenet.net (R)

REFERENCE BOOKS

1) Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
2) Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)
3) Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai, 1196p
4) De A.K., Environmental Chemistry, Wiley Eastern Ltd.
5) Down to Earth, Centre for Science and Environment (R)

(M) Magazine (R) Reference (TB) Textbook

COURSE OUTCOMES

Upon completion of this course, the students will be able to understand:

1) Public awareness of environment at infant stage.
2) Ignorance and incomplete knowledge has lead to misconception
3) Development and improvement in standard of living has lead to serious environmental disasters.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO6**	**PO6**	**PO7**	**PO8**	**PO9**
CO1			✓			✓			
CO2						✓			
CO3									✓

P03PC502	HEAT AND MASS TRANSFER	L	T	P
		4	0	0

COURSE OBJECTIVES

- To understand the modes of heat transfer through various configuration.
- To learn the mechanism of heat transfer in both steady and unsteady state conditions.
- To understand the concept of heat transfer and physical significance of non-dimensional numbers and numerical heat transfer.
- To learn the thermal analysis of heat exchangers and basic concepts of mass transfer.

Unit–I : Conduction

General heat conduction equation – Cartesian, Cylindrical and Spherical Coordinates – Modes and Basic Laws of Heat Transfer – Electrical Analogy to heat flow – concept of thermal resistance – 1D steady state heat conduction in simple Geometries; Composite walls, concentric cylinder and sphere-problems – critical radius of insulations – variable thermal conductivity – extended surfaces – 1D fin of uniform cross section – simple problems

Unit–II : Two Dimensional And Unsteady State Heat Conduction

Two dimensional steady state heat conduction – conduction shape factor - One dimensional numerical analysis in conduction – conversion of partial differential equation (steady and unsteady) into finite difference equation – separation of variables – numerical method of solution for simple one/two dimensional system (relaxation or Gaussian elimination or iteration method – simple problems) – Introduction to unsteady state heat conduction – Lumped Analysis – Semi Infinite and Infinite Solids – Use of Heisler's charts.

Unit–III : Convection

Introduction to dimensional analysis – Buckingham's π theorem method applied to convection – Non dimensional numbers and their significance – Introduction to free and forced convection – Boundary Layer Concept (without problem) – Forced convection : External flow – Flow over plates, cylinders spheres – problems – Internal flow – flow through pipes – free convection : flow over vertical plate and cylinder – horizontal plate, cylinder and sphere (simple problems).

Heat transfer with phase change – boiling – various Regimes of boiling – condensation – film wise and drop wise condensation – problems.

Unit–IV : Radiation

Introduction – radiation properties – Total emissive power – spectral emissive power – black and grey body concept – radiosity – radiation intensity – radiation laws – Geometrical shape / view factors – reciprocity theorem/relations – radiation heat exchange between black and grey bodies – electrical analogy – radiation shields – reradiating surfaces.

Unit–V : Applications

Heat exchanger – basic types and classification – construction of heat exchangers – Thermal analysis: LMTD – effectiveness – NTU method – fouling factor

– overall heat transfer coefficient – combined heat transfer by conduction, convection and radiation – automobile and electronic component cooling.

Mass transfer concept and Fick's first law of diffusion – analogy between heat and mass transport. Diffusion mechanism of air – water (two component system).

TEXT BOOKS

1) Rajput, R.K., Heat and Mass Transfer, 3rd ed., S.Chand & Company, 2006.
2) Domkundwar and A. Arora, A Course in Heat and Mass Transfer, Danpati Rai & Sans, New Delhi, 2004.

REFERENCES:

1) Dr. G. Kamaraj and Dr. P. Raveendiran, Heat and Mass Transfer, Scitech pub., 2008.
2) Holman, J.P., Heat Transfer, McGraw Hill Co., 2007.
3) Ozisik, M.N., Basic Heat Transfer, McGraw Hill Co., 1985.
4) Nag, P.K., 2005. Heat Transfer, TMH Pub.
5) Kothandaraman, C.P., Fundaments of Heat and Mass Transfer, 2nd ed., New Age International, 2004.

COURSE OUTCOMES

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

1) Understand the mechanism of heat and mass transfer and its application.
2) Design thermal insulation system
3) Design the heat exchangers

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2			✓	✓	✓				✓
CO3			✓	✓					

P03CP505	**MECHANICAL LAB – III**	**L**	**T**	**P**
		0	**0**	**3**

COURSE OBJECTIVES:

- To supplement the principles learnt in kinematics and Dynamics of Machinery.
- To make the students understand the working principle of various types of governors, balancing systems, Cam analyzer, Torsional vibration of single rotor system, whirling speed concept, action of forces in gyroscope.

LIST OF EXPERIMENTS:

- Experimental verification of natural frequency in undamped vibration of single rotor system.
- Determine the characteristic curves of watt/ Hartnell governors.
- Determination of mass moment of inertia of connecting rod and fly wheel.
- Studies on cam analyser

- Study of gyroscopic couple.
- Whirling of speed – determination of critical speed.
- Study and experiments on static and dynamic balancing of rotating masses.

COURSE OUTCOMES:

1) Upon the completion of the course, the students will be able to:
2) Determine the mass moment of inertia of connecting rod and flywheel either experimentally of theoretically or both.
3) Understand the working principle of governors.
4) Calculate the stiffness of springs.
5) Analyze the different types of motion in cams.
6) Ability to analyze particle dynamics

Mapping with Programme Outcomes									
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓							
CO2	✓	✓							
CO3		✓					✓		
CO4				✓	✓				
CO5			✓						✓

SIXTH SEMESTER

P03PC601	REFRIGERATION AND AIRCONDITIONING	L	T	P
		4	0	0

COURSE OBJECTIVES

- To provide in-depth study of the basics of refrigeration and air-conditioning
- To study the various refrigeration systems and their thermodynamic cycles.
- To study the basics of psychrometry and cooling load calculations of air-conditioning systems.

Unit–I

Introduction – Unit of refrigeration – Refrigeration systems – Refrigeration cycles and concepts – Coefficient of Performance – Reversed Carnot cycle – Refrigeration System - Heat pump – Air Refrigeration – types – problems – Air craft Refrigeration system (Description only).

Unit–II

Introduction to Steam Jet Refrigeration, vapour absorption refrigeration and solar refrigeration – (Description only) – performance Analysis of vapour compression cycle – Ideal and actual conditions – Problems – Representation of cycle on p-h and T-s diagram – Properties of refrigerants and their choice for different applications – Eco friendly refrigerant.

Unit–III

Refrigeration equipment – (Description only) – Compressors – Reciprocating, centrifugal and screw – open, hermetic and semi-hermetic Units – condensers – air and water cooled condensers, evaporative condensers – Evaporators – Double tube, shell and tube, dry and flooded types – Expansion devices – Protection devices – High and Low pressure cut out Thermostat – solenoid valve.

Unit–IV

Psychrometry of Airconditioning Processes – sensible heating and cooling, latent heat process, total heat process, sensible heat factor – bypass factor – cooling and Dehumidifying coil, heat coils, air washer, adiabatic dehumidifiers, water and steam injection – Adiabatic mixing – Problems on Psychrometric processes.

Unit–V

Air-conditioning system – classification – Unitary, packaged and central type summer and winter air conditioning systems – (Description only) – merits and demerits – Comfort indices – Air purification – Air-conditioning – Heat gain and load calculations – RSHF, GSHF and ERSHF – energy efficiency in building – Need for reheating.

TEXT BOOKS

1) Arora, C.P., "Refrigeration and Air Conditioning", McGraw Hill, 3rd ed, New Delhi, 2010.
2) R.S. Khurmi & J.K. Guptha, Refrigeration and Air-Conditioning, S.Chand & company, 3rd ed, New Delhi, 2005.

REFERENCES

1) Arora, S.C. & Domkundwar, S., Refrigeration and Air-conditioning, Dhanpat Rai & Sons, NewDelhi, 1995.

2) Stoecker, W.F. and Jones J. W., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi, 1986.
3) Ballaney, P.L., Refrigeration and Air-conditioning, Khanna Publisher, New Delhi, 2003.
4) Roy J. Dossat, "Principles of Refrigeration", Pearson Education Asia, 4th ed, 2009.
5) "ASHRAE Hand book", Fundamentals 2010.

COURSE OUTCOMES

Upon completion of this course the student will able to understand the

1) Operation of different types of refrigeration and air conditioning systems
2) Psychrometry of mixture of water vapor and air.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2		✓	✓	✓					

03CP605	**MECHANICAL LAB – IV**	**L**	**T**	**P**
		0	**0**	**3**

COURSE OBJECTIVES

- To make the students understand the modes of heat transfer and to conduct the trails on various experiments to analyze the heat transfer parameters.
- To study and determine the properties of fuel like kinematic viscosity, calorific value etc.
- To study the effect of temperature on fuel properties

LIST OF EXPERIMENTS

1) Experiment on (parallel flow and counter flow) heat exchanger
2) Determination of Stefan-Boltzmann constant
3) Determination of critical heat flux
4) Experiment on composite wall apparatus.
5) Natural convection from vertical cylinder
6) Determination of calorific value of liquid fuel
7) Determination of flash and fire point of liquid fuel
8) Determination of cloud and pour point fuel
9) Determination of kinematic viscosity of fuel

COURSE OUTCOMES

Upon completing this course, students should be able to:

1) Calculate the temperature distribution and heat conduction in the metal rod.
2) Evaluate the radiation heat transfer between surfaces.
3) Analyze the performance of heat exchanger.
4) Determine kinematic viscosity and the influence of temperature on viscosity.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1		✓		✓					
CO2	✓	✓							
CO3	✓								
CO4	✓	✓	✓						

SEVENTH SEMESTER

P00HS701	ENGINEERING ETHICS	L	T	P
		4	0	0

COURSE OBJECTIVES

- To understand the moral and ethical dimensions in engineering.
- To take balanced decisions.

Unit–I

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories.

Unit–II

Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study.

Unit–III

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk - Chernobyl Case Studies and Bhopal.

Unit–IV

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

Unit–V

Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct

TEXT BOOKS

1) Govindarajan, M., Natarajan, S. and Senthilkumar, V.S., "Professional Ethics and Human Values", PHI Learning, New Delhi, 2013.
2) Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York, 2005.

REFERENCES

1) Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Thompson Learning, 2000.

2) Charles D. Fleddermann, “Engineering Ethics”, Prentice Hall, New Mexico, 1999.
3) John R. Boatright, “Ethics and the Conduct of Business”, Pearson Education, 2003.
4) Edmund G. Seebauer and Robert L. Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, 2001.
5) David Ermann and Michele S. Shauf, “Computers, Ethics and Society”, Oxford University Press, (2003).

COURSE OUTCOMES

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

1) Understand the relationship between the engineer and the society.
2) Learn the importance of codes in engineering practice.
3) Acquire knowledge on the legal, moral and ethical aspects in engineering.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1						✓	✓		
CO2	✓		✓			✓			
CO3						✓	✓	✓	

P03PV704	**PROJECT WORK & VIVA VOCE**	**L**	**T**	**P**
				8

COURSE OBJECTIVES

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews and viva voce examination.

COURSE OUTCOMES

Upon completing this course, students should be able to:

- Take up any challenging practical problems and find solution by formulating proper methodology.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1		✓	✓	✓	✓		✓		✓

PROFESSIONAL ELECTIVES

03PEXXX	APPLIED THERMAL ENGINEERING	L	T	P
		4	0	0

COURSE OBJECTIVES

- To apply the thermodynamic concepts into various thermal application like rotary compressors, steam nozzles, steam turbines and gas turbines. To study the basics of jet propulsion and rocket propulsion

Unit–I

Rotary Compressors: Centrifugal compressor - velocity diagrams - performance characteristics - pressure coefficient and slip factor - surging Axial, radial and mixed flow compressors - velocity diagrams - performance characteristics .

Unit–II

Steam Nozzles - Effect of back pressure - condition for maximum discharge - effect of friction - supersaturated flow - impulse steam turbine - velocity diagrams - blade efficiency - stage efficiency - end thrust - reheat factor.

Unit–III

Reaction steam turbine - degree of reaction - 50 % reaction turbine - influence of blade speed to steam speed - height of reaction blading - Method of compounding steam turbines - Methods of governing steam turbines.

Unit–IV

Gas turbine - cycles - optimum pressure ratio for maximum output - component efficiencies – inter-cooling and reheating, regeneration - gas turbine combustion chambers - different types of combustor arrangements.

Unit–V

Introduction to Jet propulsion systems - Aerofoil theory - Lift and Drag - Ramjet - Turbojet - Rocket propulsion - Thrust - Specific impulse - propulsion efficiency and overall efficiency.

TEXT BOOKS

1) Ballaney, P.L., Thermal Engineering, 24th edition, Khanna Publishers, New Delhi, 2003.
2) Khurmi, R.S., Thermal Engineering, S.Chand& Co., New Delhi.14th ed. 2005.

REFERENCES

1) Cohen and Rogers, Gas Turbine Theory and applications,
2) Kearton, Theory of steam turbine, CBS Pub.2001.
3) Mathur, M.L. & Mehta, F.S., Thermodynamics and Heat Power Engineering, Vol-I and Vol-II, Jain Brothers, New Delhi, 2002.

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1) Analyse the theory and performance of steam turbines

2) Understand performance of gas turbines

3) Analyse the performance of jet and rocket propulsion systems

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2	✓	✓							
CO3	✓	✓	✓						✓

03PEXXX	**AUTOMOTIVE ENGINEERING**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

- To impart the knowledge about the engine chassis, transmission, steering, suspension systems, rear axles and final drive of Automobiles.
- To Study the concept of electrical system, sensors and fuel injection system in automobiles

Unit–I

Engine chassis frame – layout of chassis and its main components – functions of the chassis frame – types – laden – monocoque – various loads acting on the chassis frame. The Clutch - Function- Single plate, multi plate clutches - Torque converters.

Unit–II

Gear Boxes - Function – Sliding mesh - Constant mesh and synchromesh gear boxes - Selector Mechanism – Working of Automatic gear boxes - over drive - Front wheel drive - Propeller shaft and universal joints - Constant velocity Universal joints.

UNIT–III

Front axle and steering geometry - Principle of power steering - steering mechanism – Re-circulating ball mechanism - cam & double pin steering gear boxes - Camber angle, Caster angle, King pin inclination - Types of frames and suspension systems. Independent suspension - Rear suspension - Pneumatic suspension.

Unit–IV

Rear axle - final drive - Single and double reduction axle, torque and thrust members - arrangements. Differential - function of differential - differential lock - rear axle-housing construction - Rear axle arrangements. Brakes - Mechanical, disc, hydraulic and pneumatic brakes - servo brakes – antilock braking systems.

Unit–V

Electrical system of the automobile - Battery – Ignition system - Gasoline injection- throttle body injection and multi point fuel injection systems- controls -– CRDI system for diesel engine. Engine sensors - types– oxygen sensors, crank angle position sensors – fuel metering, vehicle speed sensors - detonation sensor – altitude sensor, flow sensor, throttle position sensors, relays. GPS navigation system.

TEXT BOOKS

1) William H. Crouse and Donald L. Anglin, “Automotive Mechanics”, Tata McGraw Hill, 2004, Tenth Edition.
2) Gupta, R.B., Automobile Engineering, Sathya Prakasam New Market, New Rohta road, New Delhi.

REFERENCES

1) Mangal, M.K., Diesel Mechanics, Tata McGraw Hill.
2) Crouse William, Automotive Emission Control, Gregg Division McGraw Hill.
3) Bosch, “Automotive Hand Book”, Robert Bosch GmbH, Germany, 2004, Sixth Edition.
4) John B. Heywood, Internal Combustion Engines, McGraw Hill.
5) Newton & Steeds, Motor Vehicles.

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1) Identify the different systems in an automobile
2) Understand different auxiliary, sensors, fuel injection and transmission systems in automobiles.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1		✓	✓						✓
CO2	✓	✓			✓				✓

03PEXXX	**APPLIED MECHANICS OF MACHINES**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

- To determine the dynamic forces associated with rotating, reciprocating and accelerating masses at high speeds.
- To carryout dynamic analysis of mechanism to reduce vibration, wear, noise and / or even failure of the mechanism.
- To study and understand the working principle of various mechanisms for control like governor, gyroscopes and flywheel.
- To inculcate in the student the ability to analyse any problem in a simple and logical manner.

Unit–I : Turning Moment Diagram And Flywheel

Turning moment and flywheel – Inertia force and inertia torque calculations – Turning moment in reciprocating engine – coefficient of fluctuation of energy – fluctuation of speed – Flywheels for machines like punch press and I.C. Engines.

Unit–II : Mechanisms For Control

Governors – Types – Centrifugal governors – Gravity controlled and spring controlled centrifugal governors – Characteristics – Effect of friction – Controlling force.

Gyroscopes – Gyroscopic forces – torques – stabilization – Gyroscopic applications in ship, motor cycle, aircrafts and automobiles.

Unit–III : Balancing

Static and dynamic balancing – Balancing of rotating masses – Single rotating mass by single mass in the same plane – Single rotating mass by two masses in different plane – different masses rotating in the same plane and in different planes.

Balancing of reciprocating masses – multi-cylinder in-line, V- type, radial and locomotive engines – Primary and Secondary forces – Partial balancing – Tractive efforts, swaying couple and hammer blow in locomotives – Direct and reverse crank method. Balancing of linkages – Balancing machines – Balancing standards – Field balancing of single disc.

Unit–IV : Vibration – Longitudinal

Vibration of single degree freedom systems – free, forced and damped oscillation – Damping factor – Logarithmic decrement Forced vibration – Magnification factor – Vibrating isolation and Transmissibility – Vibration measuring instruments.

Unit–V : Vibration – Transverse and Torsional

Transverse vibration-natural frequency by energy method – Dunkerly method-Whirling of shaft – critical speed with single and two rotors.

Torsional oscillation of single, two and three rotor systems – equivalent shaft-Geared systems

TEXT BOOKS

1) Rattan, S.S., "Theory of Machines", 3rd Edition, Tata McGraw Hill, 2009.
2) Thomas Bevan, "Theory of Machines", 3rd Edition, CBS Publishers and Distributors, 2005.

REFERENCES

1) Dr. R.K. Bansal and Dr. J.S. Brar, "A Text book of Theory of Machines (In S.I. Units)", 5 th Edition(Revised), Laxmi Publications (P) Ltd., 2016.
2) Khurmi, R.S., Theory of Machines", 14th Edition, S. Chand Publications ,2015.
3) Sadhu Singh, Theory of Machines, Pearson, 2013.
4) Rao, J.S. and Dukkipati, R.V., "Mechanisms and Machine Theory", Wiley-Eastern Ltd., New Delhi, 1992.
5) Ghosh, A. and Mallick, A.K., "Theory of Mechanisms and Machines", Affiliated East-West Pvt. Ltd., New Delhi, 1988.

COURSE OUTCOMES

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

1) Provide a clear and through presentation of the theory and application of mechanics of machines.
2) Apply the concept of balancing to reduce the ill effects of unbalanced forces in rotating and reciprocating machines.
3) Apply the concept of mechanical vibrations to one degree of freedom systems with different system components.
4) Develop the ability to use mathematics as a tool whereby the solution to a problem may be carried out in the most direct and effective manner.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2		✓	✓						
CO3					✓				✓
CO4	✓								✓

03PEXXX	INDUSTRIAL RELATIONS & ORGANIZATIONAL DEVELOPMENT	L	T	P
		4	0	0

COURSE OBJECTIVES

- To inculcate the changes in the Industrial relation policies and economic policies.
- To acquaint the student with the determinants of intra -individual, inter-personnel and inter-group behaviour in organisational setting and to equip them with behavioural skills in managing people at work.
- To provide an overview of theories and practices in organizational behaviour in individual, group and organizational level.

Unit–I

Impact of Industrial Revolution – Industrial Relations: Concept – Importance of Industrial Relations – Scope and Aspects of Industrial Relations –Factors Affecting Industrial Relations – Perspectives/Approaches to Industrial Relations – Organisation of Industrial Relations – Dimensions of Industrial Relations Work – Prerequisite Successful Industrial Relations Programme.

Unit–II

Evolution of Industrial System – Anatomy of industrial conflicts - Genesis of Industrial Conflicts – Industrial Conflicts/Disputes – Concept and Essential of a Dispute – Classification of Industrial Disputes – Impact of Industrial Disputes – Cause of Industrial Conflicts –Strikes – Typology of Strikes — Lockouts.

The state and industrial relations policy - Evolution of Industrial relations policies – Industrial Relations Policy During the plan Period – The Plan Period – Recognition of Unions Machinery for solving the Dispute - Standing Orders – Grievances – Procedure for Settlement –Essence of Model Grievance Procedure.

Unit–III

The Industrial Disputes Act, 1947 - Wage Legislations - The Payment of Bonus Act, 1965 - The Factories Act, 1948.

Unit–IV

Group Behaviour: Group Dynamics, Cohesiveness and Productivity; Management of Dysfunctional groups; Group Decision Making; Organisational Politics. Leadership- Concept and Styles; Fielder's Contingency Model; House's Path -Goal Theory; Leadership Effectiveness; Sources, patterns, levels, and types of conflict; Traditional and modern approaches to conflict; Functional and dysfunctional conflicts; Resolution of conflict.

Unit–V

Organization structure – Formation – Groups in organizations – Influence – Group dynamics – Emergence of informal leaders and working norms – Group

decision making techniques – Team building - Interpersonal relations – Communication – Control.

Meaning – Importance – Leadership styles – Theories – Leaders Vs Managers – Sources of power – Power centers – Power and Politics.

Organizational culture and climate – Factors affecting organizational climate – Importance. Job satisfaction – Determinants – Measurements – Influence on behavior. Organizational change – Importance – Stability Vs Change – Proactive Vs Reaction change – the change process – Resistance to change – Managing change. Stress – Work Stressors – Prevention and Management of stress – Balancing work and Life. Organizational development – Characteristics – Objectivess –. Organizational effectiveness Developing Gender sensitive workplace .

TEXT BOOKS

1) Mamoria, Mamoria and Gankar, "Dynamics of Industrial Relations", Himalaya Publishing House, Sixteenth Edition, 2008.
2) Stephen P. Robins, Organisational Behavior, PHI Learning / Pearson Education, 11th edition, 2008. 11 2. Fred Luthans, Organisational Behavior, McGraw Hill, 11th Edition, 2001.

REFERENCES:

1) Mc Shane & Von Glinov, Organisational Behaviour, 4th Edition, Tata McGraw Hill, 2007.
2) Nelson, Quick, Khandelwal. ORGB – An innovative approach to learning and teaching. Cengage learning. 2nd edition. 2012.
3) Ivancevich, Konopaske & Maheson, Oranisational Behaviour & Management, 7th edition, Tata McGraw Hill, 2008.
4) Udai Pareek, Understanding Organisational Behaviour, 3rd Edition, Oxford Higher Education, 2011.
5) Jerald Greenberg, Behaviour in Organization, PHI Learning. 10th edition. 2011

COURSE OUTCOMES

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

1) Understand the industrial disputes, conflicts, typology of strikes and lockouts.
2) Gain skills in managing grievances in the industry to handle the industrial policy during the plan period.
3) Obtain the better knowledge about group dynamics and group behaviour.
4) Understand the importance of prevention and managing of stress for the workers, and make them capable in increasing the job satisfaction in the industry.
5) Acquire leadership skills.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1			✓			✓			✓
CO2			✓			✓			
CO3			✓			✓	✓		
CO4			✓			✓			
CO5	✓								✓

03PEXXX	INDUSTRIAL ENGINEERING AND MANAGEMENT	L	T	P
		4	0	0

COURSE OBJECTIVES

- To introduce students various Industrial Engineering and Management concepts.
- To provide an understanding of the systematic approaches of various management functions.
- To enhance the management skills through the application of appropriate techniques.

Unit–I : Engineering Economics

Engineering Economics - nature and scope of managerial economics - basic economic tools in managerial economics - decision and efficiency analysis. Consumer behaviour - law of demand and supply - elasticity - determinants - uses. Pricing under different market conditions: Monopoly - monopolistic competition - oligopoly, pricing policies - Porter's five forces - model of competition. Financial markets: Primary and secondary markets - money market instruments - capital market instruments. National income - concepts. Trade and development: Free trade versus protection - balance of payments - globalisation - W.T.O.

Unit–II : Organizational Behavior

Organizational Components to be Managed - Individual Behaviour: Governing factors -Determinants of personality . Motivation – Importance – Theories: Maslow's Theory of Need Hierarchy - Theory X and Theory Y - techniques of motivation. Job satisfaction – Governing factors – Effects.Group Dynamics - Development of Inter-personal Relationship.Group Behaviour -Group cohesiveness.Conflict - Functional and Dysfunctional Conflict - Conflict resolution model.Stress – Sources – Management of Stress. Leadership – Types –Theories:Hersey and Blanchard's situational leadership model - Path-Goal theory

Unit–III : Elements of Management

Principles of Management - Functions of management - Scientific management: Contributions of Taylor, Gilberth, Gantt- Forms of business organisation - line, functional, line and staff organisations - Industrial ownership: single, partnership, joint stock company, co- operative organisations, state and central government owned.

Costing

Objectives - Elements of costs - estimation of selling price, Allocation of overheads - Introduction to activity based costing.

Unit–IV

Break-even analysis - concept and applications - Depreciation - straight line and declining balance method.

Plant Location: Influencing factors. Location models – Breakeven analysis – Qualitative factor rating Method.

Plan Layout: Layout Objectivess – Types of Layout – Load distance analysis – Muthur grid technique. Concept of Line balance – Largest candidate rule.

Unit–V

Method Study: Objectivess and procedure for methods analysis, Recording techniques,

Operations Process Chart, Flow Process Chart, Man-Machine chart , Multiple Activity Chart, and Two Handed process chart, String Diagram, Therbligs, Micro motion and macro-motion study: Principles of motion economy.

Work Measurement: Objectives, Work measurement techniques – time study, work sampling -Determination of time standards- Observed time, basic time, normal time, rating factors, allowances, and standard time.

TEXT BOOKS

1) Industrial Engineering, Kumar, B., Khanna Publications, 1995.
2) M. Govindarajan and S.Natarajan, Principles of Management, Prentice Hall of India Pvt. Ltd. New Delhi, 2007.

REFERENCES

1) Jain. S.K., Applied Economics for Managers and Engineers, Vikas Publishers, 1997.
2) Chandran, S., Organizational Behaviors, Vikas Publishing House Pvt. Ltd., 1994.
3) Herald Koontz and Heinz Weihrich, 'Essentials of Management', McGraw Hill Publishing Company, Singapore International Edition, 1980.
4) Mechanical Estimating and Costing, TTTI Madras, Tata McGraw Hill.
5) Sharma, S.C., Banga, T.R. and Agarwal, N.K., Industrial Engineering and Management Science, Khanna Pub., New Delhi, 1998.

COURSE OUTCOMES

Upon completing this course, students are able to:

1) Recognize the factors such as demand and production for pricing criteria
2) Determine the cost and profit conditions to cover up for the benefits of markets
3) Understand and learn the effective interpersonal, team building and leadership skills
4) Improve the organizational performance through the effective management of human resources
5) Practice the process of management's four functions: planning, organizing, leading, and controlling

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓		✓		✓	✓			
CO2		✓				✓		✓	✓
CO3		✓	✓			✓			
CO4			✓		✓	✓			
CO5			✓				✓	✓	✓

03PEXXX	PLANT LAYOUT AND MATERIALS HANDLING	L	T	P
		4	0	0

COURSE OBJECTIVES

- To impart knowledge to students in the factors to be considered for a plant location, different types of plant layouts and their importance, importance and scope of material handling.

Unit–I

Plant Location: Factors to be considered - influence of location in Plant layout - Selection of plant site. Consideration in facilities planning and layout. Physical facilities: Equipments required for plant operation. Capacity serviceability and flexibility and analysis in selection of equipments, space requirements, man power requirements.

Unit–II

Plant layout: Need for layout, types of layout, factors influencing product, process, fixed and combination layout; tools and techniques for developing layout, process chart, flow diagram, string diagram, template and scale models- machine date. Layout planning procedure, visualization of layout, balancing of fabrication and assembly lines.

Unit–III

Material handling: Importants and scope, principles of material handling. Planning, Operating and costing principles - types of materials handling systems, factors influencing their choice.

Unit–IV

Industrial building and utilities: Centralised electrical, pneumatic water line systems. Types of buildings, lighting, heating, air-condition and ventilation utilities planning and maintenance, waste handling, statutory requirements, packing and storage of materials, importance of packaging, layout for packaging - Packaging machinery - wrapping and packing of materials, cushion materials.

Unit–V

Analysis of material handling: Factors involved, motor analysis, flow analysis, graphic analysis, safety analysis, equipment cost analysis, pelletization analysis for operation, material handling surveys.

TEXT BOOKS

1) James M. Apple, Principles of Layout and Material Handling, Ronald Press 1977.
2) M. Moore James, Plant Layout and Design, Macmillan Co., New York, 1963.

REFERENCES

1) R. Muther, Practical Plant Layout, McGraw Hill, 1955
2) Facility Layout & Location an Analytical Approach/ RL Francis/Leon F. McGinnis, Jr /John A. White /PHI.
3) Production and Operations Management/ R. Panneerselvam/Age.
4) Introduction to Material Handling/ Ray, Siddhartha/ New Age.
5) Facilities Planning/ James A. Tompkins/ John A White/ Wiley India Edition.

COURSE OUTCOMES

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

1) Impart the knowledge on identify plant locations, different types of plant layout and their importance
2) Design / development of problem analysis on material handling
3) Understand the modern tool usage of plant layout & material handling.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓		✓			✓			
CO2		✓	✓				✓		
CO3					✓		✓		✓

03PEXXX	**RENEWABLE ENERGY SOURCES**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

This course will enable the student,

- To gain knowledge on the various renewable energy sources like solar, wind, geothermal, biogas, biomass, OTEC and tidal.
- To understand the construction and working of various solar energy gadgets.

Unit–I

Alternative energy sources, Global and Indian energy scenario. Solar Energy: Introduction – Solar Radiation Measurement and Instruments – Data and estimation.

Unit–II

Flat plate collectors – General description, characteristics of flat plate collector – overall heat transfer coefficient – collector heat transfer coefficient – collector heat removal factor and flow factor performance – Solar selective surface.

Unit–III

Focusing solar collectors. Type – General characteristics – material and construction – Performance – Solar furnace.

Unit–IV

Solar air heater: Different types – performance and application – simple problems.

Solar water heater: types, characteristics and performance - simple problems.

Solar Cookers – Fundamentals of solar stills – Solar ponds and solar pumps – solar cabinet dryers – Forced convection solar dryers – Principles of solar cells.

Solar space heating and cooling system – Elementary design methods. Storage of solar energy.

Unit–V

Wind energy utilization: Introduction – Types of wind mills – elementary design. Elementary ideas of tidal and ocean thermal energy and geo thermal energy : Biomass as a source of energy – Production of fuel from agricultural waste – Biogas – Generation and utilization.

TEXT BOOKS

1) G.D. Rai, "Non Conventional Energy Sources", Khanna Publishers, New Delhi, 2014.
2) Twidell, J.W. & Weir, A., "Renewable Energy Resources", EFN Spon Ltd., UK, 2005.

REFERENCES

1) Garg, H.P., Solar Energy Fundamentals and Applications, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2008.
2) Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 2012.
3) Sukhatme, S.P., "Solar Energy: Principles of Thermal Collection and Storage", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009.
4) Tiwari, G.N., "Solar Energy - Fundamentals Design, Modelling and applications", Alpha Science Intl Ltd, 2015.
5) Khan, B.H., "Non-Conventional Energy Resources", The McGraw Hill Companies, 2009.

COURSE OUTCOMES

Upon completion of this course students will be able to

1) Understand and learn the importance of renewable energy.
2) Design various renewable energy gadgets
3) Understand the thermal storage of energy.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1			✓			✓			✓
CO2	✓	✓	✓			✓			
CO3	✓	✓					✓		✓

03PEXXX	**FUELS AND COMBUSTION**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

- To impart the knowledge about the different types of fuels.
- To study the principles of combustion, flame properties and fuel handling devices.
- To study the petroleum refining process and combustion systems.

Unit–I

Fuels-solid, liquid and gaseous fuels-characteristics. Coal- coking and caking coals- Composition and characteristics- Estimation of calorific value-Proximate analysis, Ultimate analysis. Flue gas analyser- Orsat apparatus, Carburisation, gasification and liquefaction of coal. Hydrogenation of coal, Handling and storage.

Unit–II

Petroleum – origin of petroleum-classification, composition and properties – specific gravity – viscosity – flash point – fire point – cloud point –pour point, freezing point, smoke point, carbon residue, diesel index, sulphur content, moisture content, octane and cetane number. Petroleum refining and other

conversion processes. Liquefaction of solid fuels. Storage and handling of liquid fuels.

Unit–III

Gaseous fuels- composition and properties-Gas calorimeter-fuel types-methane-wood gas- water gas- LPG-LNG-CNG -blast furnace gas-Gobar gas-Syn gas-producer gas- Gasifiers-Biogas-digesters –reactions. Comparative study of solid, liquid and gaseous fuels.

Unit–IV

Principle of combustion - stoichiometry, heat of reaction and formation. Combustion process- submerged combustion, slow combustion, pulsating and explosive combustion. Chemical kinetics-NOx and soot kinetics. Fuel and flue gas composition, Excess air calculation.

Unit–V

Flames-flame propagation-flame temperature-theoretical, adiabatic temperature -ignition limits- limits of in flammability. Types of burners-oil burners-types-gas burners- atmospheric and air aspiration burners-Coal burning equipments – pulverized, fluidized bed and cyclone firing.

TEXT BOOKS

1) Om Prakash Gupta, Elements of Fuels, Furnaces and Refractories, Khanna publishers, 1999.
2) Sharma S.P. and Chander, Fuels and Combustion, Tata McGraw Hill Publishing Company, 1987.

REFERENCES

1) Samir Sarkar, Fuels and Combustion, 2nd edition, Orient Longman, 1990.
2) Roger A. Strehlow, Combustion Fundamentals, McGraw Hill Publishing Company.
3) Kenneth K. Kuo, Principles of Combustion, Wiley sons.
4) Borman Gary, L. and Kenneth W. Ragland, Combustion Engineering, McGraw Hill Publishing Company, 1998.
5) Smith, M.L. and Shinson, K.W., Fuels and Combustion, McGraw Hill Publishing Company.

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1) Understand the various kinds of fuels and their characteristics.
2) Understand the thermodynamics behind combustion, flame propagation and choice of combustion systems.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓		✓			✓			
CO2	✓	✓	✓	✓					

03PEXXX	ENGINE POLLUTION AND CONTROL	L	T	P
		4	0	0

COURSE OBJECTIVES

- To create awareness on air pollution due to I.C. engines and its effects on human health.
- To study the different emission formation mechanism of engines.
- To study the methods of reducing or eliminating the harmful gases from engine.
- To study the different norms and legislations to put a check over the air pollution.
- To know about the fuel modification in I.C. engines

Unit–I

Atmospheric pollution from internal combustion engines– Global warming – Green house effect- Sources of automotive pollution – effects of pollutions on health and environment – fuels – types of hydrocarbons-properties of fuels and testing, fuel additives.

Unit–II

Pollution formation mechanism- SI and CI engine– oxides of nitrogen, Zeldovich mechanism, carbon monoxide, hydrocarbon formation and different types of smoke, smog, particulate emission, soot formation.

Unit–III

Evaporative emission control – PCV – crank case emission – Air fuel mixture – hot, cold and internal EGR - air injection – thermal reactor –water injection- in cylinder control of pollution – catalytic converters – selective catalyst reduction(SCR) – DeNOx catalyst- application of micro processor in emission control.

Unit–IV

Emission measurements-Non dispersive infrared gas analyser, gas chromatography, Chemiluminescent analyser and flame ionisation detector – smoke measurement – Particulate measurement – high volume sampler – micro dilution tunnel –noise measurement and control.

Unit–V

Fuel modification-GDI, HCCI and CRDI-driving cycles for emission measurement – chassis dynamometer – constant volume sampling (CVS) system – National and international emission norms, driving cycles.

TEXT BOOKS

1) John B. Heywood, Internal combustion engines, McGraw Hill.
2) Crouse William, Automotive emission control, Gregg Division, McGraw Hill, 1971.

REFERENCES

1) George, Springer and Donald J. Patterson, Engine emissions, pollutant formation and Measurement, Plenum press, 1973.
2) Obert, E.F., Internal Combustion engines and air pollution, Intext Educational Publishers, 1980.
3) Pundir, B.P., Engine Emissions, Narosa Publishing House, 2007.

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1) Understand the various types of engine pollution, mechanism, controlling methods and emission measuring equipments.
2) Acquire the knowledge of emission standards and fuel modification in engines.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓	✓		✓				✓
CO2	✓	✓				✓		✓	✓

03PEXXX	**OPERATIONS RESEARCH**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

- To introduce students how to use quantitative methods and techniques for effective decisions–making.
- To provide an understanding of the systematic approach to solve decision making problems.
- To enhance the decision-making skills through the application of appropriate models.

Unit–I

Linear programming - graphical method - Simplex method - Big M method- Applications – Problems.

Unit–II

Transportation problems - optimal solutions. Assignment problems - Hungarian algorithm - Travelling salesman problem – applications – Problems.

Unit–III

Waiting line Problems - cost of waiting and cost of providing service - single channel - single stage type of problems - Monte Carlo simulation for queue problems.

Network models - Minimal spanning tree problem, shortest route problem and Maximum flow problem.

Unit–IV

PERT and CPM - basic steps - rules for constructing the network - Fulkerson's rule - time estimates - PERT calculations - probability of meeting the time schedule - time - cost trade off (crashing) - difference between PERT and CPM – applications.

Unit–V

Decision Theory - Decision making under risk condition - expected value criteria - Decision trees - Decision making under uncertain conditions - Minimax, maximin, maximax, Hurwitz regret criteria.

TEXT BOOKS

1) Gupta & Hira, Operations Research, S.Chand & Co., 1998.
2) Vohra, N.D., Quantitative Techniques in Management, TMH, 1990.

REFERENCES

1) Sharma S.D., Operations Research, Kedarnath Ramnath and Co., Meerut, 1998.
2) Barry Render, Ralph M. Stair Jr., Quantitative Analysis for Management Pearson New Delhi 2010.
3) Ravindran, A., Phillips, D.T. and Solberg, J.J., Operations Research, Principles and Practice, John Wiley and Sons, Singapore, 1987.
4) Taha, Operations Research, Tata McGraw Hill, 1998.
5) Bronson, R., Theory and Problems of Operations Research, Schaum's outline series, 1997.

COURSE OUTCOMES

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

1) Impart the basic characteristics of different types of decision-making environments.
2) Enhance their ability to build and solve various operations research models.
3) Expertise to select appropriate decision making models for the real life problems.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1			✓			✓			✓
CO2	✓				✓	✓			
CO3		✓							✓

03PEXXX	**COMPUTER ORIENTED NUMERICAL ANALYSIS**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

- To learn the basics of numerical methods
- To learn the solutions of linear algebraic equations
- To learn the solutions of differential and integral equations

Unit–I

Finite difference solution of one dimensional heat equation by explicit and implicit methods – one dimensional wave equation and two dimensional Laplace and Poisson equations.

Unit–II

Interpolation – Newton – Hregory forward and backward, interpolation – Newtons divided difference formula – Lagrange's interpolation formula for unequal intervals – Guass interpolation formula – Stirling interpolation formula – Numerical differentiation – Numerical integration – Trapezoidal rule – Simpsons 1/3 and 3/8 rules.

Unit–III

Numerical solution of algebraic and transcendental equations - Bolzono's bisection method - successive approximation method - Regula-Falsi method - Newton-Raphson method, Graffe's Root Squaring method. Numerical Solution of

simultaneous linear algebraic equations - Gauss elimination method - Gauss Jordan elimination method - Gauss-Seidel iteration method - Crout's method.

Unit–IV

Numerical Solutions of ordinary differential equations of first and second order simultaneous equations - Taylor series method - Euler's method - improved Euler's method - modified Euler's method - Runge-Kutta method of second and fourth order Milne's – Predictor corrector method - Picards method.

Unit–V

Numerical Solution of partial differential equation - Elliptic equation - Poisson's equation - Laplace equation - Lieberman's iterative method - Relaxation method – Hyperbolic equations - One dimensional heat equation - Bender-Schmidt recurrence - relation - Crank - Nicholson's implicit method.

TEXT BOOKS

1) Venkatraman, M.K., Numerical Methods in Science and Engineering, National Publishing Co., Chennai, 1995.
2) Kandasamy, P., Thilagavathy K and Gunavathy K., Numerical Methods, S.Chand & Co., 2nd ed., 2005.

REFERENCES

1) Gereald, C.F. and Wheatley, P.O., Applied Numerical Analysis, Addison Wesley Pub. Co., 1994.
2) Rajaraman, V., Computer Oriented Numerical Methods, Prentice Hall of India, Delhi.
3) Sastry, S.S., Introduction to Numerical Analysis, PHI, Delhi.
4) Jain, M.K., S.R.K.Lyenger, R.K.Jain., Numerical Methods for Scientific & Engineering Computation, Wiley Eastern Ltd.
5) Br. G.T. Kochav., A Text Book on Computational Methods, Nirali Prakashan, Pune.

COURSE OUTCOMES

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

1) Learn the basics of numerical methods.
2) Solve linear algebraic, differential and integral equations.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓	✓						
CO2		✓	✓						

03PEXXX	FINITE ELEMENT METHODS	L	T	P
		4	0	0

COURSE OBJECTIVES

- To learn the basics of solid mechanics and numerical solutions
- To learn the discretization of differential equations by finite element method and solve field problems

Unit–I

Fundamentals of stress-strain relationships, Strain-displacement relationships, Initial strain due to temperature effects, Saint Venant's principle, Properties of matrices and determinants, Solution of linear algebraic systems by Gauss elimination, Cholesky factorization and conjugate gradient methods.

Unit–II

Basic concepts of FEM, Historical background of FEM, FEM in engineering applications, Boundary conditions, Need for weighted integral forms, Weighted residual approach, weak formulation of boundary value problem, variational methods - Rayleigh-Ritz method.

Unit–III

One dimensional solid and structural mechanics problems - Finite element modeling, Coordinates and shape functions, the potential energy approach, Assembly of global stiffness matrix and load vector, Treatment of boundary conditions and Quadratic shape functions.

Unit–IV

Two dimensional solid and structural mechanics simple problems – Constant strain triangle element, Axisymmetric solids subjected to axisymmetric loads, isoparametric elements and numerical integration.

Unit–V

One dimensional steady state heat transfer problems for conduction and convection – Derivation of elemental equation, One dimensional steady state fluid flow problems.

TEXT BOOKS

1) Tirupathi R. Chandrupatla & Ashok D. Belegundu, Introduction to Finite Element in Engineering, 3rd ed.2004, Prentice Hall of India, New Delhi.
2) Reddy, J.N., "An Introduction to the Finite Element Method", 3rd Edition, Tata McGraw-Hill, 2005.

REFERENCES

1) Seshu, P., "Text Book of Finite Element Analysis", Prentice Hall of India Pvt. Ltd., New Delhi, 2007.
2) Bhatti Asghar, M., "Fundamental Finite Element Analysis and Applications", John Wiley & Sons, 2005 (Indian Reprint 2013).
3) Zienkiewicz, O.C., The Finite Element Method, Third Edition, 1997, McGraw Hill, New York.
4) Krishnamoorthy, C.S., Finite Element Analysis: Theory and Programming, 1987, Tata McGraw Hill, New Delhi.

5) Timoshenko, S.P. and Goodier, J.N., Theory of Elasticity, Third Edition, 1970, McGraw Hill.

COURSE OUTCOMES

Upon completing this course, students should be able to:

1) Understand the basics of solid, structural mechanics, heat transfer and fluid flow problems.
2) Understand the physical boundary condition and formulation of global elemental equations.
3) Solve simple one and two dimensional problems.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2	✓	✓		✓					
CO3			✓	✓					✓

03PEXXX	**APPLIED MANUFACTURING TECHNOLOGIES**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

To understand the theory of metal cutting, cutting tools and materials involved in the cutting operations.

- To explore the special purpose machines and understand their working operation
- To understand the abrasive processes and their grinding metrology
- To understand the basic concepts of jigs and fixtures and their design and manufacturing
- To introduce and understand the mechanisms of unconventional machining processes and their applications

Unit–I : Theory of Metal Cutting

Material removal processes: Cutting tool geometry, Tool signature, Theory of metal cutting: orthogonal and oblique cutting, chip formation, Power requirements for turning, Cutting tool materials, Tool wear, Tool life, Tool life equation, Cutting fluids.

Unit–II : Special Purpose Machines

Capstan and turret lathes –Comparison - Turret Indexing mechanism, Bar feed mechanism.

Automats and transfer machines: Single spindle and multiple spindle automatic lathes, transfer machines - Rotary indexing lathe and drum type transfer machines.

Gear cutting – forming and generation principle, gear hobbing and gear shaping processes –finishing of gears.

Unit–III : Abrasive Machining Processes

Types of grinding process: Cylindrical grinding, surface grinding, center less grinding and internal grinding- Typical applications.

Grinding wheel: specifications and selection, Wheel truing and dressing.

Micro finishing: Honing, Lapping, Super finishing: Buffing and Polishing.

Unit–IV : Jigs and Fixtures

Elements of jigs and fixtures - 3-2-1 principle - Locating devices and types - clamping devices and types - types of jigs: drill jigs - template jigs.

Elements of fixtures: Types of fixtures - milling fixtures - turning fixtures – Modular fixtures.

Unit–V : Unconventional Machining Processes

Basic principle and metal removal mechanism of Abrasive Jet Machining (AJM), Ultrasonic Machining (USM), ElectricDischarge Machining (EDM), Electro Chemical Machining (ECM), Laser Beam Machining (LBM) and Electron Beam Machining (EBM).

Basics of Rapid prototyping.

TEXT BOOKS

1) Hajara Chowdry, et al.: Elements of Workshop Technology Vol.I & Vol.II, Media Promoters & Pub., 1997.
2) Khanna, O.P. & Lal M., Production Technology, Vol.I & Vol.II, DhanpatRai & Sons, 2000.

REFERENCES

1) Chapman, W.AJ., Workshop Technology, Vol, II & III, CBS Pub., 2001.
2) Begeman, Manufacturing Processes.

COURSE OUTCOMES

Upon completion of the course students will be able to

1) Identify, formulate and solve technical problems
2) Work effectively on teams and within a diverse environment
3) Recognize the need for self-improvement through continuing education and the ability to engage in lifelong learning.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2					✓	✓			
CO3									✓

03PEXXX	**COMPUTATIONAL FLUID DYNAMICS**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

- To gain the basic knowledge of Computational Fluid Dynamics, the various forms of the governing equations of fluid flow.
- To understand the formulation of Finite Difference & Methods and Numerical solution strategies.
- To understand the grid formation and significance of grid transformations
- To understand the finite volume method of numerical modeling and its role in the field of heat transfer and fluid flow.

Unit–I

Basic concepts of fluid flow – derivation of the governing equations, conservation of mass, momentum and energy. Mathematical classification of flow – hyperbolic, parabolic, elliptic and mixed flow types.

Unit–II

Finite difference method – forward, backward and central difference schemes, explicit and implicit methods. Properties of numerical solution methods – stability analysis, error estimating.

Unit–III

Choice of grid, grid oriented velocity components, Cartesian velocity components, staggered and collocated arrangements, adaptive grids.

Unit–IV

Lax – Wendroff technique – MacCormack's technique, relaxation technique. Artificial viscosity, ADI technique, Pressure correction technique.

Unit–V

Introduction to Finite Volume Method, difference between Finite Difference Method and Finite Volume Method. FVM formulate SIMPLE algorithm. Upwind schemes – flux vector splitting. Introduction to Turbulence Modeling , turbulence energy equations.

TEXT BOOKS

1) John D. Anderson, "Computational Fluid Dynamics – The Basics with Applications", McGraw Hill, New York, 1995.
2) Versteeg, H.K. and Malalasekara, W., "An Introduction to Computational Fluid Dynamics – The Finite Volume Method Longman, 1995.

REFERENCES

1) Muralidhar, K. and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publications, New Delhi, 2003.
2) Chung, T.J., "Computational Fluid Dynamics", Cambridge University Press, London, 2002.
3) David C. Wicox, "Turbulence Modeling for CFD", DCW industries.

COURSE OUTCOMES

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

1) Formulate basic fluid dynamics problems
2) Set up numerical experiments

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓			✓				
CO2	✓		✓		✓		✓		

OPEN ELECTIVES

07OEXXX	BIOLOGY FOR ENGINEERS	L	T	P
		4	0	0

COURSE OBJECTIVES

- The course acts as a bridge between engineering and biology to provide basic understanding of biological mechanisms of living systems from engineering perspective.
- It will illustrate the many possible means to utilize living things' relevance to engineering principles.
- With substantial knowledge and continuing interest will make a student into a specialist in the technical diversity.

Unit–I : Requirements of biological systems

Biological Units Need Water; Biological Units Need the Right Amount of Oxygen; Biological Units Need Food and Nutrients; Biological Units Become Ill in the Presence of Wastes; Biological Units Need Heat Sources and Sinks.

Unit–II : Behavior of biological systems

Biological Units Adapt to Their Environments; Biological Units Modify Their Environments; Adaptations Require Extra Energy and Resources; Biological Units, If Possible, Move to Friendlier Environments; Biological Units Evolve under Environmental Pressures.

Unit–III : Response to stress by biological systems

Crowding of Biological Units Produces Stress; Biological Units Are Affected by Chemical Stresses; Biological Units Respond to Mechanical Stresses; Optimization Is Used to Save Energy and Nutrient Resources; Biological Units Alter Themselves to Protect against Harsh Environments.

Unit–IV : Existence of biological systems

Biological Units Cooperate with Other Biological Units; Biological Units Compete with Other Biological Units; Biological Units Reproduce; Biological Units Coordinate Activities through Communication; Biological Units Maintain Stability with Exquisite Control; Biological Units go through Natural Cycles; Biological Units Need Emotional Satisfaction and Intellectual Stimulation; Biological Units Die.

Unit–V : Scaling factors and biological engineering solutions

Allometric Relationships from Evolutionary Pressure; Dimensional Analysis; Golden Ratio; Fractal Scaling within an Organism; Self-Similarity for Tissues and Organs; Self-Similarity in Populations; Systems Approach; Relationships between Engineering and Biology; The Completed Design.

TEXT BOOKS

1) Arthur T. Johnson, "Biology for Engineers", CRC Press, 2010.

REFERENCES

2) Aydin Tözeren, Stephen W. Byers, New Biology for Engineers and Computer Scientists, Pearson/Prentice Hall, 2004.

3) S. Thyaga Rajan, N. Selvamurugan, M. P. Rajesh, R. A. Nazeer, Richard W. Thilagaraj, S. Barathi, and M. K. Jaganathan, “Biology for Engineers,” Tata McGraw Hill, New Delhi, 2012.

COURSE OUTCOMES

1) The ability to understand the information known about familiar living systems.
2) The ability to anticipate the properties of an unfamiliar group of living things from knowledge about a familiar group.
3) The ability to demonstrate the relevance of engineering to biological systems.
4) The knowledge about the biological responses and it is scaling with respect to scientific principles that cannot be related back.
5) The knowledge of biological principles and generalizations that can lead to useful products and processes.
6) The ability to avoid or mitigate unintended consequences of dealing with any and all living system.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓								
CO2			✓						
CO3						✓			
CO4	✓								
CO5	✓								
CO6	✓								

00OEXXX	**HUMAN RIGHTS**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

- At the end of this course the student is expected to understand what is human rights, how to obey the rights, what is the role of a human being in making a good society for the future generations.

Unit–I

Definition of Human Rights - Nature, Content, Legitimacy and Priority - Theories on Human Rights - Historical Development of Human Rights.

Unit–II

International Human Rights - Prescription and Enforcement upto World War II - Human Rights and the U .N .O. - Universal Declaration of Human Rights - International Covenant on Civil and Political Rights - International Convenant on Economic, Social and Cultural Rights and Optional Protocol.

Unit–III

Human Rights Declarations - U.N. Human Rights Declarations - U.N. Human Commissioner.

Unit–IV

Amnesty International - Human Rights and Helsinki Process - Regional Developments -European Human Rights System - African Human Rights System - International Human Rights in Domestic courts.

Unit–V

Contemporary Issues on Human Rights: Children's Rights - Women's Rights - Dalit's Rights - Bonded Labour and Wages - Refugees - Capital Punishment. Fundamental Rights in the Indian Constitution - Directive Principles of State Policy - Fundamental Duties - National Human Rights Commission.

TEXT BOOKS

1) Desai, A.R. Violation of Democratic Rights in India, Sage Publishers, 1986.
2) S. Hick, E. Halpin and E. Hoskins, Human Rights and the Internet, Springer Publishers, 2000.

REFERENCES

1) International Bill of Human Rights, Amnesty International Publication, London, 1988.
2) Human Rights, Questions and Answers, UNESCO, 1982.
3) Mausice Cranston- What is Human Rights.
4) Timm. R.W. - Working for Justice and Human Rights.
5) Human Rights, A Selected Bibliography, USIS.

COURSE OUTCOMES

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

1) Understand the principles of human rights
2) Understand the role of human being in making a good society for the future generation.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1			✓			✓			
CO2			✓			✓			✓

00OEXXX	**ENTREPRENEURSHIP**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

- Develop an entrepreneurship sprit
- Help to identify business opportunities within an organization or independently
- Initiate action on the business plan from the prospective business through EDC

Unit–I

Meaning – Characteristics of management – Nature of management – Process of management – Functional areas of management – Management and administration – Role of management – Level of management – Evolution of management.

Unit–II

Meaning - Nature of planning – Importance of planning – Types of planning – Steps in planning – Decision making – Meaning and definition of organizing – Steps in organizing – Nature of organization – Organization structure – Purpose of organization – Principles of organization – Delegation of authority – Nature and importance of staffing.

Unit–III

Meaning and nature of direction – Principles of directing – Leadership and leadership style – Motivation – Communication – Need and feedback in communication – Importance of communication – Channels of communication – Types of communication – Forms of communication.

Unit–IV

Evolution of concept of entrepreneur – Concept of entrepreneur – Characteristics of entrepreneur – Distinction between entrepreneur and manager – Technical entrepreneur – Charms of being an entrepreneur – Types of entrepreneur – Role of entrepreneurship in economic development – Barriers in entrepreneurship.

Unit–V

Meaning of project – Project classification – Project identification – Meaning and significance of project report – Contents of a project report – Formulation of project report – Planning commission guidelines – Identification of opportunity – Project feasibility study.

TEXT BOOKS

1) Veerabhadrappahavinal, Management and entrepreneurship, New age International, New Delhi, 2008.
2) Peter f. Drucker; Innovation and entrepreneurship, Butterworth – Heinemann, London, 1985.

REFERENCES

1) **"**Creativity, Innovation, Entrepreneurship and Enterprise in Construction and Development", University of Reading, Alan Barrell – Entrepreneur in Residence Entrepreneur in Residence, University of Xiamen, Xiamen 2012.
2) "Entrepreneurship Studies", National University Commission (Nigerian University System), 2010.

COURSE OUTCOMES

At the end of this course the student should

1) Understand entrepreneurship and gain knowledge about the principles of business Plan.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1								✓	✓

00OEXXX	**NATIONAL SERVICE SCHEME**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

- Understand the community in which they work and their relation
- Identify the needs and problems of the community and involve them in problem-solving
- Develop capacity to meet emergencies and natural disasters
- Practice national integration and social harmony and
- Utilize their knowledge in finding practical solutions to individual and community problems.

Unit–I : National Service Scheme

a. History and its Objectives
b. Organizational structure of N.S.S. at National, State, University and College Levels
c. Advisory committee and their functions with special reference to college principal,
d. Programme officer, N.S.S. group leader and N.S.S. volunteers in the implementation**.**

Unit–II : National Integration

a. Need of National integration
b. Various obstacles in the way of National Integration; such as caste, religion, language and provisional problems etc.

Unit–III : Special Programme

a. Legal awareness
b. Health awareness
c. First-aid
d. Career guidance
e. Leadership training - cum - Cultural Programme
f. Globalization and its Economic Social Political and Cultural impacts.

Unit–IV : Special Camping Programme

a. Nature and its objectives
b. Selection of camp site and physical arrangement
c. Organization of N.S.S. camp through various committees and discipline in the camp.
d. Activities to be undertaken during the N.S.S. camp.
e. Use of the mass media in the N.S.S. activities.

Unit–V : N.S.S. Regular Activities

a. Traffic regulation
b. Working with Police Commissioner's Office
c. Working with Corporation of Chennai
d. Working with Health Department
e. Blind assistance
f. Garments collection
g. Non-formal education
h. 'Environmental Education, Awareness and Training (EEAT)'
i. Blood donation.

REFERENCES

1) National Service Scheme Manual, Government of India, 2006.
2) Training Programme on National Programme scheme, TISS.
3) Orientation Courses for N.S.S. Programme officers, TISS.
4) Case material as Training Aid for field workers, Gurmeet Hans.
5) Social service opportunities in Hospitals, KapilK.Krishan,TISS.

COURSE OUTCOMES

Upon completing this course, students should be able to:

1) Develop social and civic responsibility
2) Acquire competence for group living and sharing responsibilities
3) Acquire leadership qualities and democratic attitude;
4) Develop capacity to meet emergencies and natural disasters; and
5) Practice national integration

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1						✓			
CO2									✓
CO3							✓		
CO4						✓			✓
CO5									✓

02OEXXX	**DISASTER MANAGEMENT**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

- This course helps in providing the basic concepts of disasters and also gives a thorough knowledge and experience to reduce disaster risks.

Unit–I

Introduction – Disaster- Characteristics and types of Disasters- Causes and effects of Disaster -Risk- Vulnerability – Preparedness- Disaster mitigation and disaster management- Classification of mitigation measures-Vulnerability Analysis-Observation and Perception of Vulnerability- Socio-Economic Factors of Vulnerability- Vulnerability in India- Disaster related policy goals of UNDP UNDRO

and Govt. of India- Appraising disaster needs- Needs for technical expertise- Role of various Agencies in Disaster Management and Development -Disaster risk reduction planning- Role of Developmental Planning for disaster Management

Unit–II

Earthquake - Cause of Earthquake- General characteristics- Measuring Earthquakes- Distribution pattern of Earthquakes in India- Earthquake prone areas- case studies of important Indian earthquakes - Forecasting techniques and risk analysis- Possible risk reduction measures- earthquake resistance buildings and re-engineering techniques in India.

Unit–III

Tsunamis- Causes of a Tsunami- General Characteristics- Tsunami warning system-Distribution pattern of Tsunami in India- Possible risk reduction measures- Integrated coastal zone management.

Landslides- Rock falls- Avalanches- Mud flows and glaciers- Landslides and rock falls- landslide hazard zonation- Instrumentation and monitoring- Techniques for reducing landslide hazards.

Unit–IV

Tropical cyclones- Structure of tropical cyclones- Nature of tropical cyclones- Cyclone experience in India and Tamilnadu- Preparedness- Tropical cyclones and their warning systems- Tropical cyclone warning strategy in India special nature of the problem in the region- Classification- Protection of buildings from cyclones of India- Precautions during and before cyclones.

Unit–V

Coastal floods- Intensification of hazards due to human interference- Management-River and coastal floods- Temperature extremes and wild fires- Physiological hazards- Flood forecasting-mitigation- planning- management- flood prone areas the Indian scenario- Flood experience in India and Tamilnadu.

Environmental hazards- Typology- Assessment and response- Strategies -The scale of disaster-Vulnerability- Disaster trends- Paradigms towards a balanced view- Chemical hazards and toxicology-Biological hazards- Risk analysis- Other technological disasters.

TEXT BOOKS

1) David R. Godschalk (Editor), Timothy Beatiey, Philip Berke,.David J. Browt:r, Edward J. Kaiser Charles C. Boh, R. Matthew Goebel, Natural Hazard Mitigation: Recasting Disaster Policy and Planning Island Press; (January 1999), ISBN) 559636025
2) Sinha, P.C. Wind & Water Driven Disasters, 1998, 250pp, Anmol Publications

REFERENCES

1) Davide Wikersheimer Windstorm Mitigation Manual for Light Frame Construction, DIANE Publishing Co: (Paperback-May 1997)
2) Brown D Redevelopment After the Storm: Hazard Mitigation Opportunities in the Post Disater Setting. (Paperback – June 1985) Publisher: John Wiley & Sons ISBN:047191505X

3) Sinha, P.C. Technological Disasters , 1997, 516 pp Anmol Publications Trivedi,

COURSE OUTCOMES

1) Develop an understanding of the key concepts, definitions key perspectives of all Hazards Emergency Management
2) Develop a basic under understanding of Prevention, Mitigation, Preparedness, Response and Recovery

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1						✓			
CO2				✓					✓

03OEXXX	**TURBO MACHINERY**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

- To understand in-depth knowledge of dimensional analysis of turbo machines.
- To enlighten the thermodynamic aspects of energy transfer in turbo machines.
- To study the flow characteristics of turbo machines.
- To understand the process of energy transfer and operating principles of various turbo machines and their use for various engineering applications

Unit–I : Energy transfer in turbo machines

Introduction to turbo machinery – classification – applications - Euler's equations - components of energy transfer- Work and efficiencies in turbine stage (Total-to-total, Total-to-static, Polytropic and finite stage) - Effect of reheat factor in turbine-Work and efficiencies in compressors stage (Total-to-total, Static-to-static, Polytropic and finite stage) - Effect of preheat factor in compressor- simple problems.

Unit–II : Aerofoil theory

Aerofoil section – Classification - lift and drag on the blade - Blade terminology - Cascade testing -Axial turbine cascade, Nomenclature, Velocity triangles and Blade forces - lift and drag coefficients - Estimation of losses using various empirical correlations (theory only).

Axial compressor cascade, nomenclature, velocity triangles, blade forces- lift and drag coefficients, losses - Estimation of losses using empirical correlations (Howell's) - Annular cascades - Radial cascade (theory only).

Unit–III : Axial flow and radial flow fans

Axial flow fans and propeller - Types of axial fan stages - Fan stage parameters - Slip stream theory-Blade element theory - Performance of axial fans.

Centrifugal fans and Blowers - Types of centrifugal fan - Backward-Swept, radial and forward swept blade - Velocity triangles - Stage parameters - Design parameters -Performance of radial flow fans.

Unit–IV : Radial turbines

Radial turbine stages - Elements of radial turbine stage - IFR turbine with cantilever blade - Ninety degree IFR turbine - inward mix-flow turbine - velocity triangles - h-s diagram - Spouting velocity stage efficiency - Effect of exhaust diffuser - Degree of reaction - Stage losses - Performance characteristics - blade to gas speed ratio - Out ward flow radial turbine (Ljungstrom turbine) theory only.

Unit–V : Dimensional analysis and similarity law

Dimensional analysis and similarity law - Applied to Incompressible flow machines - head, capacity, power coefficient - Specific speed - Compressible flow machine - Pressure ratio - Dimensionless speed and mass flow parameter - power coefficient - similarity law - Reynolds model law and Mach model law.

TEXT BOOKS

1) Yahya. S.M., Turbines, Compressors and Fans, Second ed., 2002, Tata McGraw Hill.
2) Dixon, S.L., "Fluid Mechanics and Thermodynamics of Turbomachinery", 7lh Edition, Butterworth-Heinemann, 2014.

REFERENCES

1) Shepered, D.G., Principles of Turbo Machines, Collier Macmillan Ltd., 1961.
2) Bruno Eck.," Fans; Design and Operation of Centrifugal, Axial-Flow, and Cross-Flow Fans", Pergamom Press, 1973.
3) Shepherd, D.G., "Principles of Turbomachinery", Collier Macmillan Ltd, 1961.
4) Stepanoff, A.J., "Blowers and Pumps", John Wiley and Sons Inc. 1965.
5) Gopalakrishnan, G. and Prithvi Raj, D., "A Treatise on Turbomachines", Scitech Publications (India) Pvt. Ltd., 2nd Edition, 2008.

COURSE OUTCOMES

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

1) Impart fundamental understanding of transport processes and mathematical modeling of these transport processes through turbo machine passages.
2) Employ analytical and numerical tools required for performance evaluation and innovative research in the area of rotodynamic machines.
3) Determine the velocity triangles in turbo machinery stages operating at design and off design conditions.
4) Perform the preliminary design of turbo machines (pumps, compressors, turbines).
5) Recognize and discuss today's and tomorrow's use of turbo machines for enabling a sustainable society.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2		✓			✓				
CO3		✓							
CO4		✓		✓					
CO5			✓						

03OEXXX	VIBRATION AND NOISE CONTROL	L	T	P
		4	0	0

COURSE OBJECTIVES

- This course introduces to the students the different types of vibrations, the causes of vibrations and means of damping it out

Unit–I

Free vibrations with viscous damping,- logarithmic decrement, -forced vibrations,- vibration isolation and transmissibility- Force due to unbalance - Force due to support motion – Vibration measuring instruments - vibrometers – accelerometers.

Unit–II

Two degree of Freedom Systems: Principal modes of Vibration -spring mass system. -Double pendulum two rotor system – Vibration of geared systems – combined rectilinear and angular modes-undamped dynamic vibration absorber.

Unit–III

Multi degree freedom systems – influence numbers and Maxwell's reciprocal theorem– Matrix method - stiffness matrix, dynamic matrix– Natural frequencies and principal modes by matrix iteration

Unit–IV

Basics of noise, amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise dose level, legislation, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis.

Unit–V

Source of noise and methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers

TEXT BOOKS

1) Grover, G.K., Mechanical Vibrations, Nemchand & Bros., Roorkee, 1993.
2) Singh, V.P., Mechanical Vibration –Dhanpat Rai & Sons.

REFERENCES

1) TSE S. Morse Ivan & Hinkle T., Mechanical Vibrations, PHI.
2) Thomson, W.T. & Marie Dillon Dahleh, Theory of Vibration with Applications, Fifth Edition, 1998.
3) Rao, S.S. Mechanical Vibrations, Third Edition, Addison Wesley Publishing Company, New York, 1995.
4) Ramamurthi, V., Mechanical Vibration Practice with Basic Theory, Narosa Publishing House, 2000.
5) Amberkar, A.G., "Mechanical Vibrations and Noise Engineering", Prentice Hall of India, New Delhi, 2006.

COURSE OUTCOMES

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

1) Analyze all vibrations in a machine
2) Damp out vibrations
3)

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓		✓		✓				
CO2	✓	✓				✓			✓

03OEXXX	**TOTAL QUALITY MANAGEMENT**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

- To provide an understanding of modern techniques and tools of quality management
- To impart the knowledge and on the application of the statistical quality control techniques which are used in manufacturing and service industries.
- To provide knowledge and understanding of the modern manufacturing strategies and to present a broad conceptual framework for the management of the operations function across the supply chain.

Unit–I

Concepts of TQM – Definition of quality – Dimensions of quality - Deming, Crosby and Juran's philosophies – Barriers to TQM - Quality system – ISO 9000:2000 - ISO 14000 – QS 9000 Quality system standards - Quality costs, Seven tools for Quality Control, Seven tools for Quality management, Quality Function Deployment (QFD) - Taguchi Loss function.

Unit–II

Objectives of statistical quality control - inspection and its importance – Introduction to Single sampling plan – OC Curve - differences between inspection and quality control - Causes and types of variations - Theory of control charts, Control charts for attributes - p, np, c and u charts.

Unit–III

Control charts for variables, $\overline{X}$-R charts, standard deviation charts - Moving range chart. Relationship between statistical control limits and specification limits - modified control chart, process capability studies (Cp and Cpk) – concept of six sigma.

Unit–IV

Business Process Re- engineering – basic concepts – Bench marking: Types – reasons – process of bench marking – overview and approaches to Concurrent engineering – Agile and Lean manufacturing – FMEA – FMECA.

Unit–V

Technology management – Strategic Management – Goal – Vision – Mission statements – order winner – order qualifier - Decision support systems (DSS) –

Manufacturing flexibility – Enterprise wide information system (EWIS) – Enterprise resource planning (ERP) – selection of ERP – Product development – SWOT analysis – Value stream mapping – Customer relationship management (CRM) – Database management system (DBMS) – Re-manufacturing.

TEXT BOOKS

1) Montgomery D.C., Introduction to Statistical Quality Control, John Wiley, 1994.
2) James Evans, Managing for Quality and Performance Excellence, 2014, CENGAGE Learning.

REFERENCES

1) Gupta, R.C., Statistical Quality Control, Khanna Publication, 1998.
2) Besterfield, Total Quality Management, Pearson Education, 2nd Edition, 2003.

COURSE OUTCOMES

Upon completing this course, students should be able to:

1) Understand the core features of the Total quality management in terms of various dimensions of quality.
2) Measure the cost of poor quality and process effectiveness and efficiency to track performance quality and to identify areas for improvement
3) Develop an understanding on quality management philosophies and frameworks
4) Develop the ability to apply the tools of quality control and quality management.
5) Understand proven methodologies to enhance management processes, such as benchmarking and business process reengineering, lean manufacturing.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1					✓				
CO2			✓						
CO3		✓	✓						
CO4					✓		✓		
CO5				✓					✓

03OEXXX	**MECHATRONICS**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

- To develop an ability to identify, formulate, and solve engineering problems.
- To develop an ability to design a system, component, or process to meet desired needs within realistic constraints
- To understand the interdisciplinary applications of Electronics, Electrical, Mechanical and Computer Systems for the Control of Mechanical and Electronic Systems.

Unit–I

Introduction to Mechatronics - Open and Closed Loop System. Mathematical System Models and Transfer Function – Mechanical – Electrical - Thermal - Fluid Systems.

Unit–II

Construction and Reduction Techniques - Block Diagram - Signal Flow Graph. Stability Analysis – Routh Criterion - Frequency Response – Polar Plot - Bode Plot - Nichols Plot

Unit–III

Sensors and Transducers: Static and Dynamic Characteristics of Sensor, Potentiometers - LVDT - Capacitance Sensors - Strain Gauges - Eddy Current Sensor - Hall Effect Sensor -Temperature Sensors - Light Sensors. Signal Conditioning – Operational Amplifiers - Protection – Filtering - ADC and DAC.

Unit–IV

Actuation Systems – Construction - Working Principle - Characteristics - Stepper Motor and Servo Motor - Hydraulic and Pneumatic Systems. Introduction - Pin Configuration- Architecture of 8085 Microprocessor - Addressing Modes - Instruction Set, Timing Diagram of 8085.

UNIT–V

Introduction - Architecture of PLC - Input / Output Processing - Programming with Timers, Counters and Internal Relays. Stages of Mechatronics Design Process - Comparison of Traditional and Mechatronics Design Concepts with Examples - Case Studies of Mechatronics Systems - Pick and Place Robot - Engine Management System – Automatic Car Park Barrier.

TEXT BOOKS

1) Bolton - Mechatronics - Electronic Control Systems in Mechanical and Electrical Engineering, Addison Wesley Longman Ltd., 2003.
2) Nagoor Kani., A – Control Systems, RBA Publications, Chennai, 2000.

REFERENCES

1) Ramesh S. Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", Penram International Publishing Private Limited, 6th Edition, 2015.
2) Anthony Esposito, “Fluid Power with Applications”, Pearson Education Inc., 2003
3) Majumdar, S.R., “Pneumatic Systems – Principles and maintenance”, Tata McGraw Hill, 2001.
4) Devdas Shetty, Richard A., Kolk, “Mechatronics System Design”, Thomson Learning Publishing Company, Vikas Publishing House, 2001.

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1) Model and analyze electrical and mechanical systems and their interconnection.
2) Integrate mechanical, electronics, control and computer engineering in the design of mechatronics systems.

3) Complete design, building, interfacing and actuation of a mechatronic system for a set of specifications
4) Gain knowledge related to Microprocessor, PLC and other Electrical and Electronics Circuits.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1		✓	✓						
CO2			✓		✓				
CO3			✓			✓			
CO4				✓					✓

03OEXXX	**MICROPROCESSOR TECHNOLOGY**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

- To gain the Concepts of Binary Systems and basic knowledge of Microprocessors
- To understand the constructional details of Microprocessors
- To gain the knowledge of programming languages for Microprocessors in accordance with hardware
- To understand the interfacing of microprocessors with peripheral devices and process control applications

Unit–I

Digital Technology Overview: Number systems - Binary, Hexadecimal, Decimal - Logic gates - OR, AND, XOR, NOT, NAND, NOR gates - Boolean Algebra - DeMorgan's theorem - Karnaugh's Map - Encoders, decoders, adders, multiplexers, demultiplexers - RS, JK, D, T flip flop - Asynchronous counters - shift register.

Unit–II

Microprocessor architecture: RAM, ROM, EPROM - memory mapping - INTEL 8085 Architecture - ALU, registers, address bus, data bus, control buses, tristate devices - overview of other 8-bit,16-bit, 32-bit microprocessors (instruction set not included)

Unit–III

Microprocessor programming: INTEL 8085 Mnemonic - Data transfer, Arithemetic, Logic, Branching instructions - subroutines - simple programs

Unit–IV

Interfacing & peripheral devices: Basic interfacing concepts - 8085 interrupts, 8255 programmable peripheral interface - DMA controller - A/D & D/A conversion.

Unit–V

Control of pressure, temperature, speed -stepper motor control, process control - Automotive applications - introduction to micro controllers.

TEXT BOOKS

1) Mathur, A.P., Introduction to microprocessors, Tata McGraw Hill.
2) Ahson, S.I., Microprocessors with applications in process control, Tata McGraw Hill.

REFERENCES

1) Gaonkar, R.S., Microprocessor Architecture, Programming & Application, Wiley Eastern.
2) Leventhal, L.A., Introduction to Microprocessors software and hardware programming, PHI.
3) Barney, G.C., Intelligent Instrumentation, PHI.
4) Peatman, Designing with Micro controllers, McGraw Hill.
5) Douglas V. Hall, Microprocessors - Programming & Interfacing, McGraw Hill.

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1) Understand the basic architecture and functions of 8085 Microprocessors
2) Interface with Pheripheral Devices
3) Set up basic Process control Units.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1		✓							
CO2			✓						
CO3					✓				✓

03OEXXX	**ORGANISATIONAL BEHAVIOUR**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

- To provide an overview of theories and practices in organizational behavior in individual, group and organizational level.
- To learn human behavior and improve cooperation to achieve targets.

Unit–I : Focus and purpose

Definition, need and importance of organizational behavior – Nature and scope – Frame work – Organizational behavior models.

Unit–II : Individual Behaviour

Personality – types – Factors influencing personality – Theories – Learning – Types of learners – The learning process – Learning theories – Organizational behavior modification. Misbehavior – Types – Management Intervention. Emotions - Emotional Labour – Emotional Intelligence – Theories. Attitudes – Characteristics – Components – Formation – Measurement- Values. Perceptions – Importance – Factors influencing perception – Interpersonal perception- Impression Management. Motivation – importance – Types – Effects on work behavior.

Unit–III : Group Behaviour

Organization structure – Formation – Groups in organizations – Influence – Group dynamics – Emergence of informal leaders and working norms – Group decision making techniques – Team building - Interpersonal relations – Communication – Control.

Unit–IV : Leadership and Power

Meaning – Importance – Leadership styles – Theories – Leaders Vs Managers – Sources of power – Power centers – Power and Politics.

Unit–V : Dynamics of Organizational Behaviour

Organizational culture and climate – Factors affecting organizational climate – Importance. Job satisfaction – Determinants – Measurements – Influence on behavior. Organizational change – Importance – Stability Vs Change – Proactive Vs Reaction change – the change process – Resistance to change – Managing change. Stress – Work Stressors – Prevention and Management of stress – Balancing work and Life. Organizational development – Characteristics – Objectivess –. Organizational effectiveness

TEXT BOOKS

1) Stephen P. Robins, Organisational Behavior, PHI Learning / Pearson Education, 11th edition, 2008.
2) Fred Luthans, Organisational Behavior, McGraw Hill, 11th Edition, 2001.

REFERENCES

1) Schermerhorn, Hunt and Osborn, Organizational behavior, John Wiley, 9th Edition, 2008.
2) Udai Pareek, Understanding Organizational Behaviour, 2nd Edition, Oxford Higher Education, 2004.
3) Mc Shane & Von Glinov, Organizational Behaviour, 4th Edition, Tata Mc Graw Hill, 2007.
4) Hellrigal, Slocum and Woodman, Organizational Behavior, Cengage Learning, 11th Edition 2007.
5) Ivancevich, Konopaske & Maheson, Organizational Behaviour & Management, 7th edition, Tata McGraw Hill, 2008.

COURSE OUTCOMES

1) Design the model for every industry
2) Study the character of every individual and to shape the individual to the requirement of company
3) Identify the top level people /leader for the smooth operation of organization.
4) Improve the quality to act as a team player.
5) Identify the power centers' against the top level management.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1			✓	✓					
CO2					✓				
CO3		✓				✓			✓
CO4							✓		
CO5		✓							

03OEXXX	**QUALITY ASSURANCE AND RELIABILITY**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

- To introduce students how to use various control chart, sampling techniques for controlling quality and reliability concepts
- To provide an understanding of the systematic approach to solve quality control problems.
- To enhance the basic statistical skills.

Unit–I

Objectives of statistical quality control – inspection and its importance – difference between inspection and quality control - basic statistical methods – technique of quality control- control charts for attributes P chart with constant sub group size and variable sub group size – np chart, C – chart – U chart- illustrative examples.

Unit–II

Control chart for variables: Chart for controlling central tendency – average chart (x – chart), charts for controlling dispersion – Range cart (R-Chart) and standard deviation chart (s-Chart)-Maintenance of control charts.

Unit–III

Relationship between statistical control limits and specifications limits – Process variability-evaluation of process capability.

Unit–IV

Acceptance sampling-use of binominal-position and normal distributions in sampling-operating characteristics curves-procedure risk, consumers risk, AQL and LTPD-construction of O.C Curves use of IS 2500 part-I- Effects of sampling plan parameter changes, types of sampling plans-single sampling plan - use of BIS 2500 part I and II.

Unit–V

Reliability Engineering - Definition, failure rate, mean time to failure, mean time between failure, hazard rate, life testing – System reliability, series, parallel and mixed configuration – Active and standby redundancy – Availability and Maintainability concepts – Reliability centered maintenance –FTA, FMECA.

TEXT BOOKS

1) Gupta R.C., Statistical Quality Control, Khanna pub., New Delhi, 1998.
2) Montgomery, D.C., Introduction to Statistical Quality Control, John Wiley, 1994.

REFERENCES

1) Statistics Quality Control, Grant E.L., TMH, 1996.
2) The Assurance sciences – An Introduction to Quality control and Reliability, Siegmund Halpen, PHI Editions, 1978.
3) I.S. 2500 – 1973 Part –I and II.
4) I.S. 397 – 1970 Part I and II.
5) Reliability Engineering, Srinath L.S., Affiliated East west press, 1991.

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1) Impart the basic characteristics of different types of sampling plans and reliability concepts.
2) Enhances their ability to solve various control charts and sampling plans.
3) Expertise to select appropriate control charts and sampling plans for the real life problems.
4) Implement statistical process control and acceptance sampling procedures in manufacturing and service environment to improve quality of processes / products.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1					✓				
CO2		✓			✓				
CO3					✓				✓
CO4			✓						

03OEXXX	**CAD/CAM/CIM**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

- Understand the basic analytical fundamentals that are used to create and manipulate geometric models in a computer program,
- Implementing part programs for basic machining operations.
- Gain knowledge on how computers are integrated at various levels of design, planning and manufacturing.
- Understand the types and applications of robots

Unit–I

Computer Aided Design- fundamental of CAD - Design work station-Design Process - Applications and benefits of Computers for Design. Product cycle with CAD, Computer graphics software and database. Transformations 2D and 3D, Concatenation, Wire frame modeling, Solid modeling- C-rep, B-rep.

Unit–II

Introduction to computer graphics- Graphical Input Techniques - Introduction - Pointing, positioning, rubber banding, dragging, and positioning of text, graphics menu and menu alternatives. Fundamentals of 2-D drafting. Introduction - Fixing size of drawing, layering. Line types, Text fonts and shapes, entities, blocks, edit commands, displays commands, dimensioning, cross hatching, pattern filling and plotting a drawing.

Unit–III

Computer Aided Manufacturing- Numerical Control - Introduction - Basic Components of NC system, NC procedures, NC Co-ordinates, NC motion control systems,, NC languages- Programming, Voice NC programming - Working of Computer Numerical Control, Direct Numerical Control and Adaptive control. Advantages and Disadvantages of NC, CNC, DNC, Trends and developments in NC.

Unit–IV

Computer Integrated Manufacturing- Flexible Manufacturing system, Group Technology - Part families, part classification and coding - Production flow analysis - machine cells, design automation - Computer aided process planning - IMS components - application- Automated production.

Unit–V

Robotics-Industrial Robots - Basic components in Robotics - Cartesian Co-ordinate Robots - cylindrical co-ordinate Robots - Spherical Co-ordinate Robots - Articulated Robots - Intelligent Robots - Economics and Robot applications.

TEXT BOOKS

1) Groover, M.P. and E.W. Zimmers. CAD/CAM - Computer Aided Design and Manufacturing, Pearson Education Pvt. Ltd, 2013.
2) Radhakrishnan, R., S.Subramanian and V. Raju, CAD/CAM/CIM, New age International Pvt. Ltd. 4th edition, 2016.

REFERENCES

1) Ibrahim Zeid "Mastering CAD CAM" Tata McGraw-Hill Publishing Co.2007
2) Groover M.P Automation, production system and Computer Integrated Manufacturing System- Prentice Hall, 2014.
3) P.N. Rao, CAD/CAM Principles and Applications-Tata McGraw Hill 3rd edition, 2007.

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

1) Understand the various procedures in the design process.
2) Understand the mathematical modeling of mechanical elements.
3) Acquire the knowledge of computer aided planning and manufacturing
4) Understand the applications of computers in integrated manufacturing.
5) Understand the basic elements, working and applications of industrial robots.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2	✓	✓							
CO3				✓	✓				
CO4						✓			
CO5									✓

03OEXXX	COMPUTER INTEGRATED MANUFACTURING SYSTEMS	L	T	P
		4	0	0

COURSE OBJECTIVES

- To familiarize the basic concepts of CAD / CAM / CIM
- To introduce the various aspects of automated manufacturing
- To introduce the fundamentals of materials handling and storage system and robotics
- To introduce the concepts of automated assembly and control system

Unit–I : Introduction

Product design & CAD, CAM, CAD/CAM and CIM – CIM Hardware and Software – Three Step Process for Implementation of CIM – Production Concepts and Mathematical Models Covering Production Rate, Manufacturing Lead Time, Capacity Utilization, Availability & WIP – Automation – Reason for Automation and Automation Strategies

Unit–II : Automated Production Systems And Material Handling And Storage System

Basic Elements of an Automated System – Advanced Automated Functions – Levels of Automation - Fundamentals of Automated Production Lines – Work Part Transfer Mechanisms – Storage Buffers – Control of the Production Line – Application to Machining System. Material Handling and storage system: Overview of Materials Handling Equipment – Factors Influencing Material Handling System – 10 Principles of Material Handling – Material Transport System: Industrial Trucks, Mono-Rails and other Rail-Guided Vehicles – Conveyors, Cranes & Hoists – Automated Guided Vehicle System: Types, Guidance Technology, Vehicle Management, Dispatch Rules and Safety – Storage Systems – Performance, Storage Location Strategies, Conventional Methods – Automated Storage and Retrieval Systems – Carousel Storage Systems

Unit–III : Robotics

Industrial Robots: Definition – Robot Anatomy – Types and Classifications – Work Envelope – Co-ordinate Systems – Notations – End Effectors: Grippers and Tools – Robot Sensors and Machine Vision System – Robot Work cell – Robot programming – Robot Applications – Recent developments

Unit–IV : Group Technology & Flexible Manufacturing System

Group Technology: Definition – Part Families – Visual – Parts Classification and Coding – Case Studies in Coding – Production Flow Analysis – Composite Part

Concept – Benefits of GT – Application of GT – Cellular Manufacturing. Flexible Manufacturing System (FMS): Definition – Types of FMS – FMS Components – Workstations – FMS Layout – FMS Application and Benefits.

Unit–V : Automated Assembly, Computer Process Control and Shop Floor Control

Automated Assembly: Fundamentals – System Configuration, Part Delivery at Work Station – Design for Automated Assembly Computer Process Control: Continuous, Discrete Process, Control Requirement, Capabilities, Level of Process Control – Computer Process Control – Computer Process Interface, Computer Process Monitoring, Direct Digital Control, Supervisory Control – Distributed Control System and Personal Computer Short Floor Control: Three Phases – Factory Data Collection – Manual Method – Automated and Semi-Automated Data Collection (ADC) – Bar Code Technologies and Other ADC Technologies.

TEXT BOOKS

1) Mikell P. Groover, "Automation, Production Systems and Computer-Integrated Manufacturing", 2nd Edition, Prentice Hall of India Private Limited, New Delhi, 2007.
2) Mikell P. Groover, Weiss, M., Nagel, R.N., and Odrey, N.G., "Industrial Robotics: Technology, Programming and Applications", McGraw-Hill Book Company, New Delhi

REFERENCES

1) Radhakrishnan, P., Subramanyan, S., and Raju,.V,, "CAD/CAM/CIM", New Age International Publishers, 2000
2) Yorem Koren, "Computer Integrated Manufacturing", McGraw Hill, 2005
3) Rao, P.N, "CAD/CAM-Principles and Applications", Tata McGraw-Hill Publications, 2007

COURSE OUTCOMES

Upon completing this course, students should be able to:

1) Provide engineering knowledge on the importance of CAD / CAM / CIM
2) Understand the various aspects of automated manufacturing
3) Provide knowledge on the concepts of automated assembly and control system
4) Understand the usage of modern materials handling and storage system and industrial robots.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1					✓				
CO2	✓	✓							
CO3					✓		✓		
CO4					✓		✓		✓

03OEXXX	ARTIFICIAL INTELLIGENCE AND ROBOTICS	L	T	P
		4	0	0

COURSE OBJECTIVES

- To study the concepts of expert systems and machine learning
- To learn the methods of solving problems using Artificial Intelligence

Unit–I : Introduction

History, state of the art, Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents. PROBLEM SOLVING: Solving problems by searching –Informed search and exploration–Constraint satisfaction problems– Adversarial search, knowledge and reasoning–knowledge representation – first order logic.

Unit–II : Planning

Planning with forward and backward State space search – Partial order planning – Planning graphs– Planning with propositional logic – Planning and acting in real world.

Unit–III : Reasoning

Uncertainty – Probabilistic reasoning–Filtering and prediction–Hidden Markov models–Kalman filters– Dynamic Bayesian Networks, Speech recognition, making decisions.

Unit–IV : Learning

Forms of learning – Knowledge in learning – Statistical learning methods – reinforcement learning, communication, perceiving and acting, Probabilistic language processing, perception.

Unit–V : AI In Robotics

Robotic perception, localization, mapping- configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence in robotics.

TEXT BOOKS

1) Stuart Russell, Peter Norvig, “Artificial Intelligence: A modern approach”, Pearson Education, India 2003.
2) Negnevitsky, M, “Artificial Intelligence: A guide to Intelligent Systems”, Harlow: Addison Wesley, 2002.

REFERENCES

1) Groover, M.P., "Industrial Robotics Technology, Programming and Applications", McGraw Hill Book Co., 1995
2) David Jefferis “Artificial Intelligence: Robotics and Machine Evolution”, Crabtree Publishing Company, 1992.
3) Timothy Jordonides et al., "Expert Systems and Robotics", Springer-Verlag, New York, May 1991.
4) Fu, K.S., Gonzalez, R.C., and Lee, C.S.G., Robotics Control, Sensing, Vision and Intelligence, McGraw-Hill Publishing company, New Delhi, 2003.

COURSE OUTCOMES

Upon completing this course, students should be able to:

1) Identify problems that are amenable to solution by AI methods.
2) Formalize a given problem in the language/framework of different AI methods.
3) Implement basic AI algorithms.
4) Design and carry out an empirical evaluation of different algorithms on a problem
5) Solve complex problems in robot kinematics, dynamics and control.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1		✓							
CO2			✓						
CO3	✓								
CO4		✓							✓
CO5		✓			✓				

03OEXXX	**MAINTENANCE AND SAFETY ENGINEERING**	**L**	**T**	**P**
		4	**0**	**0**

COURSE OBJECTIVES

- To develop your ability in formulating suitable maintenance strategies to achieve reliable a manufacturing system and achieve continuous system availability for production.
- To equip you with essential system diagnosis techniques so that you can identify and take appropriate actions on error symptoms and causes of failures.
- Apply safe working practices and understand the principles of preventive and first-line maintenance.
- Understand the principles of power transmission systems; remove and refit bearings, keyed shafts, belts & chains; install & align shafts; tension drive train components and to empower you with the skills to manage manufacturing system and man safely.

Unit–I

Need for Maintenance - Types of maintenance - Maintenance organisation charts for large, medium and small size plants - Basic functions of maintenances. Preventive maintenance - Need for preventive maintenance - Starting of preventive maintenance programme - Equipment record - Check list - Inspection - What to inspect - Frequency of inspection aids to good preventive maintenance.

Unit–II

Maintenance of Ball, Roller and Tapered Bearing - Maintenance of Belt, Chain, Gears, Pulleys, Shafting and Fasteners.

Unit–III

Maintenance of cranes - Hooks and slings - Industrial trucks - Maintenance of Power Plant Equipments - Centrifugal pumps, fans & blowers.

Unit–IV

Devices for safeguarding machines - points to be considered in designing the guards - Enclosures, covers and barricades - Safeguarding of fast and loose pulleys, chain and rope drives, revolving machines, pressure plates and self acting machines - Remote tripping and starting devices.

Unit–V

Safety Engineering - Accident Prevention - Various steps to accomplish accident prevention - Safety measures and safety precaution in workshops - Protection of eyes - Protection against dangerous fumes - Protection against fire - Wage incentive to satisfy workman compensation.

TEXT BOOKS

1) Morrow, Industrial Maintenance
2) Charles D Reese, Occupational Health & Safety Management, CRC Press.

REFERENCES

1) Rolland P. Blake - Industrial Safety, Prentice Hall of India Pvt. Ltd.
2) Mayard, Industrial Engineering.
3) Agarwal, Machine Building Technology.
4) Keith Mobley, Maintenance Engineering Handbook, McGraw-Hill Companies Inc.
5) Keith Mobley, Maintenance Fundamentals, Elsevier Butterworth-Heinemann.

COURSE OUTCOMES

1) Understand the relationship of key concepts in reliability engineering and application to maintenance strategies in a manufacturing environment.
2) Establish maintenance strategies according to system characteristics and design transition programs to implement these strategies.
3) Manage the manufacturing organization with highest possible availability with safety.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1					✓				
CO2		✓							
CO3						✓	✓		✓

03OEXXX	PRODUCTION AND OPERATIONS MANAGEMENT	L	T	P
		4	0	0

COURSE OBJECTIVES

- To provide an understanding of the modern approaches to manage the operations and to present a broad conceptual framework for the management of the operations function in an organization

Unit–I

Production and operation management – Evolution and Objectives - Concept of Production system - Types of Production systems – Continuous, Intermittent - Elements of Production planning and control, concept of Productivity - Production versus Services. Aggregate planning: Costs, Strategies – Application of chase and level strategies and Transportation model - Simple problems.

Unit–II

Capacity planning: Defining and measuring capacity – determinants of effective capacity –Developing capacity alternatives.

Forecasting - components of demand - Quantitative methods - Single moving average method - Single exponential smoothing method - Simple linear regression model –- Measures of accuracy - Illustrative examples - Qualitative Methods.

Unit–III

Inventory planning and control: Need, inventory costs, Determination of EOQ, EPQ/ELS (without shortages) - Effect of quantity discounts. Determination of ROL, Safety Stocks - Methods of calculating safety stock using Normal - single period inventory model, Inventory control systems - P, Q, and S- s System.

Unit–IV

Materials Requirements Planning (MRP) - Master production schedule, Bill of materials, MRP concept, Lot sizing: Lot-for-lot technique, EOQ approach, Periodic order quantity approach – Illustrative Examples.

Unit–V

Operations scheduling and sequencing: Notations and definitions - Job shop scheduling: sequencing of n jobs through one machine - Priority decision rules – Measures of Performance - n jobs through 2 machines - Jackson's rule. Flow shop scheduling: sequencing of n jobs through 2, 3 machines, Johnson's rule. n jobs through m machines - CDS algorithm.

TEXT BOOKS

1) Production and Operations Management, R. Pannerselvam, PHI Learning Pvt. Ltd., 2008.
2) Theory and Problems in Production and Operations Management, Charry S.N, Tata McGraw Hill, 2005.

REFERENCES

1) Joseph, G. Monks, Theory and Problems of Operations Management, Tata McGraw-Hill Publishing Company Limited, 2nd Edition, 2004.

2) S. Anil Kumar, N. Suresh, Production and Operations Management, New Age International (P) Limited Publishers, 2nd Edition, 2008.
3) Everett, E. Adam, Jr. Ronald J. Ebert, Production and Operations Management, Prentice-Hall of India Private Limited, 5th Edition, 1994.

COURSE OUTCOMES

Upon completing this course, students should be able to:

1) Develop and understand the various types of production systems.
2) Differentiate Production and services.
3) Gain an understanding and appreciation of the principles and applications relevant to the planning, design and operations of manufacturing/service firms.
4) Develop the ability to identify operational methodologies to assess and improve an organizations performance.
5) Gain ability to recognize situations in a production system environment that suggests the use of certain quantitative methods to assist in decision making in the areas such as aggregate planning, Inventory control, forecasting MRP and scheduling.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓			✓					
CO2	✓								
CO3				✓		✓			
CO4					✓				
CO5				✓					✓

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