Bachelor of Technology (Mechanical Engineering) Kurukshetra University, Kurukshetra

*SCHEME OF STUDIES/EXAMINATIONS**(w.e.f. 2015-16 onwards)***

Semester–III

S. No.	Course No.	Course Title	Teaching Schedule				Allotment of Marks				Duration of Exam (Hrs.)
			L	T	P	Hours/ Week	Theory	Sessional	Practical	Total	
1	AS-201N/ HS-201N	Mathematics –III/ Fundamentals of Management	3	1	0	4	75	25	0	100	3
2	ME-201N	Basic Thermodynamics	3	1	0	4	75	25	0	100	3
3	ME-203N	Mechanics of Solid –I	3	1	0	4	75	25	0	100	3
4	ME-205N	Machine Drawing	2	3	0	5	75	25	0	100	4
5	ME-207N	Kinematics of Machines	3	1	0	4	75	25	0	100	3
6	ME-209N	Material Science	4	0	0	4	75	25	0	100	3
7	ME-211N	Kinematics of Machine Lab	0	0	2	2	0	40	60	100	3
8	ME-213N	Material Science Lab	0	0	2	2	0	40	60	100	3
9	ME-215N	Mechanics of Solid Lab	0	0	2	2	0	40	60	100	3
		Total	**18**	**7**	**6**	**31**	**450**	**270**	**180**	**900**	
10	MPC-201N	Environmental Studies*	3	0	0	3	75	25	0	100	3

**MPC-201N is a mandatory course and student has to get passing marks in order to qualify for the award of degree but its marks will not be added in the grand total.*

Bachelor of Technology (Mechanical Engineering)Kurukshetra University, Kurukshetra

*SCHEME OF STUDIES/EXAMINATIONS**(w.e.f. 2015-16 onwards)***

Semester – IV

S. No.	Course No.	Course Title	Teaching Schedule				Allotment of Marks				Duration of Exam (Hrs.)
			L	T	P	Hours/ Week	Theory	Sessional	Practical	Total	
1	AS-201N/ HS-201N	Mathematics –III/ Fundamentals of Management	3	1	0	4	75	25	0	100	3
2	ME-202N	Production Technology-I	4	0	0	4	75	25	0	100	3
3	ME-204N	Steam Generation & Power	3	1	0	4	75	25	0	100	3
4	ME-206N	Mechanics of Solid-II	3	1	0	4	75	25	0	100	3
5	ME-208N	Fluid Mechanics	4	1	0	5	75	25	0	100	3
6	ME-210N	Dynamics of Machine	3	1	0	4	75	25	0	100	3
7	ME-214N	Fluid Mechanics Lab	0	0	2	2	0	40	60	100	3
8	ME-216N	Dynamics of Machine Lab	0	0	2	2	0	40	60	100	3
9	ME-218N	Steam Generation & Power Lab	0	0	2	2	0	40	60	100	3
10	ME-220N	Production Technology Lab	0	0	3	3	0	40	60	100	
		Total	**20**	**5**	**9**	**34**	**450**	**310**	**240**	**1000**	
11	MPC-202N	Energy Studies*	3	0	0	3	75	25	0	100	3

**MPC-202N is a mandatory course and student has to get passing marks in order to qualify for the award of degree but its marks will not be added in the grand total.*

Note:*All the students have to undergo six weeks industrial training after IVth semester and it will be evaluated in Vth semester.*

Bachelor of Technology (Mechanical Engineering)Kurukshetra University, Kurukshetra

*SCHEME OF STUDIES/EXAMINATIONS**(w.e.f. 2015-16 onwards)***

Semester – V

S. No.	Course No.	Course Title	Teaching Schedule				Allotment of Marks				Duration of Exam (Hrs.)
			L	T	P	Hours/ Week	Theory	Sessional	Practical	Total	
1	ME-301N	I.C. Engine & Gas Turbine	3	1	0	4	75	25	0	100	3
2	ME-303N	Fluid Machines	3	1	0	4	75	25	0	100	3
3	ME-305N	Heat Transfer	3	1	0	4	75	25	0	100	3
4	ME-307N	Industrial Engineering	3	1	0	4	75	25	0	100	3
5	ME-309N	Machine Design-I	2	4	0	6	75	25	0	100	3
6	ME-311N	Production Technology-II	4	0	0	4	75	25	0	100	3
7	ME-313N	I.C. Engine Lab	0	0	2	2	0	40	60	100	3
8	ME-315N	Fluid Machines Lab	0	0	2	2	0	40	60	100	3
9	ME-317N	Heat Transfer Lab	0	0	2	2	0	40	60	100	3
10	ME-319N	Industrial Training (Viva-Voce)*	2	0	0	2	0	40	60	100	3
		Total	**20**	**08**	**06**	**34**	**450**	**310**	**240**	**1000**	

**The performance of the student will be evaluated after the presentation delivered and the report submitted by him/her related to Industrial training undertaken after IVth semester.*

Bachelor of Technology (Mechanical Engineering)Kurukshetra University, Kurukshetra

*SCHEME OF STUDIES/EXAMINATIONS**(w.e.f. 2015-16 onwards)***

Semester – VI

S. No.	Course No.	Course Title	Teaching Schedule				Allotment of Marks				Duration of Exam (Hrs.)
			L	T	P	Hours /Week	Theory	Sessional	Practical	Total	
1	ME-302N	Refrigeration and Air Conditioning	3	1	0	4	75	25	0	100	3
2	ME-304N	Tribology & Mechanical Vibration	3	1	0	4	75	25	0	100	3
3	ME-306N	Operation Research	3	1	0	4	75	25	0	100	3
4	CSE-209N	Essentials of IT	3	1	0	4	75	25	0	100	3
5	ME-308N	Computer Aided Design and Manufacturing	4	0	0	4	75	25	0	100	3
6	ME-310N	Machine Design-II	2	4	0	6	75	25	0	100	4
7	ME-312N	Refrigeration and Air Conditioning Lab	0	0	2	2	0	40	60	100	3
8	ME-314N	Tribology & Mechanical Vibration Lab	0	0	2	2	0	40	60	100	3
9	ME-316N	Computer Aided Design and Manufacturing Lab	0	0	2	2	0	40	60	100	3
		Total	**18**	**8**	**6**	**32**	**450**	**270**	**180**	**900**	

Note:*All the students have to undergo six weeks industrial training after VIth semester and it will be evaluated in VIIth semester.*

Bachelor of Technology (Mechanical Engineering) Kurukshetra University, Kurukshetra

*SCHEME OF STUDIES/EXAMINATIONS**(w.e.f. 2015-16 onwards)***

Semester – VII

S. No.	Course No.	Course Title	Teaching Schedule				Allotment of Marks				Duration of Exam (Hrs.)
			L	T	P	Hours/ Week	Theory	Sessional	Practical	Total	
1	ME-401N	Measurement and Control	4	0	0	4	75	25	0	100	3
2	ME-403N	Mechatronics	4	0	0	4	75	25	0	100	3
3	HS-401N	Entrepreneurship	3	0	0	3	75	25	0	100	3
4		DEC – I*	4	0	0	4	75	25	0	100	3
5		DEC –II*	3	0	0	3	75	25	0	100	3
6	ME-405N	Measurement and Control Lab	0	0	2	2	0	40	60	100	3
7	ME-407N	Mechatronics Lab	0	0	2	2	0	40	60	100	3
8	ME-409N	Project-I**	0	0	8	8	0	100	100	200	3
9	ME-411N	Industrial Training (Viva-Voce)***	2	0	0	2	0	40	60	100	3
10	ME-413N	Seminar-I	0	2	0	2		100	0	100	
		Total	**20**	**02**	**12**	**34**	**375**	**445**	**280**	**1100**	

** The students should select two Departmental Elective Courses (DEC) from the following list.*

Course No.	DEC-I	Course No.	DEC-II
ME-415N	Non-Conventional Machining	ME-427N	Finite Element Methods in Engineering
ME-417N	Soft Computing Techniques	ME-429N	Advanced Manufacturing Technology
ME-419N	Non-Destructive Evaluation & Testing	ME-431N	Robotics: Mechanics and Control
ME-421N	Design and Optimization	ME-433N	Simulation of Mechanical Systems
ME-423N	Computational Fluid Dynamics	ME-435N	Control Engineering
ME-425N	**Fundamentals of Gas Dynamics**	ME-437N	Environmental Pollution and Abatement

***The project should be initiated by the students in the beginning of VII^{h} semester and will be evaluated at the end of the semester on the basis of a presentation and report.*

****The performance of the student will be evaluated after the presentation delivered and the report submitted by the student related to Industrial training undertaken after VIth semester.*

Bachelor of Technology (Mechanical Engineering) Kurukshetra University, Kurukshetra

*SCHEME OF STUDIES/EXAMINATIONS**(w.e.f. 2015-16 onwards)***

Semester – VIII

S. No.	Course No.	Course Title	Teaching Schedule				Allotment of Marks				Duration of Exam (Hrs.)
			L	T	P	Hours/ Week	Theory	Sessional	Practical	Total	
1	ME-402N	Automobile Engineering	4	0	0	4	75	25	0	100	3
2		DEC-III*	4	0	0	4	75	25	0	100	3
3		DEC-IV*	4	0	0	4	75	25	0	100	3
4	ME-404N	Power Plant Engineering	4	0	0	4	75	25	0	100	3
5	ME-406N	Quality Assurance & Reliability	4	0	0	4	75	25	0	100	3
6	ME-408N	Automobile Engineering Lab	0	0	2	2	0	40	60	100	3
7	ME-410N	Project-II**	0	0	10	10	0	100	100	200	3
8	ME-412N	Seminar-II	0	2	0	2	0	100	0	100	
		Total	**20**	**2**	**12**	**34**	**375**	**365**	**160**	**900**	

**The student should select two Departmental Elective Courses (DEC) from the following list.*

Course No.	DEC-III	Course No.	DEC-IV
ME-414N	Smart Materials Structures & Devices	ME-426N	Manufacturing Management
ME-416N	Lubrication Technology	ME-428N	Design of Pressure Vessels and Piping
ME-418N	Energy Management	ME-430N	Concurrent Engineering
ME-420N	Waste Heat Recovery System	ME-432N	Industrial Combustion
ME-422N	Foundry Engineering	ME-434N	Metal Forming and Finishing
ME-424N	Ergonomics in Design	ME-436N	Air Craft and Rocket Propulsion

The project should be initiated by the students in the beginning of VIIIth semester and will be evaluated at the end of the semester on the basis of a presentation and report.* ***Note: *Project-II should not be related to Project-I unless it involves large amount of work, time and effort.*

B. Tech. 3rd Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
AS-201N	**MATHEMATICS-III**	3	1	0	75	25	100	3
Purpose	To acquaint the students with the basic use of PDE, Linear Programming problems, Fourier series and transforms, Complex variables and Probability							
Course Outcomes (CO)								
CO-1	This section is concerned mainly with Fourier series. However, the underlying ideas can also be extended to non-periodic phenomena. This leads to Fourier integrals and transforms which are very much useful in solving the initial and boundary value problems.							
CO-2	Students will learn about the formation and solution the partial differential equations. First order PDE of any degree by using Charpit's method will be discussed in details. In addition, how to solve homogeneous linear PDE with constant coefficients and variable separable method and LPP will be covered under this section.							
CO-3	Complex analysis is concerned with generalization of the familiar real functions of calculus and their detailed knowledge is an absolute necessity in practical work to solve engineering problems.							
CO-4	Probability theory provides models of probability distributions (theoretical models of the observable reality involving chance effects) to be tested by statistical methods which has various engineering applications, for instance, in testing materials, control of production processes, robotics, and automation in general, production planning and so on.							

UNIT-I

Fourier Analysis

Fourier series: Euler's formulae, Orthogonality conditions for the Sine and Cosine function, Dirichlet's conditions, Fourier expansion of functions having points of discontinuity, Change of interval, Odd and even functions, Half-range series.

Fourier Transforms: Fourier integrals, Fourier transforms, Fourier Cosine and Sine transforms, Properties of Fourier transforms, Convolution theorem, Parseval's identity, Fourier transforms of the derivative of a function, Application of transforms to boundary value problems (Heat conduction and vibrating string).

UNIT-II

Partial Differential Equations and LPP

Formation and Solutions of PDE, Lagrange's Linear PDE, First order non-linear PDE, Charpit's method, Homogeneous linear equations with constant coefficients, Method of separation of variables.

Solution of linear programming problems: using Graphical and Simplex methods.

UNIT-III

Theory of Complex Variables

A review of concept of functions of a complex variable, Limit, continuity, differentiability and analyticity of a function. Basic elementary complex functions (exponential functions, trigonometric & Hyperbolic functions, logarithmic functions) Cauchy-Riemann Equations.

Line integral in complex plane, definition of the complex line integral, basic properties, Cauchy's integral theorem, and Cauchy's integral formula, brief of Taylor's, Laurent's and Residue theorems (without proofs).

UNIT-IV

Probability theory:

A review of concepts of probability and random variables: definitions of probability, addition rule, conditional probability, multiplication rule, Conditional Probability, Mean, median, mode and standard deviation, Bayes' Theorem, Discrete and continuous random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, moments, moment generating function. **Standard Distributions:** Binomial, Poisson and Normal distribution.

References Books:

1. E. Kreyszig : Advanced Engineering Mathematics, Wiley India.
2. B. V. Ramana: Engineering Mathematics, Tata McGraw Hill.
3. R.K. Jain, S.R.K. Iyengar: Advanced Engineering Mathematics, Taylor & Francis.
4. Murray R. Spiegel: Schaum's Outline of Complex Variables, McGraw Hill Professional.
5. Michael D. Greenberg: Advanced Engineering Mathematics, Pearson Education, Prentice Hall.

Note: *Examiner will set eight questions by selecting two from each unit. Students will be required to attempt five questions selecting at least one question from each unit.*

B. Tech. 3rd Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
HS-201N	**FUNDAMENTALSOF MANAGEMENT**	3	0	0	75	25	100	3
Purpose	To understand the concept and techniques of controlling and new trends in management							
Course Outcomes (CO)								
CO-1	An overview about management as a discipline and its evolution							
CO-2	Understand the concept and importance of planning and organizing in an organization							
CO-3	Enabling the students to know about the importance of hiring and guiding the workforce by understanding the concept of leadership and communication in detail							
CO-4	To understand the concept and techniques of controlling and new trends in management							

UNIT-1

1. **Introduction to Management:** Meaning, Definition, nature, importance & Functions, Management as Art, Science & Profession- Management as social System, Concepts of management-Administration
2. **Evolution of Management Thought**: Development of Management Thought- Scientific management, Administrative Theory of Management, Bureaucratic Organization, Behavioral approach (Neo Classical Theory): Human Relations Movement; Behavioral Science approach; Modern approach to management – Systems approach and contingency approach.

UNIT-II

3. **Planning**: nature, purpose and functions, types of plans, planning process, Strategies and Policies: Concept of Corporate Strategy, formulation of strategy, Types of strategies, Management by objectives (MBO), SWOT analysis, Types of policies, principles of formulation of policies
4. **Organizing**: nature, importance, process, organization structure: Line and Staff organization, Delegation of Authority and responsibility, Centralization and Decentralization, Decision Making Process , Decision Making Models, Departmentalization: Concept and Types (Project and Matrix), formal & informal organizations

UNIT-III

5. **Staffing**: concept, process, features; manpower planning; Job Analysis: concept and process; Recruitment and selection: concept, process, sources of recruitment; performance appraisal, training and development
6. **Directing**: Communication- nature, process, formal and informal, barriers to Effective Communication, Theories of motivation-Maslow, Herzberg, McGregor ; Leadership –

concept and theories, Managerial Grid, Situational Leadership. Transactional and Transformational Leadership.

UNIT-IV

7. Controlling: concept, process, types, barriers to controlling, controlling Techniques: budgetary control, Return on investment, Management information system-MIS , TQM-Total Quality Management, Network Analysis- PERT and CPM.

8. Recent Trends in Management: -

Social Responsibility of Management–Management of Crisis, Total Quality Management, Stress Management, Concept of Corporate Social Responsibility (CSR) and business ethics.

Functional aspects of business: Conceptual framework of functional areas of management-Finance; Marketing and Human Resources

Text books

1. Management Concepts - Robbins, S.P; Pearson Education India
2. Principles of Management - Koontz &O'Donnel; (McGraw Hill)

Recommended books

1. *Business Organization and Management* – Basu; Tata McGraw Hill
2. Management and OB-- Mullins; Pearson Education
3. Essentials of Management – Koontz, Tata McGraw-Hill
4. Management Theory and Practice – Gupta, C.B; Sultan Chand and Sons, new Delhi
5. Prasad, Lallan and S.S. Gulshan. *Management Principles and Practices.* S. Chand& Co. Ltd., New Delhi.
6. Chhabra, T.N. *Principles and Practice of Management*. DhanpatRai& Co., Delhi.
7. Organizational behaviour – Robins Stephen P; PHI.

Note: *Examiner will set eight questions by selecting two from each unit. Students will be required to attempt five questions selecting at least one question from each unit.*

B. Tech. 3rd Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME-201N	**BASIC THERMODYNAMICS**	3	1	0	75	25	100	3
Purpose	The objective of this course is to make the students aware of Energy, Entropy, Equilibrium, various laws of thermodynamics and relations. The course will help the students to build the fundamental concepts in order to solve engineering problems.							
	Course Outcomes (CO)							
CO-1	State the thermodynamic system, properties and equilibrium. Describe the ideal and real gas laws.							
CO-2	Analyze and solve the first and second law of thermodynamics problems.							
CO-3	Define entropy and its change for different processes and also solve entropy problems							
CO-4	Describe the Availability and unavailability for steady and unsteady flow processes. Also understand the concept of irreversibility.							
CO 5	Solve the problems related to Steam and plot the processes on H-S and T-S diagram. Understand thermodynamics relations.							

UNIT-I

Basic Concepts: Thermodynamics: Macroscopic and Microscopic Approach, Thermodynamic Systems, Surrounding and Boundary, Thermodynamic Property – Intensive and Extensive, Thermodynamic Equilibrium, State, Path, Process and Cycle, Quasi-static, Reversible and Irreversible Processes, Working Substance. Concept of Thermodynamic Work and Heat, Equality of Temperature, Zeroth Law of Thermodynamic and its utility.

Ideal and Real Gases: Concept of an Ideal Gas, Basic Gas Laws, Characteristic Gas Equation, Avagadro's law and Universal Gas Constant, P-V-T surface of an Ideal Gas. Vander Waal's Equation of state, Reduced Co-ordinates, Compressibility factor and law of corresponding states. Mixture of Gases, Bass, Mole and Volume Fraction, Gibson Dalton's law, Gas Constant and specific Heats, Entropy for a mixture of Gases.

UNIT II

First Law of Thermodynamics: Energy and its Forms, Energy and 1st law of Thermodynamics, Internal Energy and Enthalpy, 1st Law Applied to Non-Flow Process, Steady Flow Process and Transient Flow Process, Throttling Process and Free Expansion Process. Numerical

Second Law of Thermodynamics: Limitations of First Law, Thermal Reservoir Heat Source and Heat Sink, Heat Engine, Refrigerator and Heat Pump, Kelvin- Planck and Clausius Statements and Their Equivalence, Perpetual Motion Machine of Second Kind. Carnot Cycle, Carnot Heat Engine and Carnot Heat Pump, Carnot's Theorem and its Corollaries, Thermodynamic Temperature Scale, Numericals

UNIT III

Entropy: Clausius Inequality and Entropy, Principle of Entropy Increase, TemperatureEntropy Plot, Entropy Change in Different Processes, Introduction to Third Law of thermodynamics. Availability, Irreversibility and Equilibrium: High and Low Grade Energy, Availability and Unavailable Energy, Loss of Available Energy Due to Heat Transfer Through a Finite Temperature Difference, Availability of a Non-Flow or Closed System, Availability of a Steady Flow System, Helmholtz and Gibb's Functions, Effectiveness and Irreversibility. Numericals.

UNIT IV

Pure Substance: Pure Substance and its Properties, Phase and Phase Transformation, Vaporization, Evaporation and Boiling, Saturated and Superheat Steam, Solid – Liquid – Vapour Equilibrium, T-V, P-V and P-T Plots During Steam Formation, Properties of Dry, Wet and Superheated Steam, Property Changes During Steam Processes, Temperature – Entropy (T-S) and Enthalpy – Entropy (H-S) Diagrams, Throttling and Measurement of Dryness Fraction of Steam. Numericals.

Thermodynamic Relations: T-Ds Relations, Enthalpy and Internal Energy as a Function of Independent Variables, Specific Heat Capacity Relations, Clapeyron Equation, Maxwell Relations.

Text Books:

1. Engineering Thermodynamics – C P Arora, Tata McGraw Hill
2. Engineering Thermodynamics – P K Nag, Tata McGraw Hill

Reference Books:

1. Thermal Science and Engineering – D S Kumar, S K Kataria and Sons
2. Engineering Thermodynamics -Work and Heat transfer – G F C Rogers and Maghew Y. R. Longman

Note: *Examiner will set eight questions by selecting two from each unit. Students will be required to attempt five questions selecting at least one question from each unit.*

B. Tech. 3rd Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME-203N	**MECHANICS OF SOLIDS-I**	3	1	0	75	25	100	3
Purpose	The objective of this course is to make the students aware of Stress, Strain and deformation of solids with the applications to beams, shafts and column and struts. The course will help the students to build the fundamental concepts in order to solve engineering problems							
Course Outcomes (CO)								
CO-1	Apply fundamental principles of mechanics & principles of equilibrium to simple and practical problems of engineering, determine centroid and moment of inertia of a different geometrical shape and able to understand its importance. Explain the basic concepts of stress and strain and solve the problems							
CO-2	Determine and calculate the values of principal stresses. Express the concept of shear force and bending moment of beams. Construct shear force and bending moment diagram for beams.							
CO-3	Express the concept of torsion of circular shaft and able to solve the problems on torsion of circular shaft. Illustrate and the solve the problems on bending and shear stresses on beams							
CO-4	Solve the problems on column and strut and Derive the derivations and solve the problems on slope and deflection.							

UNIT-I

Introduction: Force, types of forces, Characteristics of a force, System of forces, Composition and resolution of forces, forces in equilibrium, principle and laws of equilibrium, Free body diagrams, Lami's Theorem, equations of equilibrium, Concept of center of gravity and centroid, centroid of various shapes: Triangle, circle, semicircle and trapezium, theorem of parallel and perpendicular axes, moment of inertia of simple geometrical figures, polar moment of inertia. Numerical Problems

Simple stresses &strains : Concept & types of Stresses and strains, Polson's ratio, stresses and strain in simple and compound bars under axial loading, stress strain diagrams, Hooks law, elastic constants & their relationships, temperature stress & strain in simple & compound bars under axial loading, Numerical problems.

UNIT-II

Principle stresses: Two dimensional systems, stress at a point on a plane, principal stresses and principal planes, Mohr's circle of stresses, Numerical.

UNIT-III

Torsion of circular Members: Derivation of equation of torsion, Solid and hollow circular shafts, tapered shaft, stepped shaft & composite circular shafts, Numerical problems.

Flexural and shear stresses – Theory of simple bending, Assumptions, derivation of equation of bending, neutral axis, determination of bending stresses, section modulus of rectangular & circular (solid & hollow), I,T, Angle, channel sections, composite beams, shear stresses in beams with derivation, shear stress distribution across various beam sections like rectangular, circular, triangular, I, T, angle sections. Combined bending and torsion, equivalent torque. Numerical problems.

UNIT-IV

Columns & Struts: Column under axial load, concept of instability and buckling, slenderness ratio, derivation of Euler's formula for crippling load for columns of different ends, concept of equivalent length, eccentric loading, Rankine formulae and other empirical relations, Numerical problems.

Slope &Deflection: Relationship between bending moment, slope & deflection, moment area method, method of integration, Macaulay's method, calculations for slope and deflection of (i) cantilevers and (ii) simply supported beams with or without overhang under concentrated load, Uniformly distributed loads or combination of concentrated and uniformly distributed loads, Numerical problems.

Text Books:

1. Strength of Materials – R.K. Rajput, Dhanpat Rai & Sons.
2. Strength of Materials – Sadhu Singh, Khanna Publications.
3. Strength of Materials – R.K. Bansal, Laxmi Publications.

Reference Books:

1. Strength of Materials – Popov, PHI, New Delhi.
2. Strength of Materials – Robert l. Mott, Pearson, New Delhi
3. Strength of Material – Schaums Outline Series – McGraw Hill
4. Strength of Material – Rider – ELBS

Note: *Examiner will set eight questions by selecting two from each unit. Students will be required to attempt five questions selecting at least one question from each unit.*

B. Tech. 3rd Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME-205N	**MACHINEDRAWING**	2	3	0	75	25	100	4
Purpose	To understand how different parts are assembled for an assembly.							
Course Outcomes (CO)								
CO-1	Student gets aware about surface finish of the finished surface and isometric projection.							
CO-2	Student gets aware about the free hand drawings of the different joints.							
CO-3	Student gets aware about how different parts are assembled for an assembly.							

UNIT-I

Introduction to BIS Specification SP: 46 – 1988 Code of engineering drawing –Limits, fits and Tolerance (Dimensional and Geometrical tolerance), Surface finish representation, Isometric projections from orthographic views.

UNIT-II

Dimensioning, Sectioning.
Coupling: protected unprotected flange coupling, flexible coupling, Crankshaft: overhung, disc of crank, Built up crank.
Cotter: sleeve and cotter, spigot and socket, Gib and cotter.
Knuckle joint, Connecting rod, Riveted Joint. Welded Joint

UNIT-III

Assembly drawing with sectioning, bill of materials,
Assemblies: Lathe Tail stock, machine vice, pedestal bearing, drill jig and milling jig.

Text Books:

1. Machine Drawing by N D Bhat and V M Panchal, Charotar Publishing House
2. A Text Book of Machine Drawing: P S Gill , Pub.: S K Kataria& Sons
3. A Text Book of Machine Drawing: Dr.R.KDhawan, Pub.: S.Chand

Reference Books:

1. A Text Book of Machine Drawing :Laxminarayana and Mathur, Pub. : M/s. Jain Brothers, New Delhi.
2. Machine drawing : N Sidheshwar, P Kannaieh V V S Sastry, Pub.: Tata Mc Graw –Hill Publishing Ltd.
3. Machine drawing : R B Gupta Satya Prakashan

Note: Some of the exercises may be done on AUTOCAD Software.

NOTE:

(1) In the semester examination, the examiner will set two questions from each unit. The students have to attempt three questions taking one from each unit.

(2) The questions from Unit I and Unit II will carry 15 marks each. Question from Unit III will carry 45 marks.

B. Tech. 3rd Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME-207N	**KINEMATIC OFMACHINES**	3	1	0	75	25	100	3
Purpose	To understand construction and working of various types of Mechanisms.							
Course Outcomes (CO)								
CO-1	To understand the basic components and layout of linkages in the assembly of a system / machine							
CO-2	To understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.							
CO-3	To understand the motion mechanisms with lower pairs and the mechanisms used in automobile.							
CO-4	To understand the motion resulting from a belt and chain drives systems and study cam mechanisms for specified output motions							

UNIT-I

Introduction to Mechanisms and Kinematics:
Introduction, Machines and Mechanisms, Kinematics, Mechanism Terminology, Kinematic Diagrams, Kinematic Inversion, **Mobility:** Gruebler's Equation, Actuators and Drivers, **Commonly Used Links and Joints:** Eccentric Crank, Pin-in-a-Slot Joint, Screw Joint,**Special Cases of the Mobility Equation:** Coincident Joints, Exceptions to the Gruebler's equation, Idle Degrees of Freedom, **The Four-Bar Mechanism:** Grashof 's Criterion , Double Crank, Crank-Rocker, Double Rocker, Change Point Mechanism, Triple Rocker, **Slider-Crank Mechanism, Special Purpose Mechanisms: S**traight-Line Mechanisms, Parallelogram Mechanisms, Quick-Return Mechanisms, Scotch Yoke Mechanism, **Problems**

UNIT-II

Velocity determination: Kennedy's Space and body centroids, Relative velocity methods, Instantaneous center method,
Acceleration determination: Four link Mechanism, Acceleration of Intermediate and Offset points, Slider Crank Mechanism, Coriolis Acceleration components, Crank and slotted lever mechanism, Klein's and other constructions.
Kinematics Synthesis of Mechanisms: Number Synthesis, Frudenstein's equation, Chebyshev spacing of precisions points, Two and three position synthesis of four bar mechanisms and slider crank mechanisms, Overlay method, Bloch method and transmission angle.

UNIT-III

Mechanisms with Lower Pairs: Pantograph, straight-line motion mechanisms: accurate straight line motion mechanisms (Peaucellier, Hart and Scott Russell mechanism), approximate straight-line motion mechanisms (Grasshopper, Watt, Tchebicheff mechanism) Intermittent motion mechanisms, Parallel linkages, Engine pressure Indicators (Simplex Crosby, Thomson)
Automobile steering gear mechanisms: Fundamental equation for correct steering, Davis and Ackerman steering gear, Hooke's joint (universal coupling), Double hooke's joint, **Friction:** Types of friction, Laws of dry friction, Motion along inclined plane Screw threads, Wedge, screw jack, pivots and collars.

UNIT-IV

Cams and Followers: Introduction, Classification of Followers, Classification of Cams, Terms used in Radial cams, Motion of the Follower,

Displacement, Velocity and Acceleration Diagrams when (i) the Follower Moves with Uniform Velocity (ii) the Follower Moves with Simple Harmonic Motion. (iii) the follower Moves with Uniform Acceleration and Retardation, Cycloidal Motion, Construction of Cam Profiles, Cams with Specified Contours, Tangent Cam with Reciprocating Roller Follower, Circular Arc Cam with Flat-faced Follower.

Belt and Chain Drives: Open and crossed belt drives, velocity ratio, slip, material for belts, crowning of pulleys, lawof belting, types of pulleys, length of belts ratio of tensions, centrifugal tension, power transmitted by belts, initial tension, creep, chain drive, chain length, classification of chains

Suggested reading:

1. Theory of machines: S. S. Rattan, Tata McGraw Hill Publications
2. Theory of Machines and Mechanisms.:Uicker, J.J., Pennock G.R and Shigley, J.E.,3rd Edition, Oxford University Press, 2009.
3. Machines and mechanisms, Applied kinematic analysis by David h. Myszka, Prentice hall
4. Theory of Machines, V. P. Singh, Dhanpat Rai & Co. Pvt. Ltd., Delhi.
5. Mechanism synthesis and analysis: A.H. Soni, McGraw Hill Publications.
6. Mechanism: J.S. Beggs.
7. Mechanics of Machines: P.Black, Pergamon Press.
8. Theory of Machines: P.L.Ballaney, Khanna Publisher
9. "Theory of Machines:Thomas Bevan,", 3rd Edition, CBS Publishers and Distributors, 2005.

Note: *Examiner will set eight questions by selecting two from each unit. Students will be required to attempt five questions selecting at least one question from each unit.*

B. Tech. 3rd Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME-209N	**MATERIALSCIENCE**	4	0	0	75	25	100	3
Purpose	To understand internal structure and properties relationship of different types of materials.							
Course Outcomes (CO)								
CO-1	To understand the Crystal structures and deformation mechanism in various materials.							
CO-2	To study various types of phase diagrams, TTT curve and Iron carbon diagram. To learn about different heat treatment processes.							
CO-3	To learn about the structure properties and applications of Ceramics, composites, polymers and some of the advanced materials.							
CO-4	To study various types of characterization techniques and to learn about failure mechanisms like Creep and Fatigue.							

UNIT-I

Crystallography: Review of Crystal Structure, Space Lattice, Crystal Planes and Directions, Co-ordination Number, Number of Atoms per Unit Cell, Atomic Packing Factor; Numerical Problems Related to Crystallography.

Imperfection in Metal Crystals: Crystal Imperfections and their Classifications, Point Defects, Line Defects, Edge & Screw Dislocations, Surface Defects, Volume Defects, Effects of Imperfections on Metal Properties.

Deformation of Metal: Elastic and Plastic Deformation, Mechanism of Plastic Deformation, Twinning, Conventional and True Stress Strain Curves for Polycrystalline Materials, Yield Point Phenomena, Strain Ageing, Work Hardening, Bauschinger Effect, Recovery, ReCrystallization and Grain Growth.

UNIT-II

Phase Diagrams: Alloy Systems, Solid solutions, Hume Rothery's Rules, Phase Diagrams, Gibbs Phase Rule, TTT curve, The Lever Rule, binary phase diagrams, intermediate phases, intermetallic compounds, Applications of Phase Diagrams, Phase Transformation, Micro constituents of Fe-C system, Allotropic Forms of Iron, iron-iron carbide phase diagram, Modified Iron Carbon Phase Diagrams,

Heat treatment: Heat treatment of steels, Annealing, Normalising, Hardening, Tempering, Case Hardening, Surface Hardening, Ageing, Austempering and Martempering, Mass Effect, Equipment for Heat Treatment, Major Defects in Metals or Alloys due to faulty Heat treatment, recovery, recrystallization and grain growth. Microstructure, properties and applications of ferrous and non-ferrous alloys.

UNIT-III

Ceramics, Polymers and Composites:

Ceramics:

Structure, properties, processing and applications of traditional and advanced ceramics.

Polymers:
Classification, polymerization, structure and properties, additives for polymer products, processing and applications.
Composites: Properties and applications of various composites.
Advanced Materials:
Smart materials exhibiting ferroelectric, piezoelectric, opto-electric, semiconducting behaviour, Aerogels, photoconductivity and superconductivity, nanomaterials, biomaterials, super alloys, shape memory alloys, Liquid crystals, Carbon Nanotubes, Graphene and Fullerenes.

UNIT-IV

Materials Characterization Techniques:
Characterization techniques such as, scanning electron microscopy, transmission electron microscopy, atomic force microscopy, scanning tunnelling microscopy, atomic absorption spectroscopy, differential scanning calorimetry.
Failure of Materials:
Fatigue: Fatigue fracture, fatigue failure, Mechanism of Fatigue Failure, Design for Fatigue, Fatigue Life calculations, Fatigue Tests, Rotating Beam Fatigue Test, Wohler Fatigue Test, Theories of Fatigue, Corrosion Fatigue,
Creep: Creep Curve, Creep Curve equations, Types of Creep, Factors affecting Creep, Mechanism of Creep, Creep Resistant Material, Creep Fracture, Creep Test, Stress Rupture test,
Text Books:

1. Material Science by S.L. Kakani, New Age Publishers.
2. The Science and Engineering of Materials, Donald R. Askeland , Chapman & Hall.
3. Fundamentals of Material Science and Engineeringby W. D. Callister, Wiley.
4. Fundamental of Light Microscopy and Electronic Imaging by Douglas B. Murphy, Kindle Edition 2001
5. Materials Science and Engineering, V. Raghvan
6. Phase Transformation in Metals and Alloys, D. A. Porter & K. E. Easterling
7. Material Science by Narula, TMH
8. Physical Methods for Metal Characterization, PejFlewitt, Institute of Physics Pub.
9. Robert Cahn Concise Encyclopedia of Materials Characterization, Second Edition: 2nd Edition (Advances inMaterials Science and Engineering) Elsevier Publication 2005.

Note: *Examiner will set eight questions by selecting two from each unit. Students will be required to attempt five questions selecting at least one question from each unit.*

B. Tech. 3rd Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Sessional**	**Practical**	**Total**	
ME-211N	**KINEMATIC OFMACHINES LAB**	0	0	2	40	60	100	3
Purpose	To make students understand various kinds of mechanisms working around in industries and routine life.							
Course Outcomes (CO)								
CO-1	To learn about various types of basic mechanisms & their applications.							
CO-2	To learn about complex mechanisms practically used in machines.							
CO-3	To learn about steering mechanism used in automobiles							
CO-4	To learn about the working of various joints like Hooke's joint.							

List of experiments

1. To Study of the inversions of the single slider crank mechanism.
2. To verify the law of moment using Bell- crank lever.
3. To determine velocity & acceleration of slider in slider-crank mechanism and plot the following:
   a. θ v/s x (displacement of slider)
   b. θ v/s velocity and
   c. θ v/s acceleration.

   Compare the values of velocities & acceleration with those obtained theoretically.(Assume ω=I rad/sec.)**.**
4. To determine experimentally the ratio of the cutting time to idle time (cutting stroke to idle stroke) of the crank and slotted lever (QRM)/ Whitworth and compare the result to theoretical values plot the following
   a. θ v/s X (displacement of slider).
   b. θ v/s velocity.
   c. θ v/s Acceleration and to compare the values of velocities

   (Take angles θ =45˚, 90˚, 135˚, 225˚, 270˚ &335˚, ω = 1 rad/s)
5. To determine the displacement, velocities, & accelerations of the driven shaft of a Hooke's joint for a constant speed of the driver shaft.
6. To study various types of steering mechanisms.
7. To determine the value of coefficient of friction between the screw and nut of the jack, while:
   a. Raising the load
   b. Lowering the load
8. To draw experimentally a curve of the follower-displacement v/s cam-angle. Differentiate the above curve to get velocity and acceleration plot and compare the values with those obtained analytically
9. To determine the coefficient of friction between belt and pulley and plot a graph between $\log_{10} T_1/T_2$ v/s, θ.
10. To determine the value of coefficient of friction for a given pair of surfaces using friction apparatus.
11. To find out experimentally the coriolis component of acceleration and compare with theoretical values.

Note: Any 8 experiments from the above list and other 2 from others (developed by institute) are required to be performed by students in the laboratory.

B. Tech. 3rd Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Sessional**	**Practical**	**Total**	
ME-213N	**MATERIALSCIENCE LAB**	0	0	2	40	60	100	3
Purpose	To make the students aware of material structure and properties of material using different experiments.							
Course Outcomes (CO)								
CO-1	Ability to design and conduct experiments, acquire data, analyze and interpret data							
CO-2	Ability to determine the grain size and strain hardening phenomenon in different metals by means of experiments.							
CO-3	Ability to learn about stress concentration factor and microstructures of different materials.							
CO-4	To learn about heat treatment processes through experiments.							
CO-5	Ability to perform Fatigue and creep test on different materials.							

List of Experiments:

1. To study crystal structures with the help of models.
2. To study crystal imperfections with the help of models.
3. Determination of grain size for a given specimen
4. To determine the stress concentration factor at a geometrical discontinuity
5. 5.To observe and learn about the strain hardening effect in metals.
6. Comparative study of microstructures of different specimens of different materials (Mild steel, Gray C.I., Brass, Copper, Aluminium etc.)
7. To prepare a small specimen and mount it using hot mounting press.
8. To harden and temper a given steel specimen.
9. To anneal a given hardened steel specimen.
10. To analyse microstructure of quench hardened steel specimen.
11. To perform Fatigue test on fatigue testing machine.
12. To perform Creep test on creep testing machine.

Note: Any 8 experiments from the above list and other 2 from others (developed by institute) are required to be performed by students in the laboratory.

B. Tech. 3rd Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Sessional**	**Practical**	**Total**	
ME-215N	**MECHANICSOF SOLIDS LAB**	0	0	2	40	60	100	3
Purpose	To make the students aware of different properties of material using different experiments.							
Course Outcomes (CO)								
CO-1	Ability to design and conduct experiments, acquire data, analyze and interpret data							
CO-2	Ability to determine the behavior of ferrous metals subjected to normal and shear stresses by means of experiments							
CO-3	Ability to determine the behavior of structural elements, such as bars subjected to tension, compression, shear, bending, and torsion by means of experiments.							
CO-4	Physical insight into the behavior materials and structural elements, including distribution of stresses and strains, deformations and failure modes.							
CO-5	Write individual and group reports: present objectives, describe test procedures and results, synthesize and discuss the test results.							

List of Experiments:

1. To study the Brinell hardness testing machine & perform the Brinell hardness test.
2. To study the Rockwell hardness testing machine & perform the Rockwell hardness test.
3. To study the Vickers hardness testing machine & perform the Vickers hardness test.
4. To study the Erichson sheet metal testing machine & perform the Erichson sheet metal test.
5. To study the Impact testing machine and perform the Impact tests (Izod & Charpy).
6. To study the Universal testing machine and perform the tensile, compression & bending tests.
7. To perform the shear test on UTM.
8. To study the torsion testing machine and perform the torsion test.
9. To draw shear Force, Bending Moment Diagrams for a simply Supported Beam under Point and Distributed Loads.
10. To prepare the composite specimen using hot compression molding machine and test on UTM.
11. To view and measure the principal stress components and directions of principal stresses by the photo elastic method using 12" Diffused Light Research Polariscope.

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Note: Any 8 experiments from the above list and other 2 from others (developed by institute) are required to be performed by students in the laboratory.

B. Tech. 3rd Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
MPC-201N	**ENVIRONMENTALSTUDIES**	3	0	0	75	25	100	3
Purpose	To learn the multidisciplinary nature, scope and importance of Environmental Studies							
Course Outcomes (CO)								
CO-1	Basic concepts of Various kinds of Microscopy and Centrifugation Techniques							
CO-2	To learn the theoretical and practical aspects of Electrophoresis and Chromatography Techniques							
CO-3	To learn the concepts of different kinds of Spectroscopy and Colourimetry							
CO-4	To understand the concept of radioisotope techniques and their applications in research							

UNIT 1

The multidisciplinary nature of environmental studies. Definition, Scope and Importance. Need for public awareness. Natural Resources: Renewable and Non-Renewable Resources: Natural resources and associated problems.

(a) Forest Resources: Use and over-exploitation, deforestation, case studies. Timber eztraction, mining, dams and their effects on forests and tribal people.
(b) Water Resources- Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
(c) Mineral Resources- Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
(d) Food Resources- World Food Problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
(e) Energy Resources- Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies.
(f) 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 lifestyle.

UNIT II

Ecosystem-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-

a. Forest Ecosystem
b. Grassland Ecosystem
c. Desert Ecosystem
d. Aquatic Ecosystems(ponds, streams, lakes, rivers, oceans, estuaries

Field Work:Visit to a local area to document Environment ssetsriver/forest/grassland/hill/mountain.Visit to a local polluted site- Urban/Rural Industrial / Agricultural. Study of common plants, insects and birds. Study of simple ecosystems-pond, river, hill, slopes etc. (Field work equal to 5 lecture hours).

UNIT III

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

Environmental Pollution Definition. Cause, effects and control measures of- (a) Air Pollution (b) Water Pollution (c) Soil Pollution (d) Marine Pollution (e) Noise Pollution (f) Thermal Pollution (g) Nuclear Hazards

Solid waste management- cause, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies. Disaster management:floods, earthquake, cyclone and landslides

UNIT IV

Social Issues and the Environment.From unsustainable to sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people: Its problems and concerns. Case Studies.Environmental ethics-issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies.Wasteland ReclamationConsumerism 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. Public Awareness. Human population and the Environment.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.

Text Books

1. Environmental Studies- Deswal and Deswal. Dhanpat Rai & Co.
2. Environmental Science & Engineering Anandan, P. and Kumaravelan, R. 2009. Scitech Publications (India) Pvt. Ltd., India
3. Environmental Studies. Daniels Ranjit R. J. and Krishnaswamy. 2013. Wiley India.
4. Environmental Science-Botkin and Keller. 2012. Wiley, India

Note: ***Examiner will set eight questions by selecting two from each unit. Students will be required to attempt five questions selecting at least one question from each unit.***

B. Tech. 4th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME-202N	**Production Technology-I**	4	0	0	75	25	100	3
Purpose	To make student aware about various metal cutting tools, mechanism involved and machines used for metal cutting.							
Course Outcomes (CO)								
CO-1	Learn about tool geometry and nomenclature, chip classification, metal cutting theories, tool life, geometry, surface finish etc.							
CO-2	Learn about cutting fluids and tool life, economics of metal machining.							
CO-3	Learn about milling and drilling machines.							
CO-4	Learn about specifications of various machine tools, metrology, surface finish and its measurements.							

UNIT-I

Geometry of Cutting Tools:

Introduction, Geometry of single point turning tools: Cutting edges, Rake and Clearance angles, Systems of description of tool geometry, Designation of tool geometry in Machine reference system, ORS system and NRS system

Geometry of Multi point cutting tools: Geometry of Milling cutters, Geometry of Drills **Mechanics of Metal cutting:**

Cutting Tool Materials**,** Chip formation, Types of Chips, Chip control and chip breakers, orthogonal and oblique metal cutting, Chip thickness ratio, Velocity relationship in orthogonal cutting, Merchant's Analysis, Stress and Strain on the chip, Forces on single point cutting tool, Torque, heat produced, power and MRR equations, Use of Merchant's circle diagram in force analysis in orthogonal cutting for single point cutting tool.

Popular theories on mechanics of metal cutting: Earnst Merchant Theory, Merchant theory, Stabler Theory, Lee and Shaffer's Theory. Factors affecting temperature in metal cutting,

UNIT-II

Cutting Fluids and Tool life:

Cutting fluids, Purpose, Properties, Types of lubricants, Types of cutting fluids, Tool Failure, Mechanisms of Tool wear, Tool Life, Factors affecting tool life. Taylor's Tool life equation

Economics of metal machining:

Cost Considerations in Manufacturing, Elements of Machining cost, Minimum cost per piece, Maximum Production rate, Optimum cutting speed and optimum tool life for minimum cost of production and maximum production rate, Machinability, Machinability Index, Improving Machinability, Measurement of cutting forces, Tool force Dynamometers, Numerical on Mechanics of Metal cutting and economics.

UNIT-III

Milling Process:

Milling Machine Operations performed on Milling machine, Parts of Milling Machine, Types of Milling machines, fundamentals of Milling process, Milling Cutters, Elements of Plain Milling cutter, Cutter Holing devices, Cutting speed , Feed and depth of cut, Force system in Milling, Dividing head or Indexing Head, Methods of Indexing

Drilling Machine:
Types of Drills, Drilling machine Types, Drilling machine operations, Size of Drilling machine, Main parts of drilling machine, Force system in Drilling, Cutting speed, Feed and Depth of cut in drilling, MRR in drilling, Numerical Problems on Drilling.

UNIT-IV

Specification of Machine Tools:
Introduction, purpose of machine tool specifications, Methods of specification of conventional machine tools: specification of lathes, specification of drilling and boring machines, specification of shaper, planer and slotter machines, specification of milling machine, specification of gear teeth generating machines, specification of grinding machines.

Metrology
Measurements, Linear Measurement, Callipers, Vernier Calliper, Micrometer, Angular Measurement, Comparators-mechanical, electrical and optical,sine bar, auto-collimator, Surface finish and its measurement, Surface Roughness Measurement methods, Factors affecting surface finish in machining, micro and macro deviation, specifying surface finish.

Suggested reading:

1. Machining and Machine Tools by A.B. Chattopadhyay, Wiley India.
2. Manufacturing Processes by J.P. Kaushish, PHI
3. Metrology & Measurement By Bewoor, McGraw Hill.
4. A Textbook of Production Technology by P.C.Sharma, S.Chand pub.
5. Workshop Technology: B.S.Raghuwanshi, DhanpatRai Publications.
6. Production Technology: R.K.Jain, Khanna Publishers.
7. Machine Tools: R.Kesavan & B.Vijaya Ramnath, Laxmi Publications.
8. Machining and Machine Tools: A.B.Chattopadhyay, WILEY INDIA.

Note: *Examiner will set eight questions by selecting two from each unit. Students will be required to attempt five questions selecting at least one question from each unit.*

B. Tech. 4th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME-204N	**STEAMGENERATION & POWER**	3	1	0	75	25	100	3
Purpose	To make student learn about basics of Thermal engineering, steam generation and applications.							
Course Outcomes (CO)								
CO-1	Learn about boilers, types of boilers and accessories and mounting used on boilers.							
CO-2	Learn about simple and modified Rankine cycle and working of steam engine.							
CO-3	Learn about design and analysis of steam flow through steam nozzles. To learn about the working of different types of condensers.							
CO-4	Learn about working of Steam turbines and about design and analysis of the steam turbine.							

UNIT I

Introduction; classification of boilers; comparison of fire tube and water tube boiler; their advantages; description of boiler; Lancashire; locomotive; Babcock; Wilcox etc.; boiler mountings; stop valve; safety valve; blow off valve; feed check etc.; water level indicator; fusible plug; pressure gauge; boiler accessories; feed pump; feed water heater; preheater; superheater; economizer; natural draught chimney design; artificial draught; stream jet draught; mechanical draught; calculation of boiler efficiency and equivalent evaporation(no numerical problem)

UNIT II

Carnot cycle; simple and modified Rankine cycle; effect of operating parameters on rankine cycle performance; effect of superheating; effect of maximum pressure; effect of exhaust pressure; reheating and regenerative Rankine cycle; types of feed water heater; reheat factor; binary vapour cycle. Simple steam engine, compound engine; function of various components.

UNIT III

Function of steam nozzle; shape of nozzle for subsonics and supersonics flow of stream; variation of velocity; area of specific volume; steady state energy equation; continuity equation; nozzle efficiency; critical pressure ratio for maximum discharge; physical explanation of critical pressure; super saturated flow of steam; design of steam nozzle. Advantage of steam condensation; component of steam condensing plant; types of condensers; air leakage in condensers; Dalton's law of partial pressure; vacuum efficiency; calculation of cooling water requirement; air expansion pump.

UNIT IV

Introduction; classification of steam turbine; impulse turbine; working principal; compounding of impulse turbine; velocity diagram; calculation of power output and efficiency; maximum efficiency of a single stage impulse turbine; design of impulse turbine blade section; impulse reaction turbine; working principle; degree of reaction; parsons turbine; velocity diagram; calculation of power output; efficiency of blade height; condition of maximum efficiency; internal losses in steam turbine; governing of steam turbine.

Text Books :

1. Thermal Engineering – P L Ballaney, Khanna Publishers
2. Thermodynamics and Heat Engines vol II – R Yadav, Central Publishing House

Reference Books :

1. Applied Thermodynamics for Engineering Technologists – T D Eastop and A. McConkey, Pearson Education
2. Heat Engineering – V P Vasandani and D S Kumar, Metropolitan Book Co Pvt Ltd.

Note: *Examiner will set eight questions by selecting two from each unit. Students will be required to attempt five questions selecting at least one question from each unit.*

B. Tech. 4th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME-206N	**MECHANICS OFSOLIDS-II**	3	1	0	75	25	100	3

Purpose	The objective of this course is to show the development of strain energy and stresses in springs, pressure vessel, rings, links, curved bars under different loads. The course will help the students to build the fundamental concepts in order to solve engineering problems

Course Outcomes (CO)	
CO-1	Identify the basics concepts of strain energy and various theories of failures and solve the problems
CO-2	Differentiate different types of stresses induced in thin pressure vessel and solve the problems. Use of Lame's equation to calculate the stresses induced in thick pressure vessel.
CO-3	Able to compute stresses in ring, disk and cylinder due to rotation. Classify the different types of spring and analyze the stresses produced due to loading
CO-4	Determine the stresses in crane hook, rings, chain link for different cross section and also the deflection of curved bars and rings. Analyze the stresses due to unsymmetrical bending and determine the position of shear centre of different section.

UNIT-I

Strain Energy & Impact Loading: Definitions, expressions for strain energy stored in a bodywhen load is applied (i) gradually, (ii) suddenly and (iii) with impact, strain energy of beamsin bending, beam deflections, strain energy of shafts in twisting, energy methods in determining spring deflection, Castigliano's theorem, Numerical.

Theories of Elastic Failure: Various theories of elastic failures with derivations and graphicalrepresentations, applications to problems of 2- dimensional stress system with (i) Combined direct loading and bending, and (ii) combined torsional and direct loading, Numericals.

UNIT-II

Thin Walled Vessels: Hoop & Longitudinal stresses & strains in cylindrical &spherical vessels & their derivations under internal pressure, wire would cylinders, Numericals.

Thick Cylinders & Spheres: Derivation of Lame's equations, radial & hoop stresses andstrains in thick, and compound cylinders and spherical shells subjected to internal fluid pressure only, hub shrunk on solid shaft, Numericals.

UNIT-III

Rotating Rims & Discs: Stresses in uniform rotating rings & discs, rotating discs of uniform strength, stresses in (I) rotating rims, neglecting the effect of spokes, (ii) rotating cylinders, hollow cylinders & solids cylinders. Numericals.

Springs: Stresses in closed coiled helical springs, Stresses in open coiled helical spring subjected to axial loads and twisting couples, leaf springs, flat spiral springs, concentric springs, Numericals.

UNIT-IV

Bending of Curved Bars : Stresses in bars of initial large radius of curvature, bars of initialsmall radius of curvature, stresses in crane hooks, rings of circular & trapezoidal sections,deflection of curved bars & rings, deflection of rings by Castigliano's theorem, stresses in simple chain link, deflection of simple chain links, Problems.

Unsymmetrical Bending: Introduction to unsymmetrical bending, stresses due to unsymmetrical bending, deflection of beam due to unsymmetrical bending, shear center for angle, channel, and I-sections, Numericals.

Text Books:

1. Strength of Materials – R.K. Rajput, Dhanpat Rai & Sons.
2. Strength of Materials – Sadhu Singh, Khanna Publications.
3. Strength of Materials – R.K. Bansal, Laxmi Publications.

Reference Books:

1. Strength of Materials – Popov, PHI, New Delhi.
2.Strength of Materials – Robert l. Mott, Pearson, New Delhi
3. Strength of Material – Shaums Outline Series – McGraw Hill
4. Strength of Material – Rider – ELBS

Note: *Examiner will set eight questions by selecting two from each unit. Students will be required to attempt five questions selecting at least one question from each unit.*

B. Tech. 4th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME-208N	**FLUID MECHANICS**	4	1	0	75	25	100	3
Purpose	To familiarize the students with the basic concepts of Fluid Mechanics.							
Course Outcomes (CO)								
CO-1	Understand the basic concepts of fluid and learn about fluid statics.							
CO-2	Understand the basic concepts of fluid kinematics and analyse the laws of fluid dynamics and its applications.							
CO-3	Determine the major and minor losses through pipes and learn to draw the hydraulic gradient and total energy lines.							
CO-4	Understand the concept of boundary layer and flow over bodies.							

UNIT I

Fluid Properties: Concept of fluid and flow, ideal and real fluids, continuum concept, Properties of fluid: mass density, weight density, specific volume, specific gravity, viscosity, causes of viscosity, surface tension, capillarity, vapour pressure, compressibility and bulk modulus, Newtonian and non-Newtonian fluids.

Fluid Statics: Pressure, Pascal's law, hydrostatic law, pressure measurement, manometers, hydrostatic forces on submerged plane and curved surfaces, buoyancy, stability of floating and submerged bodies, liquids in relative equilibrium. Problems.

UNIT II

Fluid Kinematics: Eulerian and Lagrangian description of fluid flow; types of fluid flows, stream, streak and path lines; acceleration of a fluid particle, flow rate and continuity equation, differential equation of continuity in cartesian and polar coordinates, rotation and vorticity, circulation, stream and potential functions, flow net. Problems.

Fluid Dynamics: Concept of system and control volume, Euler's equation, Bernoulli's equation and its practical applications, venturimeter, orificemeter, orifices, mouthpieces, Impulse momentum equation, kinetic energy and momentum correction factors. Problems. **Unit III**

Viscous Flow: Flow regimes and Reynold's number, Navier-Stokes equation, relationship between shear stress and pressure gradient, flow of viscous fluids in circular pipe and between stationary and moving parallel plates, hydrodynamic lubrication, movement of piston in a dashpot, power absorbed in bearings. Problems.

Turbulent Flow Through Pipes: Transition from laminar to turbulent flow, Reynold's equation of turbulence, Shear stress in turbulent flow, Prandtl mixing length hypothesis, Major and minor losses in pipes, hydraulic gradient and total energy lines, series and parallel connection of pipes, branched pipes; equivalent pipe, power transmission through pipes, hydraulically smooth and rough pipes, velocity distribution in pipes, friction coefficients for smooth and rough pipes. Problems.

UNIT IV

Boundary Layer Flow: Boundary layer concept, displacement, momentum and energy thickness, Blasius solution, von-Karman momentum integral equation, laminar and turbulent boundary layer flows, separation of boundary layer and its control.

Flow over Bodies: Drag and lift, friction and pressure drag, lift and drag coefficients, stream lined and bluff bodies, drag on a flat plate, drag on a cylinder and an airfoil, circulation and lift on a circular cylinder and an airfoil. Problems.

Reference and Text Books:

1. Introduction to Fluid Mechanics – R.W. Fox, Alan T. McDonald, P.J. Pritchard, Wiley Publications.
2. Fluid Mechanics – Frank M. White, McGraw Hill
3. Fluid Mechanics and Fluid Power Engineering – D.S. Kumar, S.K. Kataria and Sons
4. Fluid Mechanics – Streeter V L and Wylie E B, Mc Graw Hill
5. Introduction to Fluid Mechanics and Fluid Machines – S.K. Som and G. Biswas, Tata McGraw Hill.
6. Mechanics of Fluids – I H Shames, Mc Graw Hill
7. Fluid Mechanics: Fundamnetals and Applications -YunusCengel and John Cimbala, McGraw Hill.
8. Fluid Mechanics: Pijush K. Kundu, Ira M. Cohen and David R. Rowling, Academic Press.

Note: *Examiner will set eight questions by selecting two from each unit. Students will be required to attempt five questions selecting at least one question from each unit.*

B. Tech. 4th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME-210N	**DYNAMICS OFMACHINES**	4	0	0	75	25	100	3
Purpose	To familiarize the students with the effect of dynamic forces in various machines and vehicles.							
Course Outcomes (CO)								
CO-1	To study the effect of static and dynamic forces on the components of mechanisms							
CO-2	To study the design and working of various gears and gear trains.							
CO-3	To study the various types of brakes and dynamometers.							
CO-4	To study the unbalanced forces and vibrations in various components of rotating and reciprocating machines.							
CO-5	To study the gyroscopic effect in aeroplanes, ships, two and four wheelers.							

UNIT I

Static force analysis: Static equilibrium, Equilibrium of two and three force members,Members with two forces and a torque, Equilibrium of four force members, free body diagram, Principle of Superposition, static forces Analysis of four barmechanisms and slider crank mechanism,

Dynamic Force Analysis: D'Alembert's principle, Equivalent offset inertia force, Dynamic force analysis of four bar mechanism and slider crank mechanismEngine force analysis, Turning moment on crank shaft,Dynamic Equivalent systems, Inertia of connecting rods, Inertia force in reciprocating engines(Graphical and Analytical methods), Turning moment diagrams, fluctuation of energy, Flywheels, Flywheel dimensions, Punching Press.

UNIT II

Gears: Classification of gears, Gear terminology, Fundamental law of gearing, Forms of Teeth, Cycloidal and involutes profiles of gear teeth, Interchangeable Gears, path of contact, arc of contact, number of pairs of teeth in contact (Contact Ratio), Interference in involute gears, minimum number of teeth, undercutting,

Helical, Spiral, Bevel and worm & worm gears, Terminology, Efficiency

Gear trains: Simple, compound, reverted, Planetary or epicyclic gear trains, Analysis of Epicyclic Gear trains, Torques in epicyclic gear trains, Sun and Planet gear, Automotive transmissions gear train. Differential.

UNIT III

Brakes: Types of brakes, Block and shoe brake, band brake, band and block brakes, internal expanding shoe brake, Effect of Braking.

Dynamometers: Types of Dynamometers, Pony and Rope Brake Dynamometer, Hydraulic Dynamometer, Belt Transmission Dynamometer, Epicyclic train Dynamometer, Bevis Gibson torsion dynamometer.

Governors: Types of Governors, Watt, Porter, Proell, Hartnell, Hartung, Wilson-Hartnell, Inertia Governors, Sensitiveness, Hunting, Isochronism, Stability of Governors, Effort and Power of a Governor, Controlling Force.

UNIT IV

Balancing of rotating masses: Static and Dynamic Balancing, Single Rotating mass, Many Masses rotating in same plane and in different planes. Analytical method for balancing of rotating masses.

Balancing of reciprocating masses: Reciprocating Engine, Partial Primary balance,
Balancing of Multi-cylinder in line engines, Balancing of Radial Engines, Balancing of VEngines, Balancing of Rotors

Gyroscope: Angular Velocity, Angular Acceleration, pitching and rolling, Gyroscopic couple and its effect on Aeroplanes,Naval ships, Stability of an automobile (2 & 4-wheeers), taking a turn, Gyroscopic effect in stone crusher.

Suggested reading:

1. Theory of machines: S. S. Rattan, Tata McGraw Hill Publications.
2. Theory of Machines: V. P. Singh, Dhanpat Rai & Co. Pvt. Ltd.
3. Theory of machines: Kinematics and Dynamics by Sadhu Singh, Pearson Publications
4. Theory of Machines and Mechanisms.:Uicker, J.J., Pennock G.R and Shigley, J.E.,3rd Edition, Oxford University Press, 2009.
5. Mechanism synthesis and analysis: A.H. Soni, McGraw Hill Publications.
6. Mechanism: J.S. Beggs.
7. Mechanics of Machines: P.Black, Pergamon Press.
8. Theory of Machines: P.L.Ballaney, Khanna Publisher.

Note: *Examiner will set eight questions by selecting two from each unit. Students will be required to attempt five questions selecting at least one question from each unit.*

B. Tech. 4th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Sessional**	**Practical**	**Total**	
ME-214N	**FLUIDMECHANICSLAB**	0	0	2	40	60	100	3
Purpose	To familiarize the students with the equipment and instrumentation of Fluid Mechanics.							
Course Outcomes (CO)								
CO-1	Operate fluid flow equipment and instrumentation.							
CO-2	Collect and analyse data using fluid mechanics principles and experimentation methods.							
CO-3	Determine the coefficient of discharge for various flow measurement devices.							
CO-4	Calculate flow characteristics such as Reynolds number, friction factor from laboratory measurements.							
CO-5	Identify and discuss foundation-level fluid phenomena including laminar to turbulent transition, turbulence etc.							
CO-6	Measure pressure loss due to friction for pipe flow.							

List of Experiments:

1. To determine the meta-centric height of a floating body.
2. To determine the hydrostatic force and center of pressure on both a submerged or partially submerged plane surface and compare with the theoretical result.
3. To demonstrate the working of different pressure measuring devices.
4. To measure the pressure and pressure difference by pressure gauge, single column manometer, U-Tube manometer & Inclined tube manometer.
5. To verify the Bernoulli's Theorem.
6. To determine coefficient of discharge of an orifice meter.
7. o determine the coefficient of discharge of venturimeter.
8. To determine the coefficient of discharge of Notch (V and Rectangular types).
9. To determine the coefficient of discharge, contraction & velocity of an orifice.
10. To find critical Reynolds number for a pipe flow.
11. To determine the friction factor for the pipes.
12. To determine the minor losses due to sudden enlargement, sudden contraction and bends.
13. To show the velocity and pressure variation with radius in a forced vertex flow.

Note: Any 8 experiments from the above list and other 2 from others (developed by institute) are required to be performed by students in the laboratory.

B. Tech. 4th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Sessional**	**Practical**	**Total**	
ME-216N	**DYNAMICS OFMACHINESLAB**	0	0	2	40	60	100	3
Purpose	To familiarize the students with the equipment and instrumentation of Fluid Mechanics.							
Course Outcomes (CO)								
CO-1	To learn about the working of Flywheel.							
CO-2	To experimentally calculate Gyroscopic couple of a motorised gyroscope							
CO-3	To learn about balancing of rotating mass.							
CO-4	To learn about the working of various types of governors.							
CO-5	To study various types of brakes used in automobiles.							

LIST OF EXPERIMENT

1. To determine experimentally, the moment of inertia of a flywheel and axle compare with theoretical values.
2. To find out critical speed experimentally and to compare the whirling speed of ashaft with theoretical values.
3. To find experimentally the Gyroscopic couple on motorized gyroscope andcompare with applied couple.
4. To perform the experiment of balancing of rotating parts and finds the unbalancedcouple and forces.
5. To determine experimentally the unbalance forces and couples of reciprocatingparts.
6. To calculate the torque on a planet carrier and torque on internal gear usingepicyclic gear train and holding torque apparatus.
7. To study the different types of centrifugal and inertia governors and demonstrateany one.
8. To study the automatic transmission unit.
9. To study the differential types of brakes.

Note: Any 8 experiments from the above list and other 2 from others (developed by institute) are required to be performed by students in the laboratory.

B. Tech. 4th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Sessional**	**Practical**	**Total**	
ME-218N	**STEAMGENERATION AND POWERLAB**	0	0	2	40	60	100	3
Purpose	To make the students aware of different boilers and steam turbines using different experiments.							
Course Outcomes (CO)								
CO-1	Students will be able to collect broad knowledge of about the different boilers.							
CO-2	Students will be able to understand the working of the steam engine.							
CO-3	Ability to determine the power and efficiency of the steam turbine and cooling tower							
CO-4	Able to describe quantitatively the heat balance sheet of the boiler.							

List of Experiments:

1. To study the Babcock-Wilcox boiler (Model).
2. To study thelocomotive boiler (Model).
3. To study the Lancashire boiler (Model).
4. To study the Nestler'sboiler.(Model)
5. To study various parts of the vertical steam engine.
6. To prepare heat balance sheet for given boiler.
7. To find dryness fraction of steam by separating and throttling calorimeter.
8. To find power output & efficiency of a steam turbine.
9. To study cooling tower and find its efficiency.
10. To study the various mountings and accessories of a boiler
11. To study and find volumetric efficiency of a reciprocating air compressor.
12. To find the efficiency of condenser.

Note: Any 8 experiments from the above list and other 2 from others (developed by institute) are required to be performed by students in the laboratory.

B. Tech. 4th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Sessional**	**Practical**	**Total**	
ME-220N	**PRODUCTION TECHNIOLOGYLAB**	0	0	3	40	60	100	3
Purpose	To make the students understand the different types of machines in production industries and welding machines.							
Course Outcomes (CO)								
CO-1	To practice on Milling machine							
CO-2	To make gears and study grinders.							
CO-3	To study the working CNC machines.							
CO-4	To carry welding out using TIG/MIG Welding machine.							

List of Experiments:

1. Practice of slab milling on milling machine.
2. Practice of slotting on milling machine.
3. To cut gear teeth on milling machine using dividing head.
4. Introduction to gear hobber, demonstration of gear hobbing and practice.
5. Introduction to various grinding wheels and demonstration on the surface grinder.
6. Introduction to tool and cutter grinder and dynamometer.
7. Study the constructional detail and working of CNC lathes Trainer.
8. To carry out welding using TIG/MIG welding set.
9. Introduction, demonstration & practice on profile projector & gauges.
10. To make a component on lathe machine using copy turning attachment.
11. To cut external threads on a lathe.
12. To cut multi slots on a shaper machine.
13. To perform drilling and boring operation on a Component.

Note: Any 8 experiments from the above list and other 2 from others (developed by institute) are required to be performed by students in the laboratory.

B. Tech. 4th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
MPC-202N	**ENERGY STUDIES**	3	0	0	75	25	100	3
Purpose	To make the students conversant with the basics concepts and conversion of various form of Energy							
	Course Outcomes (CO)							
CO-1	An overview about Energy , Energy Management, Audit and tariffs							
CO-2	Understand the Layout and working of Conventional Power Plants							
CO-3	Understand the Layout and working of Non-Conventional Power Plants							
CO-4	To understand the role of Energy in Economic development and Energy Scenario in India							

UNIT-I

Introduction: Types of energy, Conversion of various forms of energy, Conventional and Non-conventional sources, Need for Non-Conventional Energy based power generation.

Energy Management: General Principles of Energy Management, Energy Management Strategy.

Energy Audit: Need, Types, Methodology and Approach.

UNIT-II

Conventional Energy sources: Selection of site**,** working of Thermal, Hydro, Nuclear and Diesel power plants and their schematic diagrams & their comparative advantages- disadvantages.

UNIT-III

Non-Conventional Energy sources: Basicprinciple, site selection of Solar energy power plant, photovoltaic technologies, PV Systems and their components, Wind energy power plant, Bio energy plants,Geothermal energy plantsand tidal energy plants.MHD

UNIT-IV

Energy Scenario: Lay out of power system, Role of Energy in Economic development, energy demand, availability and consumption, Commercial and Non-commercial energy, Indian energyscenario, long term energy scenario, energy pricing, energy sector reforms in India, energy strategy for the future.

References:

1. Energy Studies-Wiley Dream tech India.
2. Non-conventional energy resources- Shobhnath Singh, Pearson.
3. Soni, Gupta, Bhatnagar: Electrical Power Systems – Dhanpat Rai& Sons
4. NEDCAP: Non Conventional Energy Guide Lines
5. G.D. Roy :Non conventional energy sources
6. B H Khan :Non Conventional energy resources - McGraw Hill
7. Meinel A B and Meinal M P,Addison: Applied Solar Energy- Wesley Publications.
8. George Sutton: Direct Energy Conversion –McGraw

Note: *Examiner will set eight questions by selecting two from each unit. Students will be required to attempt five questions selecting at least one question from each unit.*

B. Tech. 5th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME-301N	**I.C. ENGINE & GAS TURBINE**	3	1	0	75	25	100	3
Purpose	Detailed study of engines, compressors and gas turbines.							
Course Outcomes								
CO1	Introduction to basic parts of engine and basic cycles.							
CO2	Study of carburettor, injection system and to understand the combustion process.							
CO3	Lubrication system of engine and its performance parameters.							
CO4	To study the compressors and gas turbines.							

UNIT 1

Heat engines; Internal and external combustion engines; Classification of I.C. Engines; Cycle of operations in four strokes and two-stroke IC engines; Wankle Engine.

Air standard cycles: Assumptions made in air standard cycles; Otto cycle; Diesel cycle; Dual combustion cycle; Comparison of Otto, diesel and dual combustion cycles; Sterling and Ericsson cycles; Air standard efficiency, Specific work output. Specific weight; Work ratio; Mean effective pressure; Deviation of actual engine cycle from ideal cycle.

UNIT II

Mixture requirements for various operating conditions in S.I. Engines; Elementary carburetor, Calculation of fuel air ratio; The complete carburetor; Requirements of a diesel injection system; Type of injection system; Petrol injection; Requirements of ignition system; Types of ignition systems, ignition timing; Spark plugs.

S.I. engines; Ignition limits; Stages of combustion in S. I. Engines; Ignition lag; Velocity of flame propagation; Detonation; Effects of engine variables on detonation; Theories of detonation; Octane rating of fuels; Pre-ignition; S.I. engine combustion chambers. Stages of combustion in C.I. Engines; Delay period; Variables affecting delay period; Knock in C.I. Engines; Cetane rating; C.I. Engine combustion chambers.

UNIT III

Functions of a lubricating system, Types of lubrication system; Mist, Wet sump and dry sump systems; Properties of lubricating oil; SAE rating of lubricants; Engine performance and lubrication; Necessity of engine cooling; Disadvantages of overcooling; Cooling systems; Air-cooling, Water-cooling; Radiators.

Performance parameters; BHP, IHP, Mechanical efficiency; Brake mean effective pressure and indicative mean effective pressure, Torque, Volumetric efficiency; Specific fuel consumption (BSFG, ISFC); Thermal efficiency; Heat balance; Basic engine measurements; Fuel and air consumption, Brake power, Indicated power and friction power, Heat lost to coolant and exhaust gases; Performance curves; Pollutants from S.I. and C.I. Engines; Methods of emission control, Alternative fuels for I.C. Engines; The current scenario on the pollution front.

UNIT IV

Working of a single stage reciprocating air compressor; Calculation of work input; Volumetric efficiency; Isothermal efficiency; Advantages of multi stage compression; Two stage compressor

with inter-cooling; Perfect inter cooling; Optimum intercooler pressure; Rotary air compressors and their applications; Isentropic efficiency.
Brayton cycle; Components of a gas turbine plant; Open and closed types of gas turbine plants; Optimum pressure ratio; Improvements of the basic gas turbine cycle; Multi stage compression with inter-cooling; Multi stage expansion with reheating between stages; Exhaust gas heat exchanger; Application of gas turbines.

Text books:

1. Internal combustion engine by Ramalingam sci-tech publication
2. Internal combustion engine by Ganeshan TMG

Reference Books

1. Internal combustion engine by Mathur & Sharma
2. Heat power engineering by Dr. V.P. Vasandhani& Dr. D.S. Kumar

NOTE: In the semester examination, the examiner will set 8 questions in all, at least one question from each unit, and students will be required to attempt only 5 questions.

B. Tech. 5th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME-303N	**FLUID MACHINES**	3	1	0	75	25	100	3
Purpose	To make students aware of Momentum induced by Jets. Classification, Working & Design of Hydropower Plants, Turbines, Pumps and Hydraulic Machines.							
COURSE OUTCOMES								
CO1	Analysis of Momentum induced by Water Jets on stationary & moving; curved, flat & unsymmetrical single or multiple plates & vanes & on ships. Study of Dimensional Analysis Methods.							
CO2	Classification, Working, Design, Efficiencies, Characteristics & Model Testing of Hydraulic Turbines & study of Hydropower Plant & associated terms.							
CO3	Study of Classification, Working, Design, Efficiencies, Heads & Model Testing of Hydraulic Pumps.							
CO4	Study of various types of Hydraulic Machines.							

UNIT I

IMPULSE MOMENTUM BY WATER JETS: Impact of water jet: On Stationary &Moving Flat &Curved Plates, On Series of vanes Flat & Radial; Ship Propulsion by Jets; Numericals.

DIMENSIONAL ANALYSIS: Units and dimensions; Dimensional homogeneity; Dimensional analysis: Rayleigh Method & Buckingham's Pi-Theorem; Applications & limitations of dimensional analysis; Dimensionless numbers; Similitude laws; Numericals.

UNIT II:

HYDRAULIC TURBINES

INTRODUCTION: Classification of Hydraulic Machines; Hydropower plant& its Components; Surge tank and its type; Classification of turbines; Effective head, available power & Efficiencies.

PELTON TURBINE: Components; Work done & efficiency; Design: Number & Dimensions of Buckets, Speed ratio, Jet ratio, Run-away speed, jet velocity, mean wheel diameter, number of jets, maximum efficiency; Governing; Numericals.

FRANCIS TURBINE: Components; Work done & efficiency; Design: Runner, Width-Diameter ratio, Speed ratio, Flow ratio; Outward vs. Inward flow reaction turbines; Governing; Numericals.

AXIAL FLOW TURBINES: Propeller Turbine; Kaplan turbine; Components, Work done Power & Efficiency, Governing; Draft Tube: Efficiency &Types; Numericals.

DESIGN & OPERATIONAL PARAMETERS: Model testing of turbines; Specific Speed; Unit quantities; Performance Characteristic curves.

UNIT III:

HYDRAULIC PUMPS

CENTRIFUGAL PUMPS: Introduction; Components; Various Heads; Euler's head and its variation with vane shapes; Effect of finite number of vanes; Losses & efficiencies; Minimum starting speed; Limitation of suction lift; Net Positive Suction Head (NPSH); Priming; Cavitation and its effects, Cavitation parameters, Detection and Prevention of Cavitation; Multistage pumps; Specific speed and Performance; Numericals.

RECIPROCATING PUMPS: Introduction; Working principles; Classification; Components; Discharge Coefficient & slip; Work &Power input; Indicator diagram; Effect of Friction, Acceleration and Pipe friction; Maximum speed; Air vessels; Comparison with centrifugal pumps; Model testing of pumps; Numericals.

UNIT IV:

HYDRAULIC SYSTEMS

PUMPS: Propeller pump; Jet pump; Airlift pump; Gear pump; Screw pump; Vane pump; Radial piston pump; Submersible pump; Pump problems.

MACHINES: Hydraulic accumulators; Hydraulic intensifier; Hydraulic lift; Hydraulic crane; Hydraulic coupling; Torque converter; Hydraulic ram.

Text books:

1. Introduction to fluid mechanics and machinery by Som and Bishwas, TMH
2. A textbook of Fluid Mechanics & Hydraulic Machines by R. K. Bansal, Laxmi Publications

Reference Books:

1. Fluid mechanics and machinery by S. K. Aggarwal TMG
2. Fluid mechanics & fluid power engineering by D.S kumar, Katson publisher
3. Fluid mechanics and Hydraulic machine by S.S rattan, Khanna publisher

NOTE: In the semester examination, the examiner will set 8 questions in all, at least one question from each unit, and students will be required to attempt only 5 questions.

B. Tech. 5th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME-305N	**HEAT TRANSFER**	3	1	0	75	25	100	3
Purpose	To familiarize the students with the basic concepts of Heat Transfer.							
Course Outcomes								
CO1	Understand the basic modes of heat transfer and develop the general heat conduction equation.							
CO2	Analyse the one dimensional steady state heat conduction with and without heat generation.							
CO3	Determine the temperature distribution and effectiveness of extended surfaces.							
CO4	Differentiate between free and forced convection and discuss the dimensional analysis of free and forced convection.							
CO5	Understand the concept of hydrodynamic and thermal boundary layer and develop the related equations.							
CO6	Develop knowledge about the laws of thermal radiation and the concept of black body.							
CO7	Classify different types of heat exchangers and discuss LMTD and NTU approaches for the design of heat exchangers.							

UNIT I

Introduction: definition of heat, modes of heat transfer; basic laws of heat transfer, application of heat transfer, simple problems.

Conduction: Fourier equation, electrical analogy of heat conduction; thermal conductivity, the general conduction equation in cartesian, cylindrical and spherical coordinates, steady one dimensional heat conduction without internal heat generation: conduction through plane and composite wall, the cylindrical shell; the spherical shell; critical thickness of insulation; variable thermal conductivity, steady one dimensional heat conduction with uniform internal heat generation: the plane slab; cylindrical and spherical systems, unsteady heat conduction: lumped parameter analysis, introduction to Heisler charts.

UNIT II

Convection: Introduction: Newton's law of cooling, convective heat transfer coefficient, Nusselt number, convection boundary layers: Introduction of velocity and thermal boundary layers and its significance with respect to convection (without derivations of boundary layer equations), local and average convection coefficient, functional form of the solution of boundary layer equations, Physical significance of the dimensionless parameters, Reynolds analogy, ***External Forced Convection:*** Introduction to empirical method of solution, flow over a flat plate with both conditions of constant heat flux and constant temperature, cylinder in cross flow, flow over a sphere, ***Internal Forced Convection:*** Introduction to velocity profile, pressure gradient and friction factor in fully developed flow, mean temperature, energy balance considering constant surface heat flux and for constant surface temperature, convection correlations for laminar flow in circular tubes both in entry region and in the fully developed region, ***Natural convection:*** Physical considerations, governing equations (without derivations), functional form of the solution of governing equations, empirical correlations for external free convection flow over the vertical plate, horizontal and inclined plates, horizontal cylinder and sphere.

UNIT III

Radiation: fundamental concepts, absorption, reflection and transmission, black body concept, monochromatic and total emissive power, Planck's distribution law, Stefan Boltzman law, Wien's displacement law, Kirchoff's law, intensity of radiation, Lambert's cosine law, heat transfer between black surfaces, radiation shape factor, heat transfer between non-black surfaces: infinite parallel planes, infinite long concentric cylinders, small gray bodies and small body in large enclosure, electrical network approach, radiation shields.

UNIT IV

Extended Surfaces: governing equation for fins of uniform cross section, temperature distribution and heat dissipation rate in infinitely long fin, fin insulated at tip, fin losing heat at tip; efficiency and effectiveness of fins.

Heat Exchangers: classification of heat exchangers; overall heat transfer coefficient, logarithmic mean temperature difference, effectiveness of heat exchangers, NTU method of heat exchanger design, applications of heat exchangers.

Text books:

1. Fundamentals of Heat and Mass transfer – Frank P. Incropera, David P. Dewitt, T.L. Bergman and A.S. Lavine, Wiley Publications.
2. Heat Transfer: A Practical Approach - Yunus A Cengel, Tata McGraw Hill.
3. Heat Transfer – J.P. Holman, Tata McGraw Hill.

Reference Books:

1. A Text book of Heat Transfer - S.P Sukhatme, University press
2. Heat and Mass Transfer - D.S Kumar, S.K. Kataria& Sons
3. Heat and Mass Transfer – P.K. Nag, Tata McGraw Hill.
4. Heat Transfer – Y.V.C. Rao, University Press.
5. Heat Transfer – P.S.Ghoshdastidar, Oxford Press.

NOTE: In the semester examination, the examiner will set 8 questions in all, at least one question from each unit, and students will be required to attempt only 5 questions.

B. Tech. 5th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME 307N	**INDUSTRIAL ENGINEERING**	3	1	0	75	25	100	3
Purpose	To give the basic idea of industrial concept.							
Course Outcomes								
CO1	Introduction to different recording charts and technique.							
CO2	Understand the concept of industrial organization & ppc.							
CO3	Introduction, Objectives and importance of sales forecasting & inventory control.							
CO4	Introduction to wages, JIT, SCM, VE, TIME MANAGEMENT.							

UNIT I

Introduction to work study; Method study; Basic procedure, Recording techniques (Charts and diagrams); Elemental breakdown; Micro-motion studies; Therbligs; SIMO- chart principles of motion- economy. Introduction; Objectives; techniques (time) information recording; methods of things, Time study allowances; work sampling technique, Performances rat ing and its determinant ion technique, Performance rating and its determination PMTS; M.T.M., Work factor.

UNIT II

Principle of organization; Importance and characteristics of organization; Organization theories; Classical Organization theory; Neo-Classical organization theory, modern organization theory; Types of organization. Military or line organization, Functional organization, line and staff organization, Committee objectives of PPC; Functions of PPC Preplanning and planning; Routing; Estimating; scheduling; master schedule; Daily schedule; Gantt chart; Dispatching; centralized vs

UNIT III

Introduction, Objectives and importance of sales forecasting, Types of forecasting, Methods of sales forecasting, Collective opinion method, Delphi technique, economic indicator method; Regression analysis, introduction, Functions of inventory; Types of inventory; Control importance functions, Inventory costs, factors affecting inventory control, Various inventory controls models; A.B.C. analysis, lead-time calculations.

UNIT IV

Introduction, Objective; Concept and life cycle of a product and V.E.; Steps in V.E. Methodology and techniques, Fast diagram, Matrix method. Various concepts in industrial engineering.

a) WAGES AND INCENTIVES ; Concept ; Types, plans, Desirable characteristics.

b) SUPPLY CHAIN MANAGEMENT; Its Definition, Concept, Objectives, Applications, Benefits, some successful cases in Indian Industries.

c) JIT; Its definition, concept, importance, misconception, relevance, Applications, Elements of JIT (brief description)

d) TIME MANAGEMENT; Introduction, steps of time man agreement, Ways for saving time KEY for time saving.

REFERENCES AND TEXT BOOKS:

1. Industrial Engg. by M. Mahajan/lndustrial Engg. by Savita Sharma.
2. Production planning and control by S. Elion.

3. Modern Production Management by S.S. Buffa.
4. Industrial Engg. and Management manufacturing system by Surender Kumar, Satya Parkashan.
5. Essence of Supply Chain Management by R.P. Monaty and S.G. Deshmukh.
6. Industrial Engg., and management by S. Sharma and Savita Sharma.
7. Industrial Engineering and management by I P Singh, Neelam Publications..

NOTE: In the semester examination, the examiner will set 8 questions in all, at least one question from each unit, and students will be required to attempt only 5 questions.

B. Tech. 5th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME-309N	**MACHINE DESIGN-I**	2	4	0	75	25	100	3
Purpose	To understand the fundamentals for solving engineering problems relating to machine components.							
Course Outcomes								
CO1	To design the machine components for static and fluctuating loads.							
CO2	To solve the design problems of different types of joints i.e. riveted joint, welded joint, cotter and knuckle joints under different loading conditions.							
CO3	To solve the design problems of transmission shafts, keys and lever for different loading conditions							
CO4	To solve the design problems of different types of couplings, pipe joints and crane hook.							

UNIT-I

Introduction: Design concepts, overall design considerations, codes and standards, methodology for solving machine component problems. **Engineering materials:** properties, ferrous metals, non-ferrous metals, plastics and composite materials, BIS system of designation of steels, selection of engineering materials.

Design against static load: Modes of failure, factor of safety, stress concentration: causes and mitigation, **Design against fluctuating load:** Fluctuating stresses, endurance limit, low cycle and high cycle fatigue, notch sensitivity, endurance limit-approximate estimation, reversed stresses-design for finite and infinite life, cumulative damage in fatigue, Soderberg and Goodman Lines, Modified Goodman Diagrams.

UNIT-II

Threaded Joints: Basic types of screw fastening, Bolts of uniform strength, locking devices, terminology of screw threads, ISO metric screw threads, materials and manufacture, design of bolted joints, bolted joints with eccentric loads. **Cotter and Knuckle Joints:** design of cotter and knuckle joints.

Riveted and Welded Joints: Riveted joints for boiler shell according to I. B. R., riveted structural joint, eccentrically loaded riveted joint, types of welded joints, strength of welds under axial load, welds under eccentric loading.

UNIT-III

Transmission Shafts: Shaft design on strength basis and torsional rigidity basis, ASME code for shaft design, design of hollow shaft on strength basis and torsional rigidity basis.

Keys: Design of square and flat keys.

Levers: Hand and foot levers, cranked lever, lever for a lever safety valve, Bell crank lever. Miscellaneous levers.

UNIT-IV

Couplings: Types of shaft couplings, design of sleeve or muff coupling, clamp coupling, rigid flange couplings and bushed-pin flexible couplings.

Curved Beams: Design of crane hook. **Pipe Joints:** Design of circular, oval shaped and square flanged pipe joints.

Text books:

1. Mechanical Engineering Design, Joseph E. Shigley and Charles R. Mischke, Tata McGraw Hill Book Co.
2. Design of Machine Element,V. B. Bhandari, Mc Graw Hill Edu. Pvt. Ltd.
3. Machine Component Design, Robert C. Juvinall and Kurt M. Marshek, Wiley India Pvt. Ltd.
4. Mechanical Design of Machine Elements and Machines, Collins and Busby, Wiley India Pvt. Ltd.

References books:

1. Machine Design by Sharma and Aggarwal
2. Machine Design-an integrated Approach, Robert L. Norton, Addison Wisley Longman
3. PSG Design Data Book by PSG college of Engineering, PSG Publication.
4. Design Data Hand book for Mechanical Engineers by K. Mahadevan and K. Balaveera Reddy.

NOTE: In the semester examination, the examiner will set 8 questions in all, at least one question from each unit, and students will be required to attempt only 5 questions.

B. Tech. 5th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME-311N	**PRODUCTION TECHNOLOGY-II**	4	0	0	75	25	100	3
Purpose	To understand the kinematics design of machine tools and working of traditional and non-traditional production processes.							
Course Outcomes								
CO1	To learn about kinematics of machine tools which drives classification of spindle speed on lathe, design of gearbox and geared head stock.							
CO2	To understand about thread manufacturing, gear production, generation and various process on gears including gear finishing etc.							
CO3	To understand the UCM process and details about machine tool vibrations.							
CO4	To analyse jigs and fixtures.							

UNIT-I

Machine Tool Power Drives:

Power sources used in Machine tools, estimation of power requirement for machine tool Drives, hydraulic drives in machine tools, Role and general constituents of the Kinematics Structure of machine tools, different forms of machine tool kinematic structure, mechanism. Commonly used in machine tool kinematic systems, method of changing speed feed in machine Tools, need of large no of speeds and feed in machine tools, method of changing speed and feed in machine tools.

Design of speed gearbox of machine tool, procedural steps in design of SGB, Layout of spindle speed in machine tools, selection of gear layout and ray-diagram for speed gearbox, determination of dimensions of the gears and shafts of speed gear box.

UNIT-II

Thread Manufacturing:

Thread casting, thread chasing, thread rolling, die-threading and tapping, thread milling, thread grinding, thread measurement and inspection.

Gear Manufacturing and finishing:

Introduction, Classification of gear production method, Gear generation processes: gear hobbing, gear shaping, rack planning. Gear finishing methods: shaving, roll finishing, burnishing, grinding, lapping, honing.

UNIT-III

Unconventional Machining processes:

Introduction, Need for unconventional processes, Classification of unconventional machining processes, process selection, Abrasive jet machining (AJM), Water jet machining(WJM), Ultrasonic machining(USM), chemical machining (CHM), Electrochemical machining (ECM), Electric discharge machining (EDM), Wire cut EDM, laser beam machining(LBM), Electron beam machining (EBM); their process parameters, Principle of metal removal , applications, advantages and limitations.

Machine Tools vibration:

Introduction, effects of vibration on machine tools, source of vibration, types of machine tool vibrations: and self-excited vibration (chatter), causes of self-excited vibration, chatter prediction, avoidance of chatter and vibration on existing machine tools and on proposed machine tools, vibration control and isolation.

UNIT-IV

Jigs and fixtures:

Introduction to Jig and fixtures, locating and clamping, design principles common to jig and fixtures, types of jig and fixtures, indexing jig and fixtures, automated jigs and fixtures.

Fundamentals jig and fixture design, jig and fixture construction, materials for jig and fixtures, tolerance and error analysis, analysis of clamping forces.

Text books:

1. Machining and machine tools by A.B. Chattopadhyay, Wiley India.
2. Fundamentals of metal cutting and machine Tools by Juneja, New age.
3. A text book of production engineering: Dr. P.C.Sharma, S Chand Technical.

Reference Books:

1. Tool design by Donaldson, TMH.
2. Workshop Technology, vol.-II: B.S.Raghuwanshi, Dhanpat Rai publications.
3. Production Technology: R.K. JAIN, Khanna Publishers.
4. Machine Tools: Dr. R. Kesavan & B.Vijaya, Ramnath, Laxmi publications.

NOTE: In the semester examination, the examiner will set 8 questions in all, at least one question from each unit, and students will be required to attempt only 5 questions.

B. Tech. 5th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Sessional**	**Practical**	**Total**	
ME-313N	**I. C. Engine Lab**	0	0	2	40	60	100	3
Purpose	To understand the performance of C. I. and S. I. engines. Also to study cooling towers, boiler and detail parts of I C engines.							
COURSE OUTCOMES								
CO1	To understand the principle, construction and working of S.I. and C.I. engine.							
CO2	To calculate the performance parameters of reciprocating air compressor, petrol and diesel engine.							
CO3	To study lubrication, cooling systems of I C engine. Also to understand the braking system of automobile.							
CO4	To study boiler performance, fuel injection system of C I engine and brake ignition system of S I engine.							

LIST OF EXPERIMENTS

1. To make a trial on single cylinder 4-stroke Diesel Engine to calculate B. H. P., S.F.C. and to draw its characteristics curves.
2. To make a trial on 4-stroke high-speed diesel engine and to draw its Heat Balance Sheet.
3. To make a trial on Wiley's jeep Engine at constant speed to calculate B. H. P., S. F. C. Thermal efficiency and to draw its characteristic Curves.
4. To make Morse Test to calculate IHP of the multi cylinder petrol engine and to determine its mechanical efficiency.
5. To calculate the isothermal efficiency and volumetric efficiency of a 2 stage reciprocating air compressor.
6. To find out the efficiency of an air Blower.
7. To make a trial on the Boiler to calculate equivalent evaporation and efficiency of the boiler.
8. To study the following models;
   (a) Gas Turbine (b) Wankle Engine.
9. To study
   (a) Lubrication and cooling systems employed in various I. C. Engines in the Lab
   (b) Braking system of automobile in the lab
10. To study a Carburetor.
11. To study (I) the Fuel Injection System of a C. I. Engine. (II) Battery Ignition system of a S.I. Engine
12. To study Cooling Tower.
13. To study multi Cylinder four strokes vertical Diesel Engine test Rig With Hydraulic Dynamometer.

Note: Any 8 experiments from the above list and other 2 from others (developed by institute) are required to be performed by students in the laboratory.

B. Tech. 5th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Sessional**	**Practical**	**Total**	
ME-315N	**FLUID MACHINES LAB**	0	0	2	40	60	100	3
Purpose	To provide students with practical knowledge of working of Hydraulic Turbines, Pumps and Machines.							
COURSE OUTCOMES								
CO1	Students will gain knowledge of the practical working of various hydraulic turbines.							
CO2	Students will gain knowledge of the practical working of various hydraulic pumps.							
CO3	Students will gain knowledge of the practical working of various hydraulic machines.							

LIST OF EXPERIMENTS

1. To study and perform lest on the Pelton wheel and to plot curves Q, P Vs N at full, three fourth gate opening.
2. To study and perform test in the Francis Turbine and to plot curves Q, P Vs N at full, three-fourth gate opening.
3. To study and perform test on the Kaplan Turbine and to plot curves Q, P Vs N at full, three-fourth half opening.
4. To study and perform test on Centrifugal Pump and to plot curves η, Power Vs Q.
5. To study and perform test on a Hydraulic Ram and to find its Rankine, Aubussion η.
6. To study and perform test on a Reciprocating pump and to plot the P and η Vs H.
7. To study and perform test on a Gear Pump and to plot the curves Q.P Vs Pressure rise.
8. Study and perform test on a Torque Convertor and to plot the curves η & Np.
9. To study and perform test on Submersible Pump and to plot curves η, Power Vs Q.
10. To study and analyse experimentally the Impact of Jet on flat vanes.

Note: Any 8 experiments from the above list and other 2 from others (developed by institute) are required to be performed by students in the laboratory.

B. Tech. 5th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Sessional**	**Practical**	**Total**	
ME-317N	**HEAT TRANSFER LAB**	0	0	2	40	60	100	3
Purpose	To familiarize the students with the equipment and instrumentation of Heat Transfer.							
Course Outcomes								
CO1	Design and conduct experiments, acquire data, analyze and interpret data.							
CO2	Measure the thermal conductivity of metal rod, insulating material and liquids.							
CO3	Understand the concept of composite wall and determine its thermal resistance.							
CO4	Plot the temperature profile in free and forced convection.							
CO5	Measure the performance of a heat exchanger.							
CO6	Understand the concept of solar heating and measure the performance of solar equipment.							

LIST OF EXPERIMENTS:

1. To determine the thermal conductivity of a metal rod.
2. To determine the thermal conductivity of an insulating slab.
3. To determine the thermal conductivity of a liquid using Guard plate method.
4. To determine the thermal conductivity of an insulating powder.
5. To determine the thermal resistance of a composite wall.
6. To plot the temperature distribution of a pin fin in free-convection.
7. To plot the temperature distribution of a pin fin in forced-convection.
8. To study the forced convection heat transfer from a cylindrical surface.
9. To determine the electiveness of a concentric tube heat exchanger.
10. To determine the Stefan-Boltzman constant.
11. To determine the critical heat flux of a given wire.
12. To study the performance of glass in glass solar collector.
13. To study the performance of an evacuated tube based solar water heater.

Note: Any 8 experiments from the above list and other 2 from others (developed by institute) are required to be performed by students in the laboratory.

B. Tech. 5th Semester Mechanical Engineering							
ME-319N	**INDUSTRIAL TRAINING (VIVA-VOCE)**						
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessional**	**Practical**	**Total**	**Duration of exam. (Hrs.)**
2	**0**	**0**	**-**	**40**	**60**	**100**	**3**

Student will submit summer training (about 8 weeks industrial training) report and Viva-voce will be conducted for his/her assessment.

B. Tech. 6th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME-302N	**REFRIGERATION AND AIR-CONDITIONING**	3	1	0	75	25	100	3
Purpose	The objective of this course is to make the students aware of refrigeration, Air-conditioning, various methods of refrigeration. The course will help the students to build the fundamental concepts in order to solve engineering problems and to design HVAC applications.							
Course Outcomes								
CO 1	Understanding of different refrigeration processes like ice refrigeration, evaporative refrigeration, refrigeration by expansion of air, steam jet refrigeration systems etc.							
CO 2	Identify, formulate and solve air refrigeration, vapour refrigeration and vapour absorption refrigeration problems.							
CO 3	Identify and understand refrigerants and their uses as per their properties and environmental effects etc.							
CO 4	Knowledge of psychometric properties, psychometric chart and its use for different cooling and heating processes along with humidification and dehumidification.							
CO 5	Design of various air-conditioning systems by including the internal and external heat gain.							

(a) REFRIGERATION

UNIT I

Basics of heat pump & refrigerator; Carnot's refrigeration and heat pump; Units of refrigeration; COP of refrigerator and heat pump; Carnot's COP; ICE refrigeration; evaporative refrigeration; refrigeration by expansion of air; refrigeration by throttling of gas; Vapour refrigeration system; steam jet refrigeration; thermoelectric cooling; adiabatic demagnetization.

Basic principles of operation of air refrigeration system, Bell-Coleman air refrigerator; advantages of using air-refrigeration in aircrafts; disadvantages of air refrigeration in comparison to other cold producing methods; simple air refrigeration in air craft; simple evaporative type air refrigeration in aircraft; necessity of cooling the aircraft.

UNIT II

Simple Vapour Compression Refrigeration System; different compression processes(wet compression, dry or dry and saturated compression, superheated compression); Limitations of vapour compression refrigeration system if used on reverse Carnot cycle; representation of theoretical and actual cycle on T-S and P-H charts; effects of operating conditions on the performance of the system; advantages of vapour compression system over air refrigeration system.

Methods of improving COP; flash chamber; flash inter cooler; optimum interstate pressure for two stage refrigeration system; single expansion and multi expansion processes; basic introduction of single load and multi load systems; Cascade systems.

Basic absorption system; COP and Maximum COP of the absorption system; actual NH_3 absorption system; functions of various components; Li-Br absorption system; selection of refrigerant and absorbent pair in vapour absorption system; Electro refrigerator; Comparison of Compression and Absorption refrigeration systems; nomenclature of refrigerants; desirable properties of refrigerants; cold storage and ice-plants.

(b) AIR-CONDITIONING

UNIT III

Difference in refrigeration and air conditioning; Psychometric properties of moist air (wet bulb, dry bulb, dew point temperature, relative and specific humidity of moist air, temperature of adiabatic saturation); empirical relation to calculate P_v in moist air.

Psychometric chart, construction and use, mixing of two air streams; sensible heating and cooling; latent heating and cooling; humidification and dehumidification; cooling with dehumidification; cooling with adiabatic humidification; heating and humidification; by-pass factor of coil; sensible heat factor; ADP of cooing coil; Air washer.

UNIT IV

Classification; factors affecting air conditioning systems; comfort air-conditioning system; winter air conditioning system; summer air- conditioning system; year round air conditioning. unitary air-conditioning system; central air conditioning system; room sensible heat factor; Grand sensible heat factor; effective room sensible heat factor.

Inside design conditions; comfort conditions; components of cooling loads; internal heat gains from (occupancy, lighting, appliances, product and processes); system heat gain (supply air duct, A.C. fan, return air duct); external heat gain (heat gain through building, solar heat gains through outside walls and roofs); solar air temperature; solar heat gain through glass areas; heat gain due to ventilation and infiltration.

Transport air conditioning; evaporative condensers, cooling towers; heat pumps.

Text books

1. Basic Refrigeration and air-conditioning by Annanthana and Rayanan, TMG
2. Refrigeration and air-conditioning by R.C.Arora, PHI

References books

1. Refrigeration and air-conditioning by C.P arora
2. Refrigeration and air-conditioning by Arora and Domkundwar, Dhanpat rai

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B. Tech. 6th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME-304N	**Tribology & Mechanical Vibration**	3	1	0	75	25	100	3
Purpose:	To understand the vibration systems with different degrees of freedom in different modes and conditions and the basics of tribology.							
Course Outcomes								
CO 1	To understand the fundamentals of vibrations and study the systems in single D.O.F. under free and damped vibrations.							
CO 2	To study and analyze the different types of forced vibration system in single D.O.F.							
CO 3	To understand the concept of principle modes of vibrations using different methods and study lateral, longitudinal and torsional vibration in case of beams, bars and shafts respectively.							
CO 4	To understand the fundamentals of tribology of lubrication, friction and wear.							

UNIT I

Fundamentals of Vibration: Elements of a vibratory system, S.H.M., degrees of freedom, Types of vibrations, Work done by a harmonic force, Beats. **Undamped free vibrations:** Natural frequency by equilibrium and energy methods, equivalent spring, linear and torsional systems, compound pendulum, Bifilar and Trifilar suspensions.

Damped free vibrations: Different types of damping, differential equations of damped free vibrations, initial conditions, logarithmic decrement, vibrational energy and logarithmic decrement.

UNIT II

Single Degree of Freedom Systems- Forced Vibrations: Sources of excitation**,** equations of motion with harmonic force, response of rotating and reciprocating unbalanced system, Support motion,Vibration Isolation, Force and Motion transmissibility.

Forced vibrations with coloumb damping, structural damping and viscous dampings.

UNIT III

Multi-degree of freedom systems: Principle modes of vibrations, Influence co-efficient, Matrix method, orthogonality principle, Dunkerleys equation, Matrix iteration method, Holzer Method, Rayleigh Method and Rayleigh-Ritz methods, Stodola method, Hamilton principle.

Continuous systems: Transverse vibrations of strings, Longitudinal Vibrations of bars, Lateral vibration of beams, Torsional vibration of circular shafts.

UNIT IV

Introduction to Tribology, Tribology in design, Tribology in industry, economic aspects of Tribology, **Lubrication:** Basic modes of lubrication, lubricants, properties of lubricants - physical and chemical, types of additives, extreme pressure lubricants, recycling of used oils and oil conservation, disposal of scrap oil, oil emulsion.

Friction and Wear: Introduction, laws of friction, kinds of friction, causes of friction, friction measurement, theories of friction, effect of surface preparation. Introduction to Wear, Types of wear, various factors affecting wear, measurement of wear, wear between solids and liquids, theories of wear.

Text Books:

1. Grover G. K. “Mechanical Vibrations”, Nem Chand and Bros.,Roorkee
2. Meirovitch, “Elements of Mechanical Vibrations”, McGraw Hill

3. J.S.Rao and K.Gupta, 'Introductory course on theory and practice of Mechanical Vibration, New Age International.
4. Friction and wear of Materials- By E. Robinowicz, Johan Wiley
5. Tribology an Introduction - By Sushil Kumar Srivastava
6. B. C. Majumdar, "Introduction to Tribology and Bearings", S.Chand and Company Ltd. New Delhi.

Reference Books:

1. Rao S. S. "Mechanical Vibrations", Pearson Education Inc. Dorling Kindersley (India) Pvt. Ltd. New Delhi.
2. V.P. Singh, "Mechanical Vibrations", Dhanpat Rai & Co. Pvt. Ltd., Delhi
3. Prashant Sahoo, ''Engineering Tribology'', PHI publications.
4. Halling J., "Principles of Tribology", McMillan Press Ltd.

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B. Tech. 6th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME-306N	**OPERATION RESEARCH**	3	1	0	75	25	100	3
Purpose	To make the students aware of various optimization techniques used for solving engineering problems.							
Course Outcomes								
CO1	To study necessity, applications, scope related to industry. To make the students aware of linear programming and its graphical representation.							
CO 2	To minimize the transportation cost using transportation models. To discuss and understand the network analysis representations.							
CO 3	To understand simulation. Its applications, merits and demerits. Furthermore, waiting line theory and decision theory are also helpful to solve various engineering problems.							
CO 4	Solve the problems related to Queuing theory and game theory.							

UNIT 1

Introduction: Definition and Development of Operations Research, Necessity and scope of OR in Industry, Operations Research in Decision making, Models in OR, Fields of application, Difficulties and Limitation of OR.

General Linear Programming Problems: Introduction, Maximization and minimization of function with or without Constraints, Formulation of a linear programming problem, Graphical method and Simplex method, Big M method, Degeneracy, Application of linear Programming (LPP) in Mechanical Engineering.

UNIT 2

The Transportation Problems: Mathematical formulation, Stepping stone method, Modified Distribution Method, Vogels Approximation Method, Solution of balanced and unbalanced transportation problems and case of degeneracy, Assignment problems, Least time transportation problem

Network Analysis: CPM/PERT, Network Representation, Techniques for drawing network, Numbering of events (Fulkersen Rule), PERT calculations - Forward path, back-ward path, Slack, probability, comparison with PERT, Critical path, Float, Project cost, Crashing the net work, updating (PERT and CPM).

UNIT 3

Simulation: Basic concept of simulation, Applications of simulation, Merits and demerits of simulation, Monte Carlo simulation, Simulation of Inventory system, Simulation of Queuing system.

Waiting Line Theory: Basic queuing process, Basic structure of queuing models, some commonly known queuing situations, Kendall's notation, Solution to M/M/1: ∞ /FCFS models.

Decision Theory: Steps in decision theory approach, Decision Machinery environment, Decision machining under certainty and uncertainty, Decision machining under condition of risk, Decision trees, Minimum enchained criteria, Advantages and limitations of decision tree solutions, Post Optimality.

Unit 4

Queuing Theory: Introduction, Applications of queuing Theory, Waiting time and idle time costs, Single channel queuing theory and multi-channel queuing theory with Poisson arrivals and exponential services, Numerical on single channel and multi channel queuing theory.

Game Theory: Theory of games, competitive games, Rules and Terminology in game Theory, Rules for game theory- saddle point, dominance, Mixed strategy (2 x2 games) , Mixed strategy (2 x n games or m x 2 games), Mixed strategy (3 x3 games),Two person zero sum games, N-person zero sum games.

Text books

1. Operations Research by Prem Kumar Gupta and D. S. Heera, S. Chand Publications
2. Introduction to Operations Research, by F.S. Hillier and G.J. Lieberman, seventh edition, McGraw Hill publications

Reference Books:

1. Introduction to Mathematical Programming by Winston, W.L. (4th ed.), Duxbury Press.
2. Operations Research by P Sankara Iyer, Mc Graw Hill publications.

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For Mechanical Engg, Electronics Engg and Bio Tech Engg students only

B. Tech. 6th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
CSE-209N	**ESSENTIALS OF IT**	3	1	0	75	25	100	3
Purpose	**To introduce the concepts of Object Oriented Programming using Java and RDBMS**							
COURSE OUTCOMES								
CO-1	Solve Problems using various efficient and reliable Algorithms							
CO-2	Design and Study the basic concepts in Java							
CO-3	Document and implement Object oriented paradigms and design models in Java							
CO-4	Design and study RDBMS Modeling and its program implementation							

UNIT I

Problem Solving Techniques: Introduction to Problem Solving, Introduction to Algorithms and Flowchart, Searching algorithms: Linear search, Binary search and Sorting algorithms: Insertion and Selection sort, Basic Data Structures: Stack, and Linear Queue.

UNIT II

Programming Basics: Identifiers, Variables, Data Types, Operators, Control Structures: Loop, If else, Nested If, Switch Statement, Arrays, Strings, Object Oriented Concepts: Class & Object, Operator, Instance Variables & Methods, Access Specifiers, Reference Variables: This, Super, Parameter Passing Techniques, Constructors, Static, and Command Line Arguments.

UNIT III

Relationships: Inheritance, Types of Inheritance, Static Polymorphism: Method Overloading, Constructor Overloading, Method Overriding, Abstract, Interface, Introduction to Packages.

UNIT IV

RDBMS: Data Processing, Database Technology, Data Models, Data Independence, ER Modeling Concept, ER-notations, Converting ER Diagram into Relational Schema, Definition of Keys: Primary key, Foreign key, UniqueKey.

SQL: DDL Statements, DML Statements, DCL Statements, Joins, Sub queries, Views.

Books on Java

1. Java: The Complete Reference, Seventh Edition. Herbert Schildt, McGraw-Hill Education. Programming with Java 3e A Primer, E Balagurusamy, McGraw Hill Education.
2. Introduction to Java Programming, K. Somasundaram , Jaico Publishing House; 1st edition

Books on RDBMS, Oracle, MYSQL

1. Fundamentals of Database Systems, with E-book (3rd Edition) by Shamkant B.Navathe, Ramez Elmasri, Published by Addison Wesley Longman , January 15th, 2002
2. MySQL by Paul DuBois Published by New Riders.
3. Murach's MySQL Paperback, Joel Murach , Published by Shroff/Murach, 2012.
4. SQL: The Complete Reference , James R. Groff, Paul N. Weinberg, Published by McGraw-Hill Companies, March 1999.
5. Schaum's Outline of Fundamentals of Relational Databases, Ramon Mata-Toledo, Published by McGraw-Hill, 2000.

NOTE: In the semester examination, the examiner will set 8 questions in all, at least one question from each unit, and students will be required to attempt only 5 questions.

B. Tech. 6th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME-308N	**COMPUTER AIDED DESIGN AND MANUFACTURING**	4	0	0	75	25	100	3
Purpose	The subject empowers the students to know about the extreme function of computer in designing, manufacturing as well as in the business scenario.							
Course Outcomes								
CO1	Student gets aware about the introduction of CAD/CAM, and CIM. This unit explains the history and application CAD/CAM.							
CO 2	Student gets aware about the Modeling of different types of curves, surface and solid. The modeling is used for further analysis.							
CO 3	To know about the transformation of points and lines in computer aided software. Group technology is used for utilization machines.							
CO 4	Student knows the usages of the numerical control machines and its code. How computer is useful in making the process planning.							

UNIT-I

Introduction to CAD/CAM, Historical Development, Industrial look at CAD/CAM Application of CA/CAM, Display devices, Input/ Output Devices, CPU.
Introduction to CIM, Definition, Nature of Elements of CIM, CIM Wheel,
Introduction to computer aided quality control, Contact and Non Conduct Inspection Method.

UNIT-II

Wireframe modeling, Representation of curves, Parametric and non-parametric curves, straight lines, Hermite cubic splines, B splines curves.
Plane surface, ruled surface, surface of revolution, bi-cubic surface, Bezier surface, B spline surface, Solid modeling, boundary representation, sweeping, parametric solid modeling.
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UNIT-III

Introduction, Transformation of points & line, 2-D translation, rotation, Reflection, Scaling, shearing and combined transformation, Homogeneous coordinates, Orthographic and perspective Projections.
Group technology, Part families, Part classification and coding, Optiz method, product flow analysis, Machine cell Design, Advantages of GT

UNIT-IV

Numerical control, Types of NC systems, MCU & other components, Co-ordinate system, NC manual part programming, G & M codes, part program for simple parts, Computer assisted part programming.
Introduction, FMS component, Types of FMS, FMS layout, planning for FMS, advantage and applications
Introduction, conventional process planning, Steps in variant process planning, types of CAPP, planning for CAPP

Text books:

1. **Chris McMahon and Jimmie Browne**, CAD/CAM – Principle Practice and Manufacturing Management, Addison Wesley England, Second Edition, 2000.

2. **Rogers, D.F. and Adams, A**., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY, 1989
3. **Ibrahim Zeid**, CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
4. **M.P. Groover**, Automation, Productions systems and Computer-Integrated Manufacturing by Prentice – Hall

Reference Books:

1. **Ibrahim Zeid**, Mastering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
2. **P. Radhakrishnan, S. Subramanayan and V.Raju**, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.
3. **Groover M.P. and Zimmers E. W.**, CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall International, New Delhi, 1992.
4. **Dr. Sadhu Singh**, Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition, 2000.
5. **Chang, Wang &Wysk** Computer Aided Manufacturing. Prentice Hall
6. **Kundra** &**Rao**, Numerical Control and Computer Aided Manufacturing by, Rao and Tiwari, Tata Mc-Graw Hill.
7. **Mattson**, CNC programming Principles and applications, Cengage Learning India Pvt. Ltd. Delhi

NOTE: In the semester examination, the examiner will set 8 questions in all, at least one question from each unit, and students will be required to attempt only 5 questions.

B. Tech. 6th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME-310N	**MACHINE DESIGN-II**	2	4	0	75	25	100	4
Purpose	To deal effectively with engineering problems associated with an individual machine component.							
Course Outcomes								
CO 1	To analyze the force components acting on the gears and solve design problems of different types of gears.							
CO 2	To solve design problems of belts, chains, pulleys and friction clutches and brakes.							
CO 3	To make selection of bearings from manufacturer's catalogue and solve spring design problems.							
CO 4	To design and solve the problems of IC engine components and flywheels.							

UNIT-I

Gear Drives: Classification of gears, selection of type of gears, law of gearing, standard systems of gear tooth, interference and undercutting, backlash, **Spur Gears:** geometry and nomenclature, force analysis, material selection, beam strength of gear tooth, effective load on gear tooth, module estimation based on beam strength, wear strength of gear tooth, module estimation based on wear strength, spur gear design procedure. **Helical Gears:** geometry and nomenclature, force analysis, beam strength of helical gears, effective load on gear tooth, wear strength of helical gears, design procedure. **Bevel Gears:** geometry and nomenclature, force analysis, beam strength of bevel gears, effective load on gear tooth, wear strength of bevel gears, design procedure. **Worm Gears:** terminology, force analysis, friction in worm gears, material selection, strength rating and wear rating, thermal considerations and design procedure.

UNIT-II

Flat Belt Drives and Pulleys: Introduction, Selection of flat belts from manufacturer's catalogue, Pulleys for flat belts. **V-Belts and Pulley:** selection of V-Belts and V-grooved pulley. **Chain Drives:** roller chains, geometric relationships, polygonal effect, power rating, sprocket wheels, design of chain drives, chain lubrication.

Clutches: Various types of clutches in use, design of friction clutches-single disc, multidisc, cone & centrifugal, torque transmitting capacity, friction materials, thermal considerations. **Brakes:** Various types of brakes, self-energizing condition of brakes, design of shoe brakes – internal & external expanding, band brakes, thermal considerations in brake designing.

UNIT-III

Springs: Types of springs, design for helical springs against tension and their uses, compression and fluctuating loads, design of leaf springs, surging in springs.

Bearings: Classification, selection of bearing type, static and dynamic load carrying capacity, equivalent bearing load, load-life relationship, selection of bearings from manufacturer's catalogue, selection of taper roller bearing, design for cyclic loads and speeds, bearing failure-causes and analysis. **Sliding Contact Bearings:** design of journal bearings using Raimondi and Boyd's Charts.

UNIT IV

I.C. Engine Components: Design of cylinder, design of studs for cylinder head, design of piston, design of crank shaft, design of connecting rod.

Flywheel: Flywheel materials, torque analysis, coefficient of fluctuation of energy, design of solid disc and rimmed flywheel.

Text books:

1. Mechanical Engineering Design, Joseph E. Shigley and Charles R. Mischke, Tata McGraw Hill Book Co.
2. Design of Machine Element,V. B. Bhandari, Mc Graw Hill Edu. Pvt. Ltd.
3. Machine Component Design, Robert C. Juvinall and Kurt M. Marshek, Wiley India Pvt. Ltd.
4. Mechanical Design of Machine Elements and Machines, Collins and Busby, Wiley India Pvt. Ltd.

References books:

1. Machine Design by Sharma and Aggarwal
2. Machine Design-an integrated Approach, Robert L. Norton, Addison Wisley Longman
3. PSG Design Data Book by PSG college of Engineering, PSG Publication.
4. Design Data Handbook for Mechanical Engineers by K. Mahadevan and K. Balaveera Reddy.

NOTE: In the semester examination, the examiner will set 8 questions in all, at least one question from each unit, and students will be required to attempt only 5 questions.

B. Tech. 6th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Sessional**	**Practical**	**Total**	
ME-312N	**Refrigeration and Air Conditioning Lab**	0	0	2	40	60	100	3
Purpose	To make students understand about the applications of refrigeration and Air-conditioning.							
Course Outcomes:								
CO1	To understand about the basics and working principle of water cooler.							
CO2	Identify the different cycle of operation in air-conditioning							
CO3	To analyze the humidity measurement and its importance in air-conditioning							
CO4	To learn about the various control devices and parts of refrigeration and air-conditioning systems							

List of Experiments

1. To study and perform experiment on basic vapour compression Refrigeration Cycle.
2. To study and perform experiment on Solar Air-conditioner based on vapour absorption cycle.
3. To find COP of water cooler.
4. To study and perform experiments on compound compression and multi-load systems.
5. To study and perform experiment on vapour absorption apparatus.
6. Perform the experiment & calculate various performance parameters on a blower apparatus.
7. To find the performance parameter of cooling tower.
8. To study various components in room air conditioner.
9. To find RH of atmospheric air by using Sling Psychrometer.
10. To find performance of a refrigeration test rig system by using different expansion devices.
11. To study different control devices of a refrigeration system.
12. To find the performance parameters of Ice Plant.

Note: Any 8 experiments from the above list and other 2 from others (developed by institute) are required to be performed by students in the laboratory.

B. Tech. 6th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Sessional**	**Practical**	**Total**	
ME-314N	**TRIBOLOGY & MECHANICAL VIBRATION LAB**	0	0	2	40	60	100	3
Purpose:	To make the students understand about the tribological properties of specimen and principles of vibration.							
Course outcomes:								
CO 1	To understand the concept of sliding and abrasive wear using wear and friction monitoring apparatus and dry abrasion tester.							
CO 2	To measure the extreme pressure properties of a lubricant using four ball tester.							
CO 3	To study the concept of free and forced vibration for a spring mass system and determine the natural frequency.							

LIST OF EXPERIMENTS:

1. To study undamped free vibrations of equivalent spring mass system and determine the natural frequency.
2. To study the free vibration of system for different damper settings. Draw decay curve and determine the log decrement and damping factor. Find also the natural frequency.
3. To study the torsional vibration of a single rotor shaft system and determine the natural frequency.
4. To determine the radius of gyration of given bar using bifilar suspension.
5. To verify the dunker ley's rule.
6. To study the forced vibration of system with damping. Load magnification factor vs. Frequency and phase angle vs frequency curves. Also determine the damping factor.
7. To determine the two frequencies of torsional spring type double pendulum & compare them with theoretical values.
8. To determine the radius of gyration of a compound pendulum.
9. To determine the radius of gyration of disc using trifilar suspension.
10. To determine the wear rate, friction force and coefficient of friction of a metallic pin/ball by using wear and friction monitor apparatus.
11. To determine abrasion index of a material with the help of dry abrasion test rig.
12. To evaluate the wear and extreme pressure properties of a lubricating oil by using four ball tester.

Note: Any 8 experiments from the above list and other 2 from others (developed by institute) are required to be performed by students in the laboratory.

B. Tech. 6th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Sessional**	**Practical**	**Total**	
ME-316N	**COMPUTER AIDED DESIGN AND MANUFACTURING LAB**	0	0	2	40	60	100	3
Purpose	The lab empowers the students to know about the computer aided manufacturing by using CAD							
Course Outcomes								
CO1	Student gets aware about the 2D drawing and modelling.							
CO 2	Student knows how to use 3D software in part designing.							
CO 3	To know about the assembly and aware about the G codes and M codes.							
CO 4	Students will aware about the NC part programming and OPTIZE method.							

List of experiments:

1 To study the 2 dimensional drawing, orthographic views, front view, top view and side view.
2 To study the wireframe, surface and solid modelling.
3 Draw the part drawing of product 1 using any 3D software.
4 Draw the part drawing of product 2 using any 3D software.
5 Make assembly by using any 3D software.
6 To study the G codes and M codes.
7 Write a NC program for milling operation.
8 Write a NC program for drilling operation.
9 Write a NC program for turning operation.
10 To study the optiz method.

Note: Any 8 experiments from the above list and other 2 from others (developed by institute) are required to be performed by students in the laboratory. Product 1 and Product 2 must be based on ME 308N.

B. Tech. 7th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME-401N	**MEASUREMENT AND CONTROL**	4	0	0	75	25	100	3
Purpose	To understand the fundamentals of mechanical instruments and enable the students for solving the problems related transfer function of control systems							
Course Outcomes								
CO1	To study the fundamentals of measurement systems and understand the static performance characteristics of measurement systems.							
CO2	To enable the students to understand the motion, force and torque measurement and study the measurements of strain and vibration.							
CO3	To study the instruments related to pressure, flow and temperature measurements.							
CO4	Learn about various concepts related to control systems.							

UNIT-I

Fundamentals of Measurements: Definition, application of measurement instrumentation, functional elements of a generalized measuring system, measuring standards, types of measurement, types of input to measuring instruments and instrument system, classification of measuring instruments, merits and demerits of mechanical measuring systems, comparison of mechanical measuring system with electrical measuring systems, calibration.

Generalized Measurement System: Introduction, types of error, types of uncertainties, propagation of uncertainties in compound quantity, Static performance parameters: accuracy, precision, resolution, static sensitivity, linearity, hysteresis, dead band, backlash, and drift, sources of error, selection of measuring instruments, mechanical and electrical loading.

UNIT-II

Motion, Force and Torque Measurement: Introduction, relative motion, measuring devices, electromechanical, optical, photo electric, Moore-Fringe, pneumatic, absolute motion devices, seismic devices, spring mass & force balance type, calibration, hydraulic load cell, pneumatic load cell, elastic force devices, separation of force components, electro mechanical methods, torque transducer, torque meter**.**

Measurement of Strain and Vibrations: Type of strain gauges and their working, strain gauge circuits, Mcleod gauge, Pirani gauge, temperature compensation, strain rosettes, analysis of strains.

Vibration and noise measurement: Seismic instruments, vibration pick-ups and decibel meters.

UNIT-III

Pressure and Flow Measurement: Moderate pressure measurement, monometers, elastic transducer, dynamic effects of connecting tubing, high pressure transducer, low pressure measurement, calibration and testing, quantity meters, positive displacement meters, flow rate meters, variable head Meters, variable area meters, rotameters, pitot-static tube meter, drag force flow meter, turbine flow meter, electronic flow meter, electro-magnetic flow meter, hot-wire anemometer.

Temperature Measurement: Introduction, measurement of temperature, non-electrical methods – solid rod thermometer, bimetallic thermometer, liquid in- glass thermometer, pressure thermometer, electrical methods – electrical resistance thermometers, semiconductor resistance

sensors (thermistors), thermo-electric sensors, thermocouple materials, radiation methods (pyrometry), total radiation pyrometer, selective radiation pyrometer

UNIT-IV

Control Analysis: Introduction, classification of control systems, control system terminology, servomechanism, process control and regulators, manual and automatic control systems, physical systems and mathematical models, linear control systems, Laplace transform, transfer function, block diagram, signal flow graphs.

Reference and Text Books:

1. Mechanical measurements & control- By D.S. Kumar, Metropolitan book
2. Instrumentation and Mechanical measurements- By A.K. Tayal, Galgotia Publ.
3. Measurements systems application and design-By Ernest Doebelin, McGraw-Hill
4. Automatic Control Systems- By S. Hasan Saeed

NOTE: In the semester examination, the examiner will set 8 questions in all, at least one question from each unit, and students will be required to attempt only 5 questions.

B. Tech. 7th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME-403N	**MECHATRONICS**	4	0	0	75	25	100	3
Purpose	The Objective of this course is to make the students aware about Mechanical and Electronic instruments together for different applications. This course will help students to build the fundamental concepts of inter disciplinary problems.							
Course Outcomes								
CO 1	To understand Mechatronics system and study of number system and Boolean algebra and able to convert number systems from one system to another.							
CO 2	Students will be able to understand different sensors and transducers as well as recognize various Pneumatic and Hydraulic system components along with their symbols.							
CO 3	Able to explain mechanical actuation systems and architecture of microprocessors.							
CO 4	Able to understand basic structure of PLC and its applications and concepts of Robotics.							

UNIT- I

Introduction to Mechatronics and its Systems: Evolution, Scope, Measurement Systems, Control Systems, open and close loop systems, sequential controllers and microprocessor based controllers, mechatronics approach.

Basics of Digital Technology: Number System, Boolean algebra, Logic Functions, Karnaugh Maps, Timing Diagrams, Flip-Flops, Applications.

UNIT - II

Sensors and transducers: Introduction, performance terminology-Displacement, Position and Proximity, Velocity and motion, force, Fluid Pressure-Temperature Sensors-Light Sensors-Selection of Sensors-Signal Processing.

Pneumatic and Hydraulic actuation systems: actuation systems, Pneumatic and hydraulic systems, directional control valves, pressure control valves, cylinders, process control valves, rotary actuators.

UNIT - III

Mechanical actuation systems: Mechanical systems, types of motion, kinematics chains, cams, gear trains, ratchet and pawl, belt and chain drives, bearings, mechanical aspects of motor selection.

Microprocessor: Introduction, Architecture, Pin Configuration, Instruction set, Programming of Microprocessors using 8085 instructions-Interfacing input and output devices-Interfacing D/A converters and A/D converters, Applications, Temperature control, Stepper motor control, Traffic light controller.

UNIT - IV

Programmable Logic Controller: Introduction, Basic structure, Input/output Processing, Programming, Mnemonics, Timers, Internal relays and counters, Data handling, Analog Input/Output, Selection of a PLC.

Robotics: Introduction, types of robots, Robotic control, Robot drive systems Robot end effectors, selection parameters of a robot, applications.

Text Books:

1. R. K Rajput, "A Textbook of Mechatronics", Edition 2010.

Reference Books:

1. Bolton W., "Mechatronics", Longman, Second Edition, 2004.
2. Histand Michael B. and Alciatore David G., "Introduction to Mechatronics and Measurement Systems", McGraw Hill International Editions, 2003.
3. HMT Ltd., "Mechatronics", Tata McGraw Hill Publishing Co. Ltd., 1998.
4. Nitaigour Premchand Mahalik, "Mechatronics Principles, Concepts and Applications", Tata McGraw-Hill publishing company Ltd, 2003.

NOTE: In the semester examination, the examiner will set 8 questions in all, at least one question from each unit, and students will be required to attempt only 5 questions.

B. Tech. 7th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
HS-401N	**ENTREPRENEURESHIP**	3	0	0	75	25	100	3
Purpose	**To familiarize the students with the basics of Entrepreneurship**							
Course Outcomes								
CO 1	Students will be able understand who the entrepreneurs are and what competences needed							
CO 2	Students will be able to understand insights into the management, opportunity search, identification of a product, market flexibility studies, project finalization etc. required for small business enterprise.							
CO 3	Students will be able to write a report and do oral presentation on the topics such as product identification, business ideas, export marketing etc.							
CO 4	Students will be able to know the different financial and other assistance available for establishing small industrial units.							

UNIT –I

Entrepreneurship : Concept and Definitions; Entrepreneurship and Economic Development; Types of Entrepreneurs; Factor Affecting Entrepreneurial Growth – Economic, Non-Economic Factors; EDP Programmes; Entrepreneurial Training; Traits/Qualities of an Entrepreneurs; Manager Vs. Entrepreneur, types of entrepreneurships, Entrepreneurial myths.

UNIT-II

Opportunity Identification and Product Selection: Entrepreneurial Opportunity Search &Identification; Criteria to Select a Product; Conducting Feasibility Studies; Sources of business ideas, launching a new product; export marketing, Methods of Project Appraisal, Project Report Preparation; Project Planning and Scheduling. Sources of finance for entrepreneurs.

UNIT –III

Small Enterprises and Enterprise Launching Formalities : Definition of Small Scale; Rationale; Objective; Scope; SSI; Registration; NOC from Pollution Board; Machinery and Equipment Selection , Role of SSI in Economic Development of India; major problem faced by SSI,MSMEs – Definition and Significance in Indian Economy; MSME Schemes, Challenges and Difficulties in availing MSME Schemes.

UNIT -IV

Role of Support Institutions and Management of Small Business : Director of Industries; DIC; SIDO; SIDBI; Small Industries Development Corporation (SIDC); SISI; NSIC; NISBUD; State Financial Corporation SIC; Venture Capital : Concept, venture capital financing schemes offered by various financial institutions in India, Legal issues – Forming business entity, considerations and criteria, requirements for formation of a Private/Public Limited Company,

Note:

• Exercises / activities should be conducted on ‘generating business ideas’ and identifying problems and opportunities.

• Interactive sessions with Entrepreneurs, authorities of financial institutions, Government officials should be organized.

Suggested Readings:

1. "Entrepreneurship development small business enterprises", Pearson, Poornima M Charantimath,2013.
2. Roy Rajiv, "Entrepreneurship", Oxford University Press, 2011.
3. "Innovation and Entrepreneurship",Harper business- Drucker.F, Peter, 2006.
4. "Entrepreneurship", Tata Mc-graw Hill Publishing Co.ltd new Delhi- Robert D. Hisrich, Mathew J. Manimala, Michael P Peters and Dean A. Shepherd, 8th Edition, 2012
5. Enterpreneurship Development- S.Chand & Co.,Delhi- S.S.Khanka 1999
6. Small-Scale Industries and Entrepreneurship. Himalaya Publishing House, Delhi – Vasant Desai 2003.
7. Entrepreneurship Management -Cynthia, Kaulgud, Aruna, Vikas Publishing House, Delhi, 2003.
8. Entrepreneurship Ideas in Action- L. Greene, Thomson Asia Pvt. Ltd., Singapore, 2004.

Note: Question Paper will consist of four units. Eight questions will be set in the question paper by selecting two from each unit. The students will be required to attempt five questions, selecting at least one from each unit.

B. Tech. 7th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Sessional**	**Practical**	**Total**	
ME-405N	**MEASUREMENT AND CONTROL LAB**	0	0	2	40	60	100	3
Purpose	To enable the students to understand about the applications of measurement systems.							
Course Outcomes								
CO1	To understand about the basics and working principle of pressure, temperature and flow measurement.							
CO 2	Identify the different variation of measurement parameter with various input conditions							
CO 3	To analyze the primary, secondary and tertiary measurements.							
CO 4	To learn about the various control devices and parts of measurement systems							

LIST OF EXPERIMENTS:

1. Study of a strain gage based cantilever beam and measurement of strain on the beam
2. Study of a LVDT and measurement of linear displacement
3. Study of an inductive pick up and measurement of linear displacement
4. Study of a LDR and measurement of linear displacement
5. Study of capacitive pick up and measurement of angular displacement
6. Study of temperature transducers and measurement of temperature of fluid
7. Study of a LVDT (strain gage based) and measurement of linear displacement.
8. Study of a torque pick up and measurement of torque .
9. Study of a pressure pick up and measurement of pressure of fluid.
10. Study of load cell and measurement of load with load cell
11. Study of non-contact type speed pick up and measurement of rotational speed
12. Comparison of sensitivity of thermocouple, thermister and RTD

Note: **At least eight experiments should be performed from the above list.**

B. Tech. 7th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Sessional**	**Practical**	**Total**	
ME-407N	**MECHATRONICS LAB**	0	0	2	40	60	100	3
Purpose	To know the method of programming the microprocessor and also the design, modeling & analysis of basic electrical, hydraulic & pneumatic Systems which enable the students to understand the concept of mechatronics.							
Course Outcomes								
CO 1	Able to perform operations on Assembly language programming of 8085							
CO 2	Able to understand distinguish hydraulic and pneumatic control system							
CO 3	Able To demonstrate experiments on DC motor, traffic light and stepper motor interface							
CO 4	Able to demonstrate working of sensors and transducer.							

LIST OF EXPERIMENTS:

1. To perform various operation on Assembly language programming of 8085 – Addition – Subtraction Multiplication – Division – Sorting – Code Conversion.
2. To Study Stepper motor interface.
3. To study the Traffic light interface using a PLC kit.
4. To Perform Speed control of DC motor kit.
5. To Study various types of Sensors and transducers.
6. To Study hydraulic System.
7. To study Pneumatic and electro-pneumatic circuits.
8. To study PLC and its applications.
9. To Study image processing technique.

Note: Any 8 experiments from the above list and other 2 from others (developed by institute) are required to be performed by students in the laboratory.

B. Tech. 7th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam**
		L	**T**	**P**	**Sessional**	**Practical**	**Total**	
ME-409N	**PROJECT-1**	0	0	8	100	100	200	3
Purpose	To know the method of programming the microprocessor and also the design, modeling & analysis of basic electrical, hydraulic & pneumatic Systems which enable the students to understand the concept of mechatronics.							
Course Outcomes								
CO 1	Able to perform operations on Assembly language programming of 8085							
CO 2	Able to understand distinguish hydraulic and pneumatic control system							
CO 3	Able To demonstrate experiments on DC motor, traffic light and stepper motor interface							
CO 4	Able to demonstrate working of sensors and transducer.							

The students expected to take up a project under the guidance of teacher from the college. The project must be based on mechanical engineering problems, which can be extended up to the full semester. The students may be asked to work individually or in a group not more than four students in a group. Viva- voce must be based on the preliminary report submitted by students related to the project.

B. Tech. 7th Semester Mechanical Engineering						
ME-411N	**INDUSTRIAL TRAINING (VIVA-VOCE)**					
Lecture	**Tutorial**	**Practical**	**Sessional**	**Practical**	**Total**	**Duration of Exam. (Hrs.)**
2	**0**	**0**	**40**	**60**	**100**	**3**

The training report will be submitted by the students along with the certificate indicating the duration of training and the nature of Project-done.

The students will have to appear for viva-voce examination based on training performed at the end of previous semester in industries.

	B. Tech. 7th Semester Mechanical Engineering					
ME-413N	**SEMINAR- I**					
Lecture	**Tutorial**	**Practical**	**Sessional**	**Practical**	**Total**	**Duration of Exam. (Hrs.)**
0	**2**	**0**	**100**	**0**	**100**	

The students are required to deliver a seminar on some emerging areas of Mechanical Engineering, given as follows:

- CAD/CAM/CAE/FEA
- Robotics
- Machine Vision
- Automation
- Tribology
- CFD
- Energy Conservation
- Alternate Energy Sources
- Hybrid Fuels
- Advances in IC Engines
- Vehicle Dynamics
- Aerodynamics
- Advanced Manufacturing Techniques
- Advanced Engineering Materials
- Supply Chain Management
- Business Process Re-engineering
- Six-Sigma Technique
- Lean Manufacturing Technique
- Just-in-Time Technique
- Agile Manufacturing
- Value Engineering
- Reliability Engineering
- Any other topic related to Design/Thermal/Industrial/Production Engineering

The student will deliver a power point presentation for about 30 minutes in the seminar on any of the above topics. This will be followed by question answering session for about 10 minutes. The questions on the seminar topic will be asked by the teacher concerned and class students. The students will also prepare a detailed report in MS word and after spiral binding will submit it to the teacher concerned. The report is to be submitted at least one week prior to the presentation. The grades/awards will be given according to the student's presentation, report submitted, and answering of questions asked after the presentation.

ELECTIVE -I

B. Tech. 7th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME-415N	**NON-CONVENTIONAL MACHINING**	4	0	0	75	25	100	3
Purpose	This course provides the knowledge about the advanced technologies and different processes of Non-conventional machining.							
COURSE OUTCOMES								
CO1	To impart the basic knowledge of various Non-conventional machining processes, rapid prototyping processes and process parameters and metal removal mechanism of Ultra-Sonic machining process.							
CO2	To acquaint the student with deep knowhow about the Electrochemical and Electro Discharge machining processes.							
CO3	To acquaint the students to classify the various kind of Jet machining processes, process parameters and metal removal mechanism, limitations and applications associated with these processes.							
CO4	To make the students to understand the process mechanism of Rapid Prototyping processes and rapid tools used in industries.							

UNIT I

Introduction: Introduction, need of Non-conventional machining processes, Rapid prototyping processes, their classification, consideration in process selection.

Ultrasonic Machining: Element of process, design of cutting tool, metal removal mechanism, effect of parameters, economic consideration, limitation and applications, surface finish.

UNIT II

Electrochemical Machining: Element of process, process chemistry, metal removal mechanism, tool design, accuracy, surface finish and work material characteristics, economic consideration, advantage, limitation and application, Electrochemical grinding, debarring and honing, chemical machining.

EDM: Principal and metal removal mechanism, generators, electrode feed control, electrode material, tool electrode tool design, EDM wire cutting, surface finish, accuracy and application.

UNIT III

Jet Machining: Principal and metal removal mechanism of abrasive and water jet machining, process variables, design of nozzle, advantage, limitation and application.

Plasma arc machining, Electron beam machining, Laser beam machining, their principal of metal removal mechanism, process parameter, advantage and limitations.

UNIT IV

Rapid Prototyping: Fundamentals, process chain, physics of processes, principal and process mechanism of SLA, SGA, LOM, FDM, and SLS processes, their advantage and limitations, application of RP process, RP data format, STL file format, STL file problems, STL file repair, others translators and formats.

Rapid Tooling Process: Introduction, fundamentals, classifications, indirect RT processes, principal of Silicon Rubber Molding, Epoxy Tooling, Spray Metal Tooling, Pattern for investment casting, Vacuum casting and vacuum forming processes, direct RT processes, Shape Deposition manufacturing, their advantage, limitations and applications.

Reference and Text Books:

1. Modern machining processes – By P.C. Pandey and M.S. Shan.
2. Machining Science – By Gosh and Malik, Affiliated East west
3. Nontraditional Manufacturing Processes – By G.F. Benedict, Maicel Dekker.
4. Advanced Method Of Machining – By J.A. Mcgeongh, Chapman And Hall.
5. Electrochemical Machining Of Metals – By Ruryantsev & Davydov, Mir Pub.
6. Rapid Prototyping: Principal And Application by CK Chua, World Scientific Publishing.

NOTE: In the semester examination, the examiner will set 8 questions in all, at least one question from each unit, and students will be required to attempt only 5 questions.

B. Tech. 7th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME-417N	**SOFT COMPUTING TECHNIQUES**	4	0	0	75	25	100	3
Purpose	This course is designed to give an insight into the latest developments regarding smart materials and their use in structures.							
Course Outcomes								
CO 1	To expose the concepts of feed forward neural networks.							
CO 2	To provide adequate knowledge about feedback neural networks.							
CO 3	To teach about the concept of fuzziness involved in various systems.							
CO 4	To expose the ideas about genetic algorithm and to provide adequate knowledge about of FLC and NN toolbox.							

UNIT I

Introduction and Artificial Neural Networks

Introduction of soft computing – soft computing vs. hard computing various types of soft computing techniques applications of soft computing Neuron Nerve structure and synapse Artificial

Neuron and its model activation Functions Neural network architecture single layer and multilayer feed forward networks McCulloch Pitts neuron model, perceptron model Adaline and Madaline multilayer perception model back propagation learning methods effect of learning rule coefficient back propagation algorithm factors affecting back propagation training applications.

UNIT II

Artificial Neural Networks

Counter propagation network architecture functioning & characteristics of counter Propagation Network Hopfield/ Recurrent network configuration stability Constraints Associative Memory and Characteristics limitations and applications Hopfield v/s Boltzman machine Adaptive Resonance Theory Architecture Classifications Implementation and training Associative Memory.

UNIT III

Fuzzy Logic System

Introduction to crisp sets and fuzzy sets basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control Fuzzification inferencing and defuzzification Fuzzy knowledge and rule bases Fuzzy modeling and control schemes for nonlinear systems. Self-organizing fuzzy logic control Fuzzy logic control for nonlinear time delay system.

UNIT IV

Genetic Algorithm

Basic concept of Genetic algorithm and detail algorithmic steps adjustment of free Parameters Solution of typical control problems using genetic algorithm Concept on some other search techniques like tabu search and ant colony search techniques for solving optimization problems.

Applications

GA application to power system optimization problem Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab Neural Network toolbox. Stability analysis of Neural Network Interconnection Systems, Implementation of fuzzy logic controller using Matlab fuzzy logic toolbox Stability analysis of fuzzy control systems.

REFERENCES:

1. Laurene V. Fausett, Fundamentals of Neural Networks: Architectures, Algorithms and Applications, Pearson Education,
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications" Wiley India.
3. Zimmermann H.J. "Fuzzy set theory and its Applications" Springer international edition, 2011.
4. David E. Goldberg, "Genetic Algorithms in Search, Optimization, and Machine Learning", Pearson Education, 2009.
5. W.T.Miller, R.S.Sutton and P.J.Webrose, "Neural Networks for Control", MIT Press, 1996.
6. http://www.myreaders.info/html/soft_computing.html

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B. Tech. 7th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME-419N	**NON-DESTRUCTIVE EVALUATION AND TESTING**	4	0	0	75	25	100	3
Purpose	To give the basic idea of NON-DESTRUCTIVE EVALUATION AND TESTING							
Course Outcomes								
CO1	To make student able to acquire knowledge of different types of NDT techniques.							
CO2	To make student able to understand the basic principles underlying each NDT techniques.							
CO3	To make student able to acquire knowledge of established NDE techniques and basic familiarity of emerging NDET Techniques							
CO4	To make student able to become familiar with common types of defects arising in different types of manufactured products and the NDT method(s) best suited to evaluate them.							

UNIT I

Introduction to NDET and Surface NDT Techniques: Introduction to non-destructive testing and evaluation, visual examination, liquid penetrant testing and magnetic particle testing. Advantages and limitations of each of these techniques.

UNIT II

Radiographic Testing: Radiography principle, electromagnetic radiation sources, X-ray films, exposure, penetrometer, radiographic imaging, inspection standards and techniques, neutron radiography. Radiography applications, limitations and safety.

UNIT III

Eddy Current Testing and Ultrasonic Testing: Eddy current principle, depth of penetration, eddy current response, eddy current instrumentation, probe configuration, applications and limitations. Properties of sound beam, ultrasonic transducers, inspection methods, flaw characterization technique, immersion testing. Special/Emerging Techniques Leak testing, Acoustic Emission testing, Holography, Thermography, Magnetic Resonance Imaging, Magnetic Barkhausen Effect. In-situ metallography

UNIT IV

Defects in materials / products and Selection of NDET Methods: Study of defects in castings, weldments, forgings, rolled products etc. and defects arising during service. Selection of NDET methods to evaluate them. Standards and codes.

Reference and Text books:

1. Baldevraj, Jayakumar T., Thavasimuthu M., (2008) “Practical Non-Destructive Testing”, 3rd edition, Narosa Publishers.

Reference Books

1. American Society for Metals, “Non-Destructive Evaluation and Quality Control”: Metals Hand Book: 1992, Vol. 17, 9th Ed, Metals Park, OH.

2. Paul E Mix, "Introduction to nondestructive testing: a training guide", Wiley, 2nd edition New Jersey, 2005.
3. Ravi Prakash, "Nondestructive Testing Techniques", New Age International Publishers, 1st rev. edition, 2010.

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B. Tech. 7th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME - 421N	**DESIGN AND OPTIMIZATION**	4	0	0	75	25	100	3
Purpose	To provide the concepts of various classical and modern methods of for constrained and unconstrained problems in both single and multivariable and Introduction to system design.							
COURSE OUTCOMES								
CO1	Students will be able to formulate optimization problems.							
CO2	The student will be able to understand and apply the concept of optimality criteria for various type of optimization problems.							
CO3	The students will be able to solve various constrained and unconstrained problems in single variable as well as multivariable.							
CO4	The students will be to understand advanced optimization techniques.							

UNIT I

Introduction to Classical Methods & Linear Programming Problems: Terminology, Design Variables, Constraints, Objective Function, Problem Formulation. Calculus method, Kuhn Tucker conditions, Method of Multipliers. Linear Programming Problem, Simplex method, Concept of Duality. Gradient Based Methods: Newton-Raphson Method, Bisection Method, Secant Method. Application to Root finding.

UNIT II

Multivariable Optimization Algorithms: Optimality Criteria, Unidirectional Search. Direct Search Methods: Hooke-Jeeves pattern search method, Powell's Conjugate Direction Method. Gradient Based Methods: Cauchy's Steepest Descent Method, Newton's method, Marquardt's Method

UNIT III

Nonlinear programming with constraints: Lagrange multipliers, Kuhn-Tucker conditions, quadratic programming. Wolfe's and Beale's method, sequential linear programming approach, penalty methods. Interior and exterior penalty function method.

UNIT IV

Advanced optimization techniques: Concepts of multi-objective optimization, genetic algorithms and simulated annealing.

Text Books:

1. S.S.Rao, Optimization-Theory and Applications, , Wiley Eastern, New Delhi, 1978
2. J.C.Pant, Introduction to Optimization, Jain Brothers, New Delhi, 1983
3. Kanthi Swaroop, et.at., Operations Research, S. Chand & Co., New Delhi
4. Kalyanmoy Deb, Optimization for Engineering Design Algorithms and Examples, Prentice Hall of India, New Delhi, 1995

NOTE: In the semester examination, the examiner will set 8 questions in all, at least one question from each unit, and students will be required to attempt only 5 questions.

B. Tech. 7th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME – 423N	**COMPUTATIONAL FLUID DYNAMICS**	4	0	0	75	25	100	3
Purpose	To familiarize the students with the basic concepts of Computational Fluid Dynamics.							
Course Outcomes								
CO1	Understand the basic equations which govern the fluid flow and heat transfer phenomena.							
CO2	Classify the different types of differential equations and analyze their mathematical behavior.							
CO3	Understand the basic concepts of discretization and error analysis.							
CO4	Analyze the steady and unsteady heat conduction & combined conduction diffusion problems.							

UNIT I

Methods of prediction: comparison of experimental investigation vs theoretical calculation; Mathematical description of physical phenomena; governing differential equations; the general form of governing differential equation; nature of co-ordinates; one way and two-way co-ordinates; proper choice of co-ordinates.

Mathematical behavior of partial differential equations: Classification of partial differential equations, general behavior of different classes of equations: Elliptic, parabolic and hyperbolic partial differential equations.

UNIT II

Discretization: The concept of discretization; Finite differences; Taylor series formulation; Finite difference discretization of ordinary and partial derivatives; Truncation error, round-off error, discretization error; Consistency and stability of numerical schemes; Variationally formulation; Method of weighted Residuals, control volume formulation.

UNIT III

Heat Conduction: Steady one-dimensional conduction, Inter-face conductivity, Non-linearity, Source-term linearization, Boundary conditions. Unsteady one-dimensional conduction: Explicit, Crank-Nicolson and Fully Implicit Schemes Discretization of two and three dimensional problems, over relaxation and under relaxation.

UNIT IV

Convection and Diffusion: Steady one dimensional convection and diffusion, Upwind scheme, Exponential scheme, Hybrid scheme, Power law scheme, Generalized formulation, Discretization equation for two and three dimensional problems, Outflow boundary condition, false diffusion.

Calculation of the flow field: Need for a special procedure, Vorticity based methods, Representation of pressure-gradient term, Representation of the continuity equation, Staggered grid, Momentum equations, Pressure velocity corrections, Pressure correction equation, SIMPLE algorithm.

Reference and Text books:

1. Numerical Heat Transfer and Fluid Flow – Suhas V. Patankar, Ane Books.
2. Computational Fluid Dynamics: The Basics with Applications – John D. Anderson Jr., McGraw Hill.
3. An Introduction to CFD: Development, Applications and Analysis – Atul Sharma, Ane Books.
4. An Introduction to Computational Fluid Dynamics: The Finite Volume Method – H. Versteeg and W. Malalasekra, Pearson Education.

NOTE: In the semester examination, the examiner will set 8 questions in all, at least one question from each unit, and students will be required to attempt only 5 questions.

B. Tech. 7th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME – 425N	**FUNDAMENTALS OF GAS DYNAMICS**	4	0	0	75	25	100	3
Purpose	To aware the students for basic concepts of gas dynamics and study flow through nozzles and diffusers. Also, to understand the concepts of flame and combustion along with propulsion.							
Course Outcomes								
CO1	To study the fundamentals of gas dynamics and its properties. Also, to understand the fundamental equations of steady flow.							
CO2	To enable the students to understand isentropic flow, adiabatic flow, frictional flow and variable area flow.							
CO3	To study the flow through nozzles and diffusers.							
CO4	Learn about various concepts related to flame, combustion and propulsion.							

UNIT I

Basic concepts of Gas Dynamics and Gas Properties*:* Units and dimensions, The concepts of a continuum, properties of the continuum. Methods of describing fluid motion, Lagrangian method. Eulerian Method. The integral form of the equations of Conservations of Mass, momentum and energy as applied to control volumes, applications to the steady flow of inviscid compressible fluids

Fundamental equations of Steady Flow: Continuity and momentum equations, The thrust function, The dynamic equation and Euler's Equation, Bernoulli's Equation. Steady flow energy equations

UNIT II

Isentropic Flow: Introduction, Acoustic velocity, Mach number, Mach line and mach angle. Classification of flows, Kerman's rules of supersonic flow, flow parameter, critical condition stagnation values.

Adiabatic Flow: Stagnation temperature change, Rayleigh line, Pressure ratio and temperature ratio, Entropy considerations, maximum heat transfer.

Frictional Flow: The fanning equation, Friction factor and friction parameter, Fanno line, Fanno equations.

Variable Area Flow: Velocity variation with Isentropic flow, Criteria for acceleration and deceleration, Effect of pressure ratio on Nozzle operation, Convergent nozzle and convergent divergent nozzle, Effect of back pressure on nozzle flow, Isothermal flow functions, Comparison of flow in nozzle, Generalized one dimensional flow.

UNIT III

Flow Through Nozzle: Under and over expansion in nozzle flow, frictional effects on nozzle flow, operation of nozzles, analysis of shock phenomena, shocks in nozzles- normal shock waves, oblique shock waves; thermodynamic directions of a normal shock, Rankins-Hugoniat relation, strength of shock, operation of nozzles, Governing relation of the Normal shock, Pressure, Temperature, Density, Mack number across the shock, Reyleigh and Fanno lines, problems.

Flow through Diffusers: Classification of diffusers, internal compression subsonic diffusers, velocity gradient, effect of friction and area change, the conical internal-compression Subsonic

diffusers, external compression subsonic diffusers, supersonic diffusers, Normal shock supersonic diffusers, the converging diverging supersonic diffusers.

UNIT IV

Introduction to Flames and Combustion: Flame propagation, diffusion flames, premixed flames, flame velocity, theories of flame propagation, ignition for combustible mixture, flame stabilization.

Propulsion: Introduction, Brayton cycle, propulsion engines. thrust power and efficiency, thrust consideration power consideration, power conskloiftlion and efficiency consideration, open Brayton cycle for propulsion systems, turbojet, turbo propulsion, ram jet, pulse jet, numericals.

Text Books:

1. Fundamentals of Gas Dynamics- YAHA, S.M. TMI-I, India.
2. Fluid Mechanics-A.K. Mohanty, Prentice Hall of India.

Reference Books:

1. Fundamentals of Fluid Mechanics- YUAN, S.W. Prentice Hall of India.
2. Fundamentals of Gas Dynamics - Robert D. Zucker, Met tire Publication.
3. Gas Dynamics -E-., Radha Krishnan, prentice Hall of India.
4. Gas Dynamics Vol. -I Zucrotuf, Wiley.
5. Gas Dynamics - Shapiro Wiley.

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ELECTIVE-II

B. Tech. 7th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME – 427N	**FINITE ELEMENT METHODS IN ENGINEERING**	3	0	0	75	25	100	3
Purpose	Students will be able to solve the various problems related to structures, machines etc. through finite element methods. Also, enable the students for predicting the solutions of compressible and incompressible fluid friction film problems							
Course Outcomes								
CO1	To study the fundamentals of finite element methods and understand the various methods for solving engineering problems.							
CO2	To enable the students to understand higher order parametric elements and also to study element shapes, sizes and node locations.							
CO3	Enable the students for solving plane stress and strain problems, axis-symmetric and three-dimensional stress-strain problems.							
CO4	Learn about velocity-pressure and stream function-vorticity formulation. Also, to understand in viscid incompressible flow, potential function and stream function formulation.							

UNIT I

Introduction: Basic Concept, Historical background, Engineering applications, general description, Comparison with other methods.

Integral Formulations and Variational Methods: Introduction, Variational Principles and Methods, Need for weighted-integral forms, relevant mathematical concepts and formulae, weak formulation of boundary value problems, Variational Methods, Rayleigh-Ritz method, and the Method of weighted residuals.

UNIT II

Second Order Differential Equations in One Dimensions: Finite Element models: Model boundary value problem, finite element discretization, element shapes, sizes and node locations, interpolation functions, derivation of element equations, connectivity, boundary conditions, FEM solution, post-processing, compatibility and completeness requirements, convergence criteria, higher order and isoperimetric elements, natural coordinates, Lagrange and Hermite polynomials.

UNIT III

Plane Elasticity Analysis: External and internal equilibrium equations, one-dimensional stress-strain relations, plane stress and strain problems, axis-symmetric and three-dimensional stress-strain problems, strain displacement relations, boundary conditions, compatibility equations, computer programs.

UNIT IV

FEM Application to Scalar Problems: Variational approach, Galerkin approach, one-dimensional and two-dimensional steady-state problems for conduction, convection and radiation, transient problems. In viscid incompressible flow, potential function and stream function formulation, incompressible viscous flow, stream function, velocity-pressure and stream

function-vorticity formulation, Solution of incompressible and compressible fluid film lubrication problems.

Reference and Text Books:

1. The Finite Element Method - By Zienkiewicz, Tata McGraw.
2. The Finite Element Method for Engineers -By Huebner, John Wiley.
3. An Introduction to the Finite Element Method -By J.N. Reddy, McGraw Hill.
4. Finite Element Methods By R. Dhanaraj and K. Prabhakaran Nair, Oxford university press.

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B. Tech. 7th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME – 429N	**ADVANCED MANUFACTURING TECHNOLOGY**	3	0	0	75	25	100	3
Purpose	The course covers the details of the advanced machining theory and practices, advanced machining processes, advanced metal forming processes, advanced welding processes and advanced foundry processes							
Course Outcomes								
CO1	Students will be able to comprehending the surface cleaning, treatments process and vacuum mould processes.							
CO2	Students will be able analyze the advanced casting processes							
CO3	Students will be able to Synthesize the effect of variables on metal forming processes.							
CO4	Students will be able to design vacuum die and evaluate the chief factors in cost estimating.							

UNIT I

Hot machining, Machining of Plastics, Unit heads, Plastics cooling, electro forming, Surface Cleaning and Surface Treatments, Surface Coatings, Paint Coating and Slushing, Adhesive Bonds, Adhesive Bond Joints, Adhesives, Surface Coating for Tooling, Graphite Mould Coating, **Vacuum Mould Process.** Introduction, Types of Composites materials, Agglomerated Materials, Reinforced materials, Laminates, Surface Coated Materials, Production of Composite Structures, Fabrication of particulate composite Structures, Fabrication of reinforced Composite, Fabrication of Laminates, Machining, Cutting and Joining of Composites.

UNIT II

Polymers: Introduction, Polymerization, Addition of Polymers, Plastics, Types of plastics, Properties of Plastics, Processing of Thermoplastic Plastics, Injection Moulding, Casting of Plastics, Machining of plastics, other processing methods of plastics Introduction, casting, thread chasing, Thread Rolling, Die Threading and Tapping, Thread Milling, Thread Measurement and Inspection.

UNIT III

Metal Forming: Theoretical basis of metal forming, classification of metal forming processes, cold forming, hot working, Warm working, Effect of variables on metal forming processes, Methods of analysis of manufacturing processes, Open Die forging, Rolling Power Rolling, Drawing, Extrusion.

UNIT IV

Die Casting: Introduction, Product Application, Limitation of Die Casting, Die Casting Machines, Molten metal Injection systems, lot chamber machines, Cold chamber machines, Die casting Design, Design of Die casting Dies, Types of Die casting Dies, Die design, Die material, Die Manufacture, Die Lubrication and Coating, Preheating of Dies, Vacuum Die Casting, Recent trends In Die Casting Process. Definition, Cost accounting or costing, Elements of costing, cost

structures, Estimation of cost elements, Methods of estimating, Data requirements of cost estimating, Steps in making cost estimate, Chief factors in cost estimating, Numerical examples, calculation of machining times, Estimation of total unit time

Reference and Text Books:

1. Principles of Manufacturing- By J.S.Campbell, Tata McGraw-Hill
2. Production Engineering Sciences- By Pandey and Sinh Standard Pub.
3. A text book of Production Technology- By P.C. Sharma S.Chand & Company.
4. Manufacturing Materials and Processes- By Lindberg Prentice Hall
5. A text book of Production Engineering- By P.C. Sharma S.Chand & Company.

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B. Tech. 7th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME – 431N	**ROBOTICS: MECHANICS AND CONTROL**	3	0	0	75	25	100	3
Purpose	To acquaint the students about the mechanics and controls of robotic systems and its application in industries.							
Course Outcomes								
CO1	To make students to aware about the basic of robot and the various drive mechanism used in robot.							
CO2	To acquaint the students about the end effectors and robot controls.							
CO3	To impart the students to understand about the robot transformations and sensors used in robot.							
CO4	To make students understand about the robot cell design and area of application of robot.							

UNIT I

Robot anatomy: Definition, law of robotics, History and Terminology of Robotics, Accuracy and repeatability of Robotics, Simple problems.

Robot drive mechanism: Objectives, motivation, Types of drive systems, Functions of drive system, Lead Screws, Ball Screws, Chain & linkage drives, Belt drives, Gear drives, Harmonic drives.

UNIT II

Mechanical grippers: Slider crank mechanism, Screw type, Rotary actuators, cam type, Magnetic grippers, Vacuum grippers, Air operated grippers, Gripper force analysis, Gripper design-Simple problems

Robot controls: Point to point control, Continuous path control, intelligent robot control system for robot joint, Control actions, Feedback devices: Encoder, Resolver, LVDT-Motion Interpolations-Adaptive control.

UNIT III

Robot kinematics: Types- 2D, 3D Transformation-Scaling, Rotation, Translation-Homogeneous coordinates, multiple transformation-Simple problems.

Sensors in robot: Touch Sensors-Tactile sensor – Proximity and range sensors – Robotic vision sensor-Force Sensor-Light sensors, Pressure sensors.

UNIT IV

Robot cell design: Robot work cell design and control-Sequence control, Operator interface, Safety monitoring devices in Robot-Mobile robot working principle, actuation using MATLAB, NXT Software

Robot applications: Material handling, Machine loading and unloading, assembly, Inspection, Welding, Spray painting and undersea robot.

REFERENCE BOOKS:

1. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education., 2009
2. Mikell P Groover& Nicholas G Odrey, Mitchel Weiss, RogerN Nagel, AshishDutta, Industrial Robotics, Technologyprogramming and Applications, McGraw Hill, 2012
3. Richard D. Klafter, Thomas .A, ChriElewski, Michael Negin,Robotics Engineering an Integrated Approach, Phi Learning.,2009.
4. Francis N. Nagy, AndrasSiegler, Engineering foundation of Robotics, Prentice Hall Inc., 1987.
5. P.A. Janaki Raman, Robotics and Image Processing: An Introduction, Tata McGraw Hill Publishing company Ltd.,1995.
6. Fu. K. S., Gonzalez. R. C. & Lee C.S.G., "*Robotics control,sensing, vision and intelligence"*, McGraw Hill Book co, 1987
7. Craig. J. J. "*Introduction to Robotics mechanics and control"*,Addison- Wesley, 1999.
8. Ray Asfahl. C., "*Robots and Manufacturing Automation"*, JohnWiley & Sons Inc.,1985.

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B. Tech. 7th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME – 433N	**SIMULATION OF MECHANICAL SYSTEMS**	3	0	0	75	25	100	3
Purpose	To make students aware of System and environment concepts of Simulation, statistics in simulation, Modelling elements in manufacturing systems, Simulation of manufacturing systems, Modelling of manufacturing supply chains, Design of simulation experiments.							
Course Outcomes								
CO1	Students will attain the knowledge of System and environment concepts of Simulation & statistics in simulation.							
CO2	Students will attain the knowledge of Modelling elements in manufacturing systems & Simulation of manufacturing systems.							
CO3	Students will attain the knowledge of modelling of manufacturing supply chains.							
CO4	Students will attain the knowledge of Design of simulation experiments.							

UNIT I

Introduction: Concept of System and environment, Continuous and discrete systems, Linear and non-linear systems, Stochastic processes, Static and Dynamic models, Principles of modeling, Basic Simulation modeling, Role of simulation in model evaluation and studies, Steps in a simulation study, Verification, validation and credibility of simulation models, Advantages, disadvantages and pitfalls of simulation,

Statistics in Simulation: Review of basic probability and statistics, random variables and their properties, Statistical analysis for terminating simulation and steady state parameters

UNIT II

Modelling Elements In Manufacturing Systems: Definition, Classifications and characteristics of production systems; measures of manufacturing systems performance, modelling elements in manufacturing systems: processes, resources, single and multi-server queues, arrival processes, service times, downtime, manufacturing costs, resources selection rules, different manufacturing flexibilities.

Simulation of Manufacturing Systems: Simulation of Job shop, batch and Flexible manufacturing systems, Case studies for above systems.

UNIT III

Modelling of Manufacturing Supply Chains (SC): Introduction of SC, Modelling elements in SC, Measures of SC performance, brief review of bear game, SC initiatives and effect on SC performance Modelling of Supply Chain Processes at different Supply chain nodes like: Retailer, assembler, distributor, and manufacturer; Modelling of different SC processes, inventory control policies like (s, S), (s, Q) systems, production control issues like Manufacturing-to-order, Manufacturing-to-stock, Assemble-to-order, Assemble-to-stock; Modelling of material transport system in SC, Development of Simple SC models

UNIT IV

Design of Simulation Experiments: Consideration For Selecting Length of Simulation run, no of replication and warm-up period, elimination of initial bias, Finance Considerations of a simulation study, Variance reduction techniques, 2^k factorial design, fractional factorial design, factor screening, response surface, Meta-models and sensitivity, optimization procedures.

Suggested Reading:

1. Simulation Modeling and Analysis, 3e, Law A.M. and Kelton W.D., TMH, New Delhi.
2. Simulation with Arena - Kelton and Sadowski, 2003, (McGraw-Hill).
3. Analysis and Control of Production Systems, Printice Hall Publn, E.A. Elsayed and T.O. Boucher, 1994.
4. Modelling and Analysis of Dynamic Systems, C.M. Close and Dean K.F., Houghton Mifflin.
5. Simulation of Manufacturing, Allan Carrie, John Wiley & Sons.
6. System Simulation, Geoffrey Gordon, Prentice Hall, 1998.
7. Modern Production /Operations Management, 8e, Buffa E.S. and Sarin R.K., John Wiley.
8. Designing and Managing the Supply Chain, 3/e, Simchi-Levi D., Kaminsky P., Simchi-Levi E., Shankar R., TMH,
   New Delhi.

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B. Tech. 7th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME – 435N	**CONTROL ENGINEERING**	3	0	0	75	25	100	3
Purpose	Modeling, performance analysis and control with potential application to engineering systems.							
Course Outcomes								
CO1	Students will be able to understand basis of different types of control systems.							
CO2	Students will be able to Apply systems theory to complex real world problems in order to obtain models that are expressed using differential equations, transfer functions, and state space equations.							
CO3	The student will be able to Predict system behavior based on the mathematical model of that system where the model may be expressed in time or frequency domain.							
CO4	The students will be able to Analyze the behavior of closed loop systems using tools such as root locus, Routh Hurwitz, Bode.							

UNIT I

Control Systems: Introduction, Brief History of Automatic Control, Examples of Control Systems, Engineering Design, Mechatronic Systems, the Future Evolution of Control Systems

UNIT II

Mathematical Models of Systems: Differential Equations of Physical Systems, Linear Approximations of Physical Systems, the Laplace Transform, the Transfer Function of Linear Systems, Block Diagram Models and Signal-Flow Graph Models

UNIT III

Feedback Control System Characteristics: Error Signal Analysis, Sensitivity of Control Systems to Parameter Variations, Disturbance Signals in a Feedback Control System, Control of the Transient Response, Steady-State Error, The Cost of Feedback.

UNIT IV

The Design of Feedback Control Systems: Approaches to System Design, Cascade Compensation Networks, Phase-Lead Design Using the Bode Diagram, Phase-Lead Design Using the Root Locus, System Design Using Integration Networks, Phase-Lag Design Using the Root Locus, Phase-Lag Design Using the Bode Diagram, Design on the Bode Diagram Using Analytical Methods.

Text Books:

1. Modern Control System by Richarc C. Drof and Robert H. Bishop,11th Edition Person Int.
2. Modern Control Engineering by Katsuhiko Ogata, 4th Edition, Prentice Hall of India.
3. Automatic Control Systems by Benjamin C.Kuo, 8th Edition, John Wiley & Sons.
4. Control Systems Engineering by Nagrath and Gopal New Age Publication

5. Feedback and Control Systems by Joseph J Distefano 2nd Edition TMH

NOTE: In the semester examination, the examiner will set 8 questions in all, at least one question from each unit, and students will be required to attempt only 5 questions.

B. Tech. 7th Semester Mechanical Engineering

Course No.	Course Title	Teaching Schedule			Allotment of Marks			Duration of Exam (Hrs.)
		L	T	P	Theory	Sessional	Total	
ME – 437N	**ENVIRONMENTAL POLLUTION AND ABATEMENT**	3	0	0	75	25	100	3
Purpose	This course is very important for Mechanical Engineers considering the expectation of the Industries for pollution control in their premises so as to comply with newer and tougher laws and acts that are being enforced in India and globally. This course introduces the principles and methods to control air, water and soil pollution to the undergraduate students of chemical engineering.							
Course Outcomes								
CO1	To make students aware with the Recycle and reuse of waste, energy recovery and waste utilization.							
CO2	To make students aware with the Air pollution and its measurement, design of pollution abatement systems for particulate matter and gaseous constituents.							
CO3	To make students aware with the Design of waste-water and industrial effluent treatment; Hazardous waste treatment and disposal; Solid-waste disposal and recovery of useful products.							
CO4	To make students aware with the water, air and land pollution; legislation and standards; Recycle and reuse of waste, energy recovery and waste utilization.							

UNIT I

Environmental pollution: Introduction: Environment and environmental pollution from chemical process industries, characterization of emission and effluents, environmental Laws and rules, standards for ambient air, noise emission and effluents.

UNIT II

Pollution Prevention: Process modification, alternative raw material, recovery of by co-product from industrial emission effluents, recycle and reuse of waste, energy recovery and waste utilization. Material and energy balance for pollution minimization. Water use minimization, Fugitive emission/effluents and leakages and their control-housekeeping and maintenance.

Air Pollution Control: Particulate emission control by mechanical separation and electrostatic precipitation, wet gas scrubbing, gaseous emission control by absorption and adsorption, Design of cyclones, ESP, fabric filters and absorbers.

UNIT III

Water Pollution Control: Physical treatment, pre-treatment, solids removal by setting and sedimentation, filtration centrifugation, coagulation and flocculation. Waste water, waste water management.

UNIT IV

Solids Disposal: Solids waste disposal - composting, landfill, briquetting / gasification and incineration. **Biological Treatment:** Anaerobic and aerobic treatment biochemical kinetics, trickling filter, activated sludge and lagoons, aeration systems, sludge separation and drying.

Reference books:

1. "Pollution Control Acts, Rules, Notifications issued there under" CPCB, Ministry of Env. and Forest, G.O.I., 3rd Ed. 2006.
2. Vallero D; "Fundamentals of Air Pollution", 4 th Ed; Academic Press.
3. Eckenfelder W. W; "Industrial Water Pollution Control", 2 Ed; McGraw Hill.
4. Kreith F. and Tchobanoglous G., "Handbook of Solid Waste Management", 2 Ed; Mc Graw Hill.
5. Pichtel J; "Waste Management Practices: Municipal, Hazardous and Industrial", CRC.
6. Tchobanoglous G.,Burton F. L. and Stensel H.D., "Waste Water Engineering: Treatment and Reuse", 4th Ed; Tata McGraw Hill.

NOTE: In the semester examination, the examiner will set 8 questions in all, at least one question from each unit, and students will be required to attempt only 5 questions.

B. Tech. 8th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME – 402N	**AUTOMOBILE ENGINEERING**	4	0	0	75	25	100	3
Purpose	To make aware the students with the study of engineering which teaches manufacturing, and mechanical-mechanisms as well operations of automobiles. It is an introduction to vehicle engineering which deals with motorcycles, cars, buses trucks etc. It includes branch study of mechanical, electronic, and safety elements. Some of the engineering attributes and disciplines that are of importance to the automotive engineer.							
Course Outcomes								
CO1	Students will be able to Develop a strong base for understanding future developments in the automobile industry							
CO2	Students will be able to Explain the working of various parts like engine, transmission, gear box etc.							
CO3	Students will be able to Describe how the brakes and the suspension systems operate							
CO4	Students will be able to Understand the steering geometry and emission control system.							

UNIT I

Introduction: Brief history of automobiles, Main components of an automobile, Brief description of each component. Brief description of constructional details and working of a four stroke I.C. Engine (S.I. Engines and C.I. Engines) including lately developed overhead cam shaft, Multi-cylinder engines, Introduction to recent developments in I.C. Engines- Direct injection systems, Multi-point fuel injection systems, Introduction, Brief description of different components of Transmission System.

Clutch: Clutch Introduction to Clutch and its different types, Principle of Friction Clutch, Clutch Lining and friction materials used in Friction Clutches, Torque transmitted, Brief description of Cone Clutch, Single Plate and Multiplate Clutches, Dry and wet clutches, Automatic clutch action, Centrifugal clutches, Electromagnetic clutches, Fluid Flywheel.

UNIT II

Gear Box: Gear Box Air resistance, gradient resistance and rolling resistance coming across a moving automobile, Tractive effort, Variation of tractive effort with speed, Performance curves (object and need of a gear box), Sliding mesh gear box, Control mechanism, Sliding type selector mechanism, Ball type selector mechanism, Steering column gear shift control, Constant mesh gear box, Synchromesh device, Automatic transmission in general, AP automatic gear box, Torque converter, Torque converter with direct drive, Lubrication of Gear Box.

Propeller Shaft: Functions and requirements of a propeller shaft, Universal joints, Constructional forms of universal joints, Flexible-ring joints, Rubber-bushed flexible joints. Constant-velocity joints. Differential : Principle of operation, Constructional details of a typical Differential unit, Traction control differentials, Multi-plate clutch type traction control device.

UNIT III

Brakes: Functions and methods of operation, Brake efficiency. Elementary theory of shoe brake, brake shoe adjustments, A modern rear-wheel brake, Disc brakes, Brake linkages, Leverage and adjustment of the brake linkage, Servo- and power operated brakes, Vacuum brake operation,' Hydraulic Brakes-constructional details and working, Direct action vacuum servos, Power-operated brakes, A dual power air brake system,

Suspension system: Suspension principles, Road irregularities and human susceptibility, Suspension system, Damping, Double tube damper, Single tube damper, Lever arm type damper, Springs-Leaf springs, Coil and torsion springs, variable rate springs, Composite leaf springs, Rubber springs, Air springs, Adjustable and self-adjusting suspensions, Interconnected suspension system, Interconnected air and liquid suspensions, Independent suspension system, Different independent suspension layouts, McPherson strut type, Rear suspension-live axle, McPherson strut rear suspension.

UNIT IV

Steering Geometry: Castor, Camber, Kingpin inclination, Combined angle, Toe-in, Steering system-basic aims, Ackerman linkage, Steering linkages for independent suspension, Center point steering, Costarring or trailing action, Cornering power, Self-righting torque, Steering characteristics-over steer and under steer, Axle beam, Stub-axle construction, Steering column, Reversible and irreversible steering, Rack-and-pinion steering mechanism, Effect of toe-in on steering, Power steering, Vickers System. Recent trends in automobile engineering Multi fuel automobiles, Automobiles running on alternate sources of energy, Emission control through catalytic converter, Double catalytic converter, Aspects of pollution control in Automobiles.

Reference and Text Books:

1. The Motor Vehicle - By Newton, Steeds and Garretle Basic
2. Automobile Engineering - By Kirpal Singh
3. Automobile Engineering *' -By K.M. Gupta, Umesh Publications

NOTE: In the semester examination, the examiner will set 8 questions in all, at least one question from each unit, and students will be required to attempt only 5 questions.

B. Tech. 8th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME – 404N	**POWER PLANT ENGINEERING**	4	0	0	75	25	100	3
Purpose	To make student aware about the modern aspects of power generation, problems of energy demand and supply and power plant economics.							
Course Outcomes								
CO1	To introduce about the different sources of energy, hydrology and hydro power generation.							
CO2	To analyze the steam power cycles, steam generators, fuels and different handling systems in power plants.							
CO3	To understand the concept of combined cycles power generation and diesel engine power plants.							
CO4	To know about the nuclear energy and the economics of power generation.							

UNIT I

Energy Sources: Conventional and non-conventional sources of energy, Geothermal power plants, Tidal power plants, Windmills, Solar power plants, Solar thermal, Solar Photovoltaic: Direct energy conversion systems, Energy sources in India, Recent developments in power plants.
Hydroelectric Power Plant: Hydrology, Rainfall, runoff, hydrographs, flow duration curves, Site selection for hydro power plants, Classification of hydro power plants, Storage type hydro power plant and its operation, Estimation of power availability, Selection of water turbines, Combination of hydro power plants with steam plants, advantages and disadvantages of hydro power plants.

UNIT II

Analysis of Steam Cycle: The Carnot, The ideal Rankine cycle, externally irreversible Rankine cycle, Superheat, Reheat, Regeneration, internally irreversible Rankine cycle, open feed water heaters, closed type feed water heaters, Typical layout of steam power plant, Efficiency and heat rate.
Steam Generators: Introduction to steam generators, Steam generator control, Fluidized bed boilers, Modern high pressure boilers, Supercritical boilers, Ultra supercritical technology, Advanced Ultra supercritical technology, Flue gas de-nitrification and desulphurization, fabric filters and baghouses, feed water treatment, Deaeration, Internal treatment, boiler blowdown, steam purity.
Fuel and Combustion: Coal as fuel, classification of coals, analysis of coal, Coal handling, Dead and live storage, Combustion of coal, combustion equipment for coal burning, mechanical stokers, pulverized fuels and burners, Cyclone furnace, Low NO_X burners, Ash handling and disposal, Dust collectors. Heat balance sheet for thermal power plants, environmental aspects of power generations.

UNIT III

Diesel Engine Power Plants: Applications of diesel engines in power field, Advantages and disadvantages of diesel plants over thermal power plants, Schematic arrangement of diesel

engine power plant, Different systems of diesel power plant, Performance Characteristics, Supercharging, Layout of Diesel Engine power plant.

Gas Turbine and Combined Cycles: Gas turbine cycles, the ideal Brayton cycle, the non-ideal Brayton cycle, Modification of the Brayton cycle, Gas turbine characteristics, Combined Cycles: combined cycles with heat recovery boiler, The STAG combined-cycle power plant, combined cycles with multi-pressure steam, combined cycle for nuclear power plants.

UNIT IV

Nuclear Power Plants: Basic theory and terminology, Nuclear fission and fusion processes, Fission chain reaction, Moderation, Fertile materials, Nuclear fuels, General components of nuclear reactor, Different types of reactors: PWR, BWR, GCR, LMFBR, CANDU-PHW, India's nuclear power program, Disposal of nuclear waste and related issues.

Economics of Power Generation: Introduction to economics of power generation, Different terms and definitions, Cost analysis, Selection of power plant equipment, factors affecting economics of generation and distribution of power, Performance and operating characteristics of power plants, Economic load sharing, Tariff for electrical energy.

Text Books:

1. Power Plant Engineering by Morse.
2. Power Plant Engineering by PK Nag.
3. Power Plant Technology -By El-Wakil.
4. Power Plant Engineering by Domkundawar.

Reference Books:

1. Power Plant Engineering -By P.C. Sharma
2. Power Plant Technology- By G.D.Rai
3. Power Plant Engineering by R.K. Rajput

NOTE: In the semester examination, the examiner will set 8 questions in all, at least one question from each unit, and students will be required to attempt only 5 questions.

B. Tech. 8th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME – 406N	**QUALITY ASSURANCE & RELIABILITY**	4	0	0	75	25	100	3
Purpose	This course provides the understanding of Concepts of quality in engineering domain. Various aspects of quality such as quality management, statistical quality control, system reliability, etc. will be taught to students.							
Course Outcomes								
CO1	Students will understand the concepts of quality, quality assurance and management.							
CO2	Students will be able to demonstrate the ability to use the methods of statistical process control and able to use and interpret control charts for variables.							
CO3	Students will be able to use and interpret control charts for attributes, also able to understand sampling inspection.							
CO4	Understand the concepts of reliability, carry out reliability data analysis, Get acquainted with computation of system reliability and reliability improvement methods.							

UNIT I

Introduction- Definition of Quality, Quality function, Dimensions of Quality, Brief history of quality methodology, Statistical methods for quality improvement, Quality costs, Introduction to Quality function deployment.

Quality Assurance (QA) - Introduction, Definition, Management principles in QA, Forms of QA, QA in different stages. Quality planning, QA program, QA aspect, Quality in material management, Vendor selection & development.

UNIT II

Statistical Process Control - Introduction to statistical process control, Concept of variation, Assignable & Chance causes, Attributes & variables, Frequency distribution curve & its types. Normal Distribution curve, Problems on FD curve & ND curve, Application of SPC.

Control Charts for Variables- Definition, Formulae & its problems. Control chart patterns, Process capability. Problems on x & R chart and Process capability.

UNIT III

Control Charts for Attributes- Definition, Formulae & its problems. Problems on p, c charts. Choice between variables and attributes control charts. Guidelines for implementing control charts.

Sampling Inspection - Sampling: Definition, types of sampling, importance, benefits and limitations of sampling, Operating Characteristic Curve, Average Outgoing Quality Curve, Errors in Making Inferences from Control Charts (Type I and II errors).

UNIT IV

Reliability Concepts - Introduction of Reliability concepts, Failure data analysis and examples, Failure rate, Failure density, Probability of failure, Mortality rate, Mean time to failure,

Reliability in terms of Hazard rate and Failure Density, examples, Useful life and wear out phase of a system,

System Reliability and Improvement: Reliability of series and parallel connected systems and examples, Logic diagrams, Improvement of system reliability, Element Redundancy, Unit redundancy, Standby redundancy.

Suggested Reading:

1. Grant E L, Statistical Quality Control", McGraw-Hill.
2. Mahajan, "Quality Control and Reliability", Dhanpat Rai & Sons
3. Srinath L S, "Reliability Engineering", East west press.
4. Sharma S C, Inspection Quality Control and Reliability, Khanna Publishers

NOTE: In the semester examination, the examiner will set 8 questions in all, at least one question from each unit, and students will be required to attempt only 5 questions.

B. Tech. 8th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME – 408N	**AUTOMOBILE ENGINEERING LAB**	0	0	2	40	60	100	3
Purpose	To understand construction details and working of various parts of automotive system							
Course Outcomes								
CO1	To make students aware with constructional details and working of Cylinder, Ignition System and Injection System of I C Engine.							
CO2	To make students aware with constructional details of Automotive Clutches, Automotive Transmission Systems Automotive Drive Lines & Differentials.							
CO3	To make students aware with the Design and constructional details of Automotive Suspension Systems and Automotive Suspension Systems.							
CO4	To make students aware with t Design and constructional details Automotive Tyres & wheels Automotive Brake Systems Automotive Emission / Pollution control systems.							

LIST OF EXPERIMENTS:

1. To study and prepare report on the constructional details, working principles and operation of the following Automotive Engine Systems & Sub Systems.
(a) Multi-cylinder: Diesel and Petrol Engines.
(b) Engine cooling & lubricating Systems.
(c) Engine starting Systems.
(d) Contact Point & Electronic Ignition Systems.

2. To study and prepare report on the constructional details, working principles and operation of the following Fuels supply systems:
(a) Carburetors (b) Diesel Fuel Injection Systems (c) Gasoline Fuel Injection Systems.

3. To study and prepare report on the constructional details, working principles and operation of the following Automotive Clutches. (a) Coil-Spring Clutch (b) Diaphragm – Spring Clutch. (c) Double Disk Clutch.

4. To study and prepare report on the constructional details, working principles and operation of the following Automotive Transmission systems. (a) Synchromesh – Four speed Range. (b) Transaxle with Dual Speed Range. (c) Four Wheel Drive and Transfer Case. (d) Steering Column and Floor – Shift levers.

5. To study and prepare report on the constructional details, working principles and operation of the following Automotive Drive Lines & Differentials. (a) Rear Wheel Drive Line. (b) Front Wheel Drive Line. (c) Differentials, Drive Axles and Four Wheel Drive Line.

6. To study and prepare report on the constructional details, working principles and operation of the following Automotive Suspension Systems. (a) Front Suspension System. (b) Rear Suspension System.

7. To study and prepare report on the constructional details, working principles and operation of the following Automotive Suspension Systems. (a) Manual Steering Systems, e.g. Pitman –arm steering, Rack & Pinion steering. (b) Power steering Systems, e.g. Rack and Pinion Power Steering System. (c) Steering Wheels and Columns e.g. Tilt & Telescopic steering Wheels, Collapsible Steering Columns.

8. To study and prepare report on the constructional details, working principles and operation of the following Automotive Tyres& wheels. (a) Various Types of Bias & Radial Tyres. (b) Various Types of wheels.

9. To study and prepare report on the constructional details, working principles and operation of the Automotive Brake systems. (a) Hydraulic & Pneumatic Brake systems. (b) Drum Brake System. (c) Disk Brake System. (d) Antilock Brake System. (e) System Packing & Other Brakes.

10.To study and prepare report on the constructional details, working principles and operation of Automotive Emission / Pollution control systems.

NOTE:

1. At least ten experiments are to be performed in the Semester.

2. At least eight experiments should be performed from the above list. Remaining two experiments may either be performed from the above list or as designed & set by the concerned institution as per the scope of the syllabus

B. Tech. 8th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Practical**	**Sessional**	**Total**	
ME – 410N	**PROJECT-II**	0	0	**10**	100	100	200	3

The students expected to take up a project under the guidance of teacher from the college. The project must be based on mechanical engineering problems, which can be extended up to the full semester. The students may be asked to work individually or in a group not more than four students in a group. Viva- voce must be based on the preliminary report submitted by students related to the project.

B. Tech. 8th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Practical**	**Sessional**	**Total**	
ME–412N	**SEMINAR- II**	0	2	0	0	100	100	

The students are required to deliver a seminar on some emerging areas of Mechanical Engineering, given as follows:

- CAD/CAM/CAE/FEA
- Robotics
- Machine Vision
- Automation
- Tribology
- CFD
- Energy Conservation
- Alternate Energy Sources
- Hybrid Fuels
- Advances in IC Engines
- Vehicle Dynamics
- Aerodynamics
- Advanced Manufacturing Techniques
- Advanced Engineering Materials
- Supply Chain Management
- Business Process Re-engineering
- Six-Sigma Technique
- Lean Manufacturing Technique
- Just-in-Time Technique
- Agile Manufacturing
- Value Engineering
- Reliability Engineering
- Any other topic related to Design/Thermal/Industrial/Production Engineering

The student will deliver a power point presentation for about 30 minutes in the seminar on any of the above topics. This will be followed by question answering session for about 10 minutes. The questions on the seminar topic will be asked by the teacher concerned and class students. The students will also prepare a detailed report in MS word and after spiral binding will submit it to the teacher concerned. The report is to be submitted at least one week prior to the presentation. The grades/awards will be given according to the student's presentation, report submitted, and answering of questions asked after the presentation.

ELECTIVE-III

B. Tech. 8th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME – 414N	**SMART MATERIALS, STRUCTURES & DEVICES**	4	0	0	75	25	100	3
Purpose	This course is designed to give an insight into the latest developments regarding smart materials and their use in structures.							
Course Outcomes								
CO1	Describe the basic concepts related to Smart materials and Intelligent Materials.							
CO2	Describe the role of various smart materials in structural systems and usage of Electrorheological fluids.							
CO3	Describe the working and Engineering applications of Piezoelectric materials							
CO4	To make student understand the Structural Applications of Smart Materials and different aspects of Biomimetic structural design.							

UNIT-I

Smart materials:

Introduction, Historical Perspective, Overview of Microsystems and Smart Systems, Need for Miniaturization, Role of Microfabrication, Typical applications of Microsystems and Smart Systems.

Intelligent materials:

Structural Materials, Functional Materials, Primitive functions of Intelligent Materials, Intelligence inherent in Materials, Materials Intelligently Harmonizing with Humanity, Intelligent Biological Materials.

UNIT-II

Smart Materials and Structural Systems:

The principal ingredients of a premier class of smart materials, Actuator Materials, Sensing Technologies, Micro-sensors, Intelligent Systems, Hybrid Smart Materials, Passive Sensory Smart Structures, Reactive actuator based Smart Structures, Active Sensing and Reactive Smart Structures. Smart Skins, Synthesis of Future smart systems.

Electrorheological Fluids:

Suspension and Electro-rheological fluids, The Electro-Rheological Phenomenon, Charge Migration mechanism for the dispersed phase, Electrorheological Fluid Actuators, Experimental investigations.

UNIT-III

Piezoelectric Materials:

Introduction, Basic Principle, History, Classification of Dielectric materials, Important Dielectric Parameters, Electrostrictive effect, Piezoelectric Effect, Pyroelectric Effect, Ferroelectric Materials, Poling. Examples of Piezoelectric Materials: Quartz, Lead Zirconate Titanate(PZT), Fabrication of PZT, Polymer Piezoelectric Materials, Barium Titanate, Zinc Oxide Thin Films, Polymer Composites.

Engineering Applications of Piezoelectric Materials:

Gas Lighter, Pressure Sensor, Accelerometer, Piezoelectric Gyroscope, Piezoelectric Microphone, Piezoelectric Actuators, Piezoelectric Motor, Piezoelectric Transformer

UNIT-IV

Structural Applications of Smart Materials:

Introduction, Materials and Applications; Shape Memory alloys, Substitute for steel, Engineered Cementitious Composites, Carbon Fiber Reinforced Concrete, Smart Concrete, ER/MR Fluids, Induced Strain Actuators. Active Control of Structures, Passive Control of Structures, Hybrid Control, Smart Material Tag, Retrofitting, Restoration of Cultural Heritage using SMA Devices, SMA for Seismic Retrofit of Bridges, Self-Healing Materials, Self-Stressing for Active Control, Structural Health Monitoring, Active Railway Track Support, Active Structural Control against Wind.

Biomimetic Structural Design:

Biomimetic, Characteristics of Natural Structures, Biomimetic Structural Design; Fiber Reinforced Organic Matrix Natural Composites, Fiber Reinforced Natural Ceramers: Bone and Antler, Fiber Reinforced Organic Matrix and Ceramic Matrix Composites: Mollusks, Biomimetic Sensing, Cochlea, Bats, Challenges and Opportunities

References:

1. Smart Materials and Structures by B.V. Gandhi and B.S. Thompson, Chapman and Hall Pub.
2. Smart Materials Edited by Mel Schwartz , CRC Press.
3. Smart Structures Analysis and Design by A.V. Srinivasan and D. Michael McFarlaid, Cambridge University Press.
4. Piezoelectric Materials and Devices: Applications in Engineering and Medical Sciences by M.S. Vijaya, CRC Press.
5. Smart Structures and Materials by Brian Culshaw, Artech House.
6. Smart Structures by Gauenzi, P., Wiley Publication.
7. Piezoelectricity by Cady, W. G., Dover Publication.

NOTE: In the semester examination, the examiner will set 8 questions in all, at least one question from each unit, and students will be required to attempt only 5 questions.

B. Tech. 8th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME – 416N	**LUBRICATION TECHNOLOGY**	4	0	0	75	25	100	3
Purpose	Providing a fundamental understanding of lubricants and lubricant technology including emerging lubricants such as synthetic and environmentally friendly lubricants & application & usage of lubricants in Automobiles & Machines.							
Course Outcomes								
CO1	Students will interpret, exemplify & use the terminology pertaining to Lubricants & Lubrication as in Industries & can differentiate & classify various types of lubricants based upon their properties.							
CO2	Students will attain knowledge regarding the production or distillation of Mineral & Chemically modified lubricating base oils & Need, Application, Uses, Classification & Properties of Synthesized base oils & Metal Working Fluids.							
CO3	Students will attain a theoretical understanding of various types of lubrications & their applications to avoid/reduce friction & wear.							
CO4	Students will be able to classify & theoretically distinguish between various Steam & Gas Turbine Oils, Compressor, Vacuum Pump & Refrigeration Oils.							

UNIT I

BASICS OF LUBRICANTS

Terminology related to Lubricants & Lubrication: Viscosity; Absolute & Kinematic Viscosity; Newtonian & Non- Newtonian Fluids; Viscosity Measurement; Viscosity Index; Additives; Base Stocks; Anti-Foam Agents; Anti-oxidant; Anti-Wear Agents; Aromatic agents; Role of lubricants in Asperity; Boundary Lubrication; Corrosion Inhibitor; Demulsibility; Detergent; Dielectric Strength; Diester; Dispersant; Dropping Point; Dry Running; Emulsifier; Extreme-Pressure Agent; Film Strength (Lubricity); Hydrolytic Stability; Neutralization Number; Oxidative Stability; Paraffinic etc.

Lubricants: Introduction; Functions of lubricants, types and properties; Mineral Oils, Synthetic Oils, Biodegradable, Environment friendly oils; Automotive Engine Oils; Metal Working Fluids; Aviation Oils; Greases.

UNIT II

Mineral & Chemically modified lubricating base oils: Introduction; Steps Involved in production of Mineral base oils in refineries; Vacuum Distillates characteristics & Properties; Conventional refinery production of Lubricating base oils;

Synthesized base oils: Introduction, Need, Application & Uses, Classification, Properties.

Metal Working Fluids: Classification of Metal Working Fluids; Emulsions & Lubricants; Surface Active compounds in metal working fluids; rolling oils for steel; performance evaluation of steel rolling oils.

UNIT III

Lubrication, Friction & Wear

Introduction; Dry friction; Boundary lubrication; Hydrodynamic, Hydrostatic and Elasto-hydrodynamic lubrication; Lubricant additives; Principles, application to rolling contact bearings, cams, Gears.

UNIT IV

Industrial Lubricants

Steam & Gas Turbine Oils: Classification of Turbine Oils, Properties & Functions of Turbine Oils, Viscosity, Rust & Corrosion Protection, Demulsibility, Air Release, Foam Control, Anti-wear Property, Oxidation Stability, Gas Turbine Oils.

Compressor, Vacuum Pump & Refrigeration Oils: Classification & Specifications of Compressor Oils, Functions of Compressor Oils; Lubrication of Reciprocating Compressor: Compressor Oil properties; Synthetic compressor oils; Vacuum Pump oils; Refrigeration compressor oils; requirement & specification of Refrigeration oils.

Suggested Reading:

1. Developments in Lubricant Technology – By S.P. Srivastava, Wiley
2. Mechanics and Chemistry in Lubrication- By Dorinson and Ludema , Elsevier
3. Friction and wear of Materials- By E. Robinowicz, Johan Wiley
4. Principles of Lubrication-By A. Cameron, Longmans
5. Chemistry and Technology of Lubricants – By R. M. Mortier, S. T. Orszulik, Springer-Science + Business Media, B.V.
6. Lubricant Additives: Chemistry and Applications - Second Edition edited by Leslie R. Rudnick, CRC Press, Taylor & Francis Group.

NOTE: In the semester examination, the examiner will set 8 questions in all, at least one question from each unit, and students will be required to attempt only 5 questions.

B. Tech. 8th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME–418N	**ENERGY MANAGEMENT**	4	0	0	75	25	100	3
Purpose	This course will enlighten the students about the knowledge of Site & Building Surveys, HVAC Systems, Illumination Systems, Process Energy, Building Envelope, Economics & Use of Computers in Energy Management.							
Course Outcomes								
CO1	Students will be able to discuss how Site & Building Surveys are done & the key parameters involved. The technicalities, operating principles & classification of HVAC Systems.							
CO2	Students can describe the fundamental principles, classification & can solve technical problems regarding Illumination Systems & principles, application & advantages of Process Energy.							
CO3	Students will be able to describe the Economics of Energy Management & Conservation Building Envelopes its design & other key considerations.							
CO4	Students can theoretically explain the use of Computers in Energy Management.							

UNIT I

Site & Building Surveys: Phases involved in surveys: Initiation phase, audit and analysis phase, implementation phase; General methodology for Building and Site Energy Audit**; Site survey**: Methodology, Site survey-electrical system, steam and water systems; **Building Survey:** Methodology, Basic energy audit instrumentation, Measurement for building surveys.

Heating, Venting & Air Conditioning System: General principles**;** The requirements for human comfort**;** Description of typical systems-dual duct HVAC system**;** Multi zone HVAC systems: Variable and Volume systems, Terminal repeat system, Evaporative systems, Package system**;** Basic principle governing HVAC system, Package system**;** Energy management opportunities in HVAC systems; Modeling of Heating and cooling loads in buildings; Problems.

UNIT II

Illumination or Lightning Systems: General principles**;** Illumination and human comfort**;** Basic principles of lighting system**;** Typical illumination system and equipment; Fundamentals of single phase and 3 phase A.C. circuits**;** Energy management opportunities for lighting systems, motors and electrical heat**;** Electrical analysis and their parameters, peak demand control**;** Problems.

Process Energy: General principles; Process heat; Energy saving in: Condensate return, Steam generation and distribution, Automotive fuel control, Hot water and Water pumping; Direct and indirect Fired furnaces *over* process electricity; Other process energy forms-compressed air and manufacturing processes; Problems.

UNIT III

Economics of Energy Management: General consideration, life cycle costing, break-even analysis, cost of money, benefit/cost analysis, payback period analysis, prospective rate of to return, problems.

Building Envelope: Environmental conformation; Passive design; Conservation building envelope design consideration; Integration of building system; Energy storage problems.

UNIT IV

Energy Management Principle Involving Computers: Basics of computer use**;** Analysis: Engineering and Economic calculations, Simulation, Forecast**;** CAD/CAM controls: Microprocessor and Minicomputers**;** Building cycling and control**;** Peak demand limiting and control: Industrial power management; Problems.

Text Book:

1. Energy Management Principles by Criag B. Smith, Published by Pergamon Press.

2. Energy systems and developments – Jyoti Parikh, Oxford University Press.

Reference Books:

1. Energy – resources, demand and conservation with reference to India – Chaman Kashkari, Tata Mc Graw Hill Co. Ltd.

2. Integrated renewable energy for rural development – Proceedings of Natural solar energy convention, Calcutta.

NOTE: In the semester examination, the examiner will set 8 questions in all, at least one question from each unit, and students will be required to attempt only 5 questions.

B. Tech. 8th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME–420N	**WASTE HEAT RECOVERY SYSTEM**	4	0	0	75	25	100	3
Purpose	This course provides the knowledge about upcoming concept of Waste Heat Recovery Systems & Cogeneration and also enables the students to think and analyse the techno economic viability of various energy efficient systems.							
Course Outcomes								
CO1	Students will develop an understanding to the basics of Waste heat recovery & then can classify the commercially viable waste heat recovery devices along with their applications & associated saving potential.							
CO2	Students will be able to describe the basic thermodynamic principles of cogeneration, the cogeneration technologies based on steam turbine, gas turbine and IC engine.							
CO3	Students will attain a theoretical understanding of applications & issues related to waste heat recovery & cogeneration technologies.							
CO4	Students will theoretically analyze the Economical & environmental aspects of Waste heat recovery systems & Cogeneration.							

UNIT I

Waste Heat Recovery

Introduction; Heat Losses; Heat recovery from heat treatment furnace; Heat Recovery Classification and Application; Benefits of Waste Heat Recovery; Development of a Waste Heat Recovery System; Commercial Waste Heat Recovery Devices: Heat Pipe, Economizer, Shell and Tube Heat Exchanger, Plate heat exchanger, Run Around Coil Exchanger, Waste Heat Boilers, Heat Pumps, Thermo compressor, Direct Contact Heat Exchanger.

UNIT II

Cogeneration

Principles of cogeneration; Performance indices of cogeneration systems; Cogeneration systems based on steam turbine, gas turbine, combined cycle, and IC engines.

Advanced cogeneration systems based on fuel cells, Stirling Engines; Cogeneration plants electrical interconnection issues - Utility and cogeneration plant-interconnection issues.

UNIT III

Waste Heat Recovery & Cogeneration: Applications

Applications of cogeneration: Utility sector, Industrial, Construction and Rural sectors; Impacts of waste heat recovery & cogeneration plants: Fuel, Electricity and Environment.

Waste heat sources; Selection criteria for waste heat recovery technologies; Recuperative and regenerative heat exchangers for waste heat recovery; Waste heat boilers: Classification, Design considerations, Sizing, Location, Performance calculations, Service conditions; Heat pumps - types, design.

UNIT IV

Waste Heat Recovery & Cogeneration: Economics

Application. Economic analysis of cogeneration and waste heat recovery systems. procedure for optimization of system selection and design, load curves, sensitivity analysis. Regulatory and financial framework for cogeneration and waste heat recovery systems. Environmental considerations. Mitigation of harmful emissions from energy production, conversion and utilization technologies. Control of air, water and ground pollution.

Suggested Reading:

1. Khartchenko N.V. Green Power: Eco-Friendly Energy Engineering, Tech Books, New Delhi,2004.
2. Boyce M.P. cogeneration and combined cycle power plants, ASME press, 2nd ed., 2010
3. Pehnt M. et al. Micro Cogeneration Springer, 2005.
4. Meckler, M., Hyman L.B. Sustainable on-Site CHP Systems, McGraw-Hill, 2010.
5. Obara S. Distributed energy systems, Nova Science, 2009.
6. Khartchenko N.V. Advanced Energy Systems, Taylor and Francis, Washington DC, 1998.
7. Harvey D.L. Handbook on Low-Energy Buildings and District-Energy Systems, Earthscan, 2006.

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B. Tech. 8th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME–422N	**FOUNDRY ENGINEERING**	4	0	0	75	25	100	3
Purpose	The present course focus on giving the exposure of various Foundry processes for a product whose scale ranges from miniature to extra-large, Moulding-Coring practice, Melting inoculations practices, Quality Control of the casting.							
Course Outcomes								
CO 1	Express Knowledge about the fundamentals of the casting, basic terminology related to casting process.							
CO 2	Decide the alternative method for the manufacturing of component for engineering Applications.							
CO 3	Select the methods of the casting and Decide correct melting practice of different cast alloy & different melt-treatments.							
CO 4	Demonstrate the ability to select the proper molding material, type of furnace with relevant refractory material, use appropriate casting design and temperature measurement device to obtain quality cast products.							
CO 5	Minimize the defects generated during casting.							

UNIT-I

Introduction: Introduction to metal casting and foundry industry in modern industrial scenario. Advantages and limitations of casting methods. Classification of foundries. Different sections in a foundry and their functions. Important cast metals and alloys-their composition, properties and uses.

Patterns: Types of patterns, brief classification of pattern making materials, consideration in selection of pattern materials, color coding, pattern allowances, core boxes, types of core boxes.

UNIT-II

Moulding and core making: Ingredients of common type of moulding and core making sands, their properties and behavior, testing of sands and clay.

Moulding processes: Classification of molding processes and casting processes, brief description of all processes such as green sand dry sand, loam sand floor, pit and machine molding.

Casting processes: Shell molding, CO_2 silicate process, Investment casting process, permanent moulding process, Gravity and pressure die casting, centrifugal casting process.

UNIT-III

Elements of Gating system: Classification, basic consideration in gating design, gating ratio, gating practice for ferrous and nonferrous alloys, pouring equipment.

Risering Practice: function of riser, directional and progressive solidification, centerline feeding resistance, riser efficiency, riser design consideration, risering curves, Cain's, N.R.L and modulus method, feeding distance feeding aids, blind and atmospheric risers.

UNIT-IV

Melting Practice: Melting of cast iron, Mechanical features of cupola, operational steps and principles of cupola operation, Advanced practices in the cupola operation, melting of aluminum and copper based alloys including mold treatments such as dressing, grain refining, and modification.

Quality control in foundry: Casting defects, their causes and remedies. Shop floor quality control tests such as composition control, Wedge test, fluidity, temperature measurement. Casting Modification by different methods like Friction stir processing.

Reference Books:

1. Manufacturing Technology: Foundry, Forming and Welding by P.N.Rao, Tata McGraw Hill Education Private Limited
2. Principles of Metal Casting, R. W. Heine, C. R. Loper and P. C. Rosenthal, (Tata McGraw Hill)
3. Principles of Foundry Technology, P. L. Jain, (Tata McGraw Hill).
4. Fundamentals of Metal Casting Technology, P. C. Mukherjee, (Oxford & IBH)
5. Foundry Technology, P. R. Beeley
6. Foundry Engineering, H. F. Taylor, M. C. Flemings, (Wiley Eastern)
7. Foundry Technology, D. Kumar & S. K. Jain, (CBS Pub.)

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B. Tech. 8th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME–424N	**ERGONOMICS IN DESIGN**	4	0	0	75	25	100	3
Purpose	To introduce basic approaches of work system design, ergonomic principles and their application in the design of work, equipment and the workplace.							
Course Outcomes								
CO 1	To demonstrate the application of work study and its methods							
CO 2	To familiarize the students with the work measurement and sampling techniques							
CO 3	To introduce the human factor engineering and the factors affecting the human performance.							
CO 4	To exercise for the design of the work space, equipment's and environment.							

UNIT I

Introduction to Work Study: Productivity, Scope of methods, motion and time study.
Work Methods Design: Operation Process Chart, Flow Process Chart, Flow Diagram, String Diagram, Man and machine chart, Two handed process chart, Travel Chart, Micro motion and memo motion study.

UNIT II

Work Measurement: Tools and Techniques
Work Sampling: Determining time standards from standard data and formulas, Pre-determined motion time standards, Work factor system, Methods time measurement, Analytical Estimation, Measuring work by physiological methods – heart rate measurement – measuring oxygen consumption– establishing time standards by physiology methods.

UNIT III

Human Factors Engineering: Introduction to ergonomics, Man/machine/environment systems concept, Human Anthropometry and its use in work place layout.
Human Performance: Information input and processing, factors affecting human performance, physical work load and energy expenditure, heat stress, manual lifting, Static and dynamic muscular load, human motor activity, metabolism, physical work load, repetitive and inspection work, measurement of physical work load, mental work load and its measurement, musculo-skeleton disorder, work duration and work pauses, principles of motion economy.

UNIT IV

Design of Work Space & Equipment: Work-space design for standing and seated workers, arrangement of components with in a physical space, Interpersonal aspect of work place design, Ergonomic Factors to be considered, design of displays and controls, design for maintainability
Design of Environment: Illumination and its effect, Climate - Heat Humidity – Body heat balance, effective temperature scales, zones of discomfort, effect of heat on body and work performance, Vibrations - Response of body to low frequency vibrations, vibrations and

discomfort, effect on health of worker, high frequency vibrations, effect of high frequency vibrations, methods of reducing vibrations, Noise - Physiological effects of noise, annoyance of noise, speed interference, hearing loss, temporary and permanent threshold shift, effect of noise on performance, reduction of noise, personal noise protection, Standards and social aspects.

Text Books:

1. Introduction to Work Study, I.L.O., 3rd Revised Edn.
2. Motion and Time Study – Design and Measurement of Work, Barnes, Raeph.m., John Wiley & sons, New York.
3. Human Factors in Engineering and Design, Macormick, E.J., Tata McGraw-Hill
4. A Guide to Ergonomics of Manufacturing, Martin Helander, TMH.
5. Human Factor Engineering, Sanders & McCormick, McGrawhill Publications.
6. Sound, Noise and Vibration Control, Lyle, F. Yerges, Van Nostrand.

Reference Books:

1. Improving Productivity and Effectiveness, Mundel, Marvin, E., Prentice Hall.
2. Human Factors Engineering & Design, Sounders, M.S. and McCornic, E.J., McGraw Hill.
3. Motion and time study, Benjamin .W. Neibel,, Richard .D .Irwin Inc., Seventh Edition.
4. Work design Stephen Konz., Publishing Horizon Inc., Second Edition.
5. Introduction to Ergonomics, Bridger R.S.,McGraw Hill.
6. Applied Ergonomics, Hand Book: Brien Shakel (Edited) Butterworth Scientific, London.
7. Work Study and Ergonomics, Shan, H.S, DhanpatRai& Sons.

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ELECTIVE-IV

B. Tech. 8th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME–426N	**Manufacturing Management**	4	0	0	75	25	100	3
Purpose	Students will be able to comprehend the major aspects of Manufacturing management like production & operation management, plant location and layout, material handling and management, Waste Management & Automation.							
Course Outcomes								
CO 1	Students will be able to attain the theoretical knowledge of production & operation management.							
CO 2	Students will be able to attain the theoretical knowledge of the concept of plant location and layout.							
CO 3	Students will be able to attain the theoretical knowledge of material handling and management.							
CO 4	Students will be able to attain the theoretical knowledge of Waste Management & Automation.							

UNIT-I

Introduction to Production and Operation Management: Introduction, Historical Evolution of Production and Operation Management, Concept of Production, Production System, Production Management, Operation System, Operation Management, Managing Global Operations, Scope of Production and Operation Management.

UNIT-II

Plant Location and Layout: Introduction and Meaning, Need for Selecting a Suitable Location, Factors influencing Plant location, Location theories, Location models, Location economics, Plant layout, Classification of layout, Design of Product layout, Design of Process layout, Service layout, Organization of physical facilities.

UNIT-III

Material Handling and Management: Introduction, Objectives of Material Handling, Principles of Material Handling, Selection of Material Handling Equipment, Evaluation of Material Handling System, Material Handling Equipment, Guidelines for Effective Utilization of Material Handling Equipment, Relationship Between Plant Layout and Material Handling, Scope and Function of Material Management, Material Planning and Control, Inventory Control, Standardization, Simplification, Ergonomics, Just-in-Time(JIT) Manufacturing.

UNIT-IV

Waste Management: Introduction Reasons for Generation and Accumulation of Obsolete, Surplus and Scrap Items, Identification and Control of Waste, Disposal of Waste.

Automation: Introduction, Types of Automation, Computer Integrated Manufacturing, Reasons for Automation, Advantages and Disadvantages of Automation, Automation Strategies, Automated Flow Lines, Automated Guided Vehicles System, Automated Storage/Retrieval System.

REFERENCES AND TEXT BOOKS:

1. Production and operational management by S. Anil Kumar/N. Suresh.
2. Production and operational management by Pratibha Garg.
3. Modern Production Management Systems by Sushil Gupta Martin Starr.
4. Manufacturing Operations Management by Sanjay Sharma.

NOTE: In the semester examination, the examiner will set 8 questions in all, at least one question from each unit, and students will be required to attempt only 5 questions.

B. Tech. 8th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME–428N	**DESIGN OF PRESSURE VESSELS AND PIPING**	4	0	0	75	25	100	3
Purpose	The main objective is to present the industrial related problems, procedures and design principles for pressure vessels and enhance the understanding of design procedure of pressure vessel and Design of piping layout.							
Course Outcomes								
CO 1	Student will attain the knowledge of Introduction to piping system and selection of piping components							
CO 2	Student will attain the knowledge of Stresses induced in Pressure vessels and stress analysis							
CO 3	Student will attain the knowledge of Detail Designing of vessels and introduction to ASME pressure vessel codes 23							
CO 4	Student will attain the knowledge of the Buckling of vessels and its preventions							

UNIT I

INTRODUCTION

Methods for determining stresses – Terminology and Ligament Efficiency – Applications.
Layout of Piping Systems
Selection of Piping Components (Flanges, Valves, Supports, Expansion Joints, etc.), Selection of Material

UNIT II

STRESSES IN PRESSURE VESSELS

Introduction – Stresses in a circular ring, cylinder – Membrane stress Analysis of Vessel Shell components – Cylindrical shells, spherical Heads, conical heads – Thermal Stresses – Discontinuity stresses in pressure vessels.

UNIT III

DESIGN OF VESSELS

Design of Tall cylindrical self-supporting process columns –Supports for short, vertical and horizontal vessels – stress concentration – at a variable Thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of Reinforcement – pressure vessel Design. Introduction to ASME pressure vessel codes 23, Piping Codes & Standards (ASME B31.3)

UNIT IV

BUCKLING OF VESSELS

Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure – Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading.
PIPING:-Introduction – Flow diagram – piping layout and piping stress Analysis, Pipe sizing, Flow and Pressure Drop Calculations, Piping Flexibility.

TEXT BOOKS:

1. John F. Harvey, "Theory and Design of Pressure Vessels", CBS Publishers and Distributors,1987.

REFERENCES:

1. Henry H. Bedner, "Pressure Vessels, Design Hand Book", CBS publishers and Distributors, 1987.
2. Stanley, M. Wales, "Chemical process equipment, selection and Design". Buterworths series in Chemical Engineering, 1988.
3. William. J., Bees, "Approximate Methods in the Design and Analysis of Pressure Vessels and Piping", Pre ASME Pressure Vessels and Piping Conference, 1997.
4. Sam Kannapan, "Introduction to Pipe Stress Analysis". John Wiley and Sons, 1985.

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B. Tech. 8th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME–430N	**CONCURRENT ENGINEERING**	4	0	0	75	25	100	3
Purpose	To make students aware of objectives of Concurrent engineering, Design Product for Customer, Design for Manufacture (DFM), Quality by Design and Design for X-ability.							
Course Outcomes								
CO 1	Students will attain the knowledge of objectives of Concurrent engineering.							
CO 2	Students will attain the knowledge of Design Product for Customer							
CO 3	Students will attain the knowledge of Design for Manufacture (DFM)							
CO 4	Students will attain the knowledge of Quality by Design and Design for X-ability:							

UNIT I

Introduction: Background and challenges faced by modern production environment, sequential engineering process, Concurrent engineering definition and requirement, meaning of concurrent objectives of CE, benefits of CE, Life cycle design of products, life cycle costs. Support for CE: Classes of support for CE activity, CE organizational, structure CE, team composition and duties, Computer based Support, CE Implementation Process.

UNIT II

Design Product for Customer: Industrial Design, Quality Function Deployment, house of quality, Translation process of quality function deployment (QFD). Modeling of Concurrent Engineering Design: Compatibility approach, Compatibility index, implementation of the Compatibility model, integrating the compatibility Concerns.

UNIT III

Design for Manufacture (DFM): Introduction, role of DFM in CE, DFM methods, e.g. value engineering, DFM guidelines, design for assembly, creative design methods, product family themes, design axioms, Taguchi design methods, Computer based approach to DFM. Evaluation of manufacturability and assemble ability.

UNIT IV

Quality by Design: Quality engineering & methodology for robust product design, parameter and Tolerance design, Quality loss function and signal to noise ratio for designing the quality, experimental approach.

Design for X-ability: Design for reliability, life cycle serviceability design, design for maintainability, design for economics, decomposition in concurrent design, concurrent design case studies.

Text Books:

1. Concurrent Engineering- Kusiak - John Wiley & Sons
2. Concurrent Engineering- Menon - Chapman & Hall

NOTE: In the semester examination, the examiner will set 8 questions in all, at least

one question from each unit, and students will be required to attempt only 5 questions.

B. Tech. 8th Semester Mechanical Engineering

Course No.	Course Title	Teaching Schedule			Allotment of Marks			Duration of Exam (Hrs.)
		L	T	P	Theory	Sessional	Total	
ME–432N	INDUSTRIAL COMBUSTION	4	0	0	75	25	100	3
Purpose	This course is designed to offer basic knowledge to the students in the area of applied Combustion. By studying this course, the student shall be able work in industrial power plants and automobile sector.							
Course Outcomes								
CO 1	Apply fundamental principles of the rate of chemical reactions and emission characteristics of fuels used in power plants and transportation sector.							
CO 2	Determine and calculate the values of the flame temperature of commercial fuels burning in the combustion chambers of internal combustion engines							
CO 3	Express the concept of Thermodynamic and transport properties of fuels at elevated pressures and temperatures prevalent in the combustion chambers of actual engines.							
CO 4	Solve the problems on the burning velocity of premixed flames and important combustion characteristics of diffusion flames.							

UNIT-I

Introduction

Historical perspective of combustion science, perspective of fuels and combustion technology. Types and general characteristics of fuels, proximate and ultimate analysis of fuels. ROM, DMMF, DAF and bone dry basis. Moisture and heating value determination, gross and net hearting values, calorimetry, Du Long's formula for HV estimation, Flue gas analysis, Orsat apparatus.

UNIT-II

Fuel Types

Solid Fuels: Peat, coal, biomass, wood waste, agro fuels, refuse derived solid fuel, testing of solid fuels. Bulk and apparent density, storage, wash ability, coking and caking coals.

Liquid Fuels: Refining, molecular structure, liquid fuel types and their characteristics, fuel quality. Liquefaction of solid fuels. Gaseous Fuels: Classification and characterization.

UNIT-III

Thermodynamics and Kinetics of Combustion

Properties of mixture, combustion stoichiometry, chemical energy, chemical equilibrium and criteria, properties of combustion products. First law combustion calculations, adiabatic flame temperature (analytical and graphical methods), simple second law analysis. Elementary reactions, chain reactions, pre-ignition kinetics, global reactions, kinetics, reaction at solid surface.

UNIT-IV

Combustion of Solid, Liquid and Gaseous Fuel

Drying, devolatilization, char combustion. Fixed bed combustion, suspension burning, fluidized bed combustion. Spray formation and droplet behavior, oil fired furnace combustion, gas turbine spray combustion, direct and indirect Injection combustion in IC engines. Energy balance and

furnace efficiency, gas burner types, pulse combustion furnace. Premixed charge engine combustion. Detonation of gaseous mixtures.

Text Books:

1. Combustion Engineering by Kenneth W. Ragland, Kenneth M. Bryden, CRC press
2. Fundamental of combustion by D P Mehta, PHI Delhi.

Reference Books:

1. Principles of combustion by Kenneth Kuan Kuo, John Wiley & Sons
2. An introduction to combustion: concept and applications by Stephen R Turns, Mc Graw-Hill companies

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B. Tech. 8th Semester Mechanical Engineering								
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Theory**	**Sessional**	**Total**	
ME–434N	**METAL FORMING AND FINISHING**	4	0	0	75	25	100	3
Purpose	Metal forming and finishing in manufacturing considers a metal-forming process as a system consisting of several interacting variables. These Includes an overall review and classification of all metal-forming processes.							
Course Outcomes								
CO 1	The Students will be able to apply the fundamentals of plastic deformation process							
CO 2	The student will be able to understand the shearing mechanism processes.							
CO 3	The students will be able to analyze the metal finishing processes.							
CO 4	The students will be able to comprehending the techniques of powder metallurgy.							

UNIT-I

Bulk Deformation Processes: Introduction Elastic and plastic deformation. Concept of strain hardening. Hot and cold working processes -rolling, forging, extrusion, swaging, wire and tube drawing. Machines and equipment for the processes. Parameters and force calculations. Test methods for formability.

Basics of plastic forming & forging, mechanics of metal working, temperature in metal working, strain rate effects, friction and lubrication, deformation zone geometry. Forging process, classification – equipment, calculation of forging loads, forging defects, residual stresses.

UNIT-II

Sheet Metal Working: Applications of sheet formed products. Shearing mechanism. Processes like blanking, piercing, punching, trimming, etc. Forming processes like bending, cup drawing, coining, embossing, etc. Presses for sheet metal working; Part feeding systems; Elements of die; punch and die clearances; Progressive, compound and combination dies. High energy rate forming processes.

UNIT-III

Metal finishing: Technological importance of metal finishing. Effect of plating variables on electro deposits. Electroplating techniques - methods of electroplating, surface preparation, Metal finishing processes: Such as diamond machining, honing, lapping's buffing etc.

UNIT-IV

Powder Metallurgy: Introduction. Production of metal powders. Compaction and sintering processes. Secondary and finishing operations. Economics, advantages, and applications of powder metallurgy.

Reference books:

1. Mechanical Metallurgy by G. E. Dieter, McGraw-Hill.
2. Metal Forming: Fundamentals and Applications by Taylan Altan (ASM Series in Metal Processing)
3. Introduction to Industrial Mechanical Working Process by G. W. Rowe
4. Materials & Processes In Manufacturing By E.Paul De Germo, J T Black & Ronald A Koshav

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one question from each unit, and students will be required to attempt only 5 questions.

B. Tech. 8th Semester Mechanical Engineering

Course No.	Course Title	Teaching Schedule			Allotment of Marks			Duration of Exam (Hrs.)
		L	T	P	Theory	Sessional	Total	
ME–436N	**AIR CRAFT AND ROCKET PROPULSION**	4	0	0	75	25	100	3
Purpose	Starting with the basic principles of Mechanics behind the generation of thrust by jet action, the course is developed logically and systematically to look into the various aspects of jet engines and the components that make them.							
Course Outcomes								
CO 1	Students will be able to synthesize compressible flow of thermodynamics properties.							
CO 2	Students will be able to evaluate Aircraft maintainability.							
CO 3	Students will be able to design performance parameters of rocket propulsion.							
CO 4	Students will be able to analyze the basic turbojet engine cycle.							

UNIT I

Review of Thermodynamics and Compressible Flow: Review Of relevant basic thermodynamics. First Law and energy analysis for closed and open systems. Second law of thermodynamics, limitations on energy conversion, process representation on h-s plane (Mollier diagrams). One-dimensional compressible flow with lumped effects of area change, friction. Heat transfer, and mass transfer and the implications there of for the production of thrust. Detailed analysis of one-dimensional steady flow in variable area passages with special reference to nozzles and diffusers.

UNIT II

Aircraft structure and Maintenance:

Various types of structures in airframe construction, tubular, stringers, formers, bulkhead, spars and ribs, honeycomb construction. Aircraft Maintainability: Evolution of maintenance philosophy, periodic maintenance system based on checks at specific intervals and continuous maintenance system. Daily Inspection and trip inspection system. On Condition maintenance techniques, their evolution and effect on design of aircraft systems.

UNIT-III

Rocket Propulsion: Application of nozzle theory and performance evaluation of rocket engines. Performance parameters of relevance to rocketry such as characteristic velocity, thrust coefficient, specific impulse, etc. Preliminary design and sizing of rocket thrust chambers.

UNIT-IV

Gas Turbine based Jet Engines: Ideal Cycle Analysis The basic turbojet engine cycle, analysis of the ideal cycle. Turbojet with afterburner, Ideal cycle, comparison of turbojet performance with and without afterburner. 4 The ideal turbofan, mixed and unmixed exhaust streams, design point optimization and performance. The turboprop engine, analysis of the ideal performance.

Reference books :

1. Oates, G. C., "Aerothermodynamics of Gas Turbine and Rocket Propulsion", AIAA Educational Series, AIAA, Washington, 1988.
2. Hill, P. G. and Peterson, C. R., "Mechanics and Thermodynamics of Propulsion", 2nd ed., Addison-Wesley Publishing Company, Inc., Reading, MA,1992.
3. Treager, I. E., "Aircraft Gas Turbine Engine Technology", 2nd ed., McGraw Hill , Inc., New York, 1979. 4. Jones, J. B. and Dugan, R. E., "Engineering Thermodynamics", Prentice Hall of India, New Delhi,2002

NOTE: In the semester examination, the examiner will set 8 questions in all, at least one question from each unit, and students will be required to attempt only 5 questions.