B. E. SYLLABUS

MECHANICAL ENGINEERING

V & VI SEMESTER

With
Scheme of Teaching
& Examination
<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name</th>
<th>Designation</th>
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<tr>
<td>1</td>
<td>Dr. Shrinivasa Rao B.R.</td>
<td>Ph.D. Professor/Vice Principal / COE</td>
</tr>
<tr>
<td>2</td>
<td>Prof. Vinaya B. R.</td>
<td>M.Tech Asso. Professor/1st year coordinator</td>
</tr>
<tr>
<td>3</td>
<td>Dr. Subrahmanya Bhat</td>
<td>Ph.D. Professor and HOD</td>
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<tr>
<td>4</td>
<td>Dr. Sudesh Bekal</td>
<td>Ph.D. Professor/ Dean(R&amp;D)</td>
</tr>
<tr>
<td>5</td>
<td>Dr. Shashikanth Karinka</td>
<td>Ph.D. Professor/ P G Coordinator</td>
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<tr>
<td>6</td>
<td>Dr. Srinivasa Pai P.</td>
<td>Ph.D. Professor/DCOE</td>
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<tr>
<td>7</td>
<td>Dr. Narasimha Marakala</td>
<td>Ph.D. Professor</td>
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<td>8</td>
<td>Dr. Muralidhara</td>
<td>Ph.D. Professor</td>
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<td>10</td>
<td>Dr. Narasimha Bailkeri</td>
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<tr>
<td>11</td>
<td>Mr. Manjunath Shenoy</td>
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<td>12</td>
<td>Mr. T.R. Venugopal</td>
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<td>13</td>
<td>Mr. Gururaj Upadhyaya</td>
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<td>Mr. Suresh Shetty</td>
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<td>15</td>
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<td>16</td>
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<td>17</td>
<td>Mr. Ravishankar Bhat</td>
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<td>18</td>
<td>Mr. P. Venkatesh Murthy</td>
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<td>19</td>
<td>Mr. Ravindra</td>
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<td>Mr. Austin Dinesh D’Souza</td>
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<td>Mr. Kumar H. S.</td>
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<td>Mrs. Rashmi P. Shetty</td>
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<td>24</td>
<td>Mr. Dilip Kumar K.</td>
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<td>Mr. Melwyn Rajesh Castelino</td>
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<td>44</td>
<td>Mr. Vincent Linish D’souza</td>
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<td>45</td>
<td>Mr. Bhaskar P. Achar</td>
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<td>Mr. Mohan Poojari</td>
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DEPARTMENT OF MECHANICAL ENGINEERING,

VISION:

To produce Mechanical engineers of the highest quality who are professionally competent and highly qualified to suit the needs of industries and organizations by promoting excellence in teaching, learning and research.

MISSION:

The Dept. of Mechanical Engineering is committed to –

- Provide high quality education to the students, to fulfill the requirements of a ‘Global Engineer’.
- Constantly strive to improve the teaching-learning methods, in order to deliver good academic programs.
- To respond to the fast evolving scientific and technological challenges in a highly competitive world.
- To inculcate, ethics, integrity, honesty, credibility, social and environmental consciousness.
Programme Educational Objectives (PEOs):

To satisfy the mission of the mechanical engineering programme, the graduates will:

1. Be able to research, design, develop, test, evaluate, and implement engineering solutions to problems that are of a complexity encountered in professional practice.
2. Be able to communicate and perform as an effective engineering professional in both individual and team-based project environments.
3. Consider the ethical implications and societal impacts of engineering solutions.

Programme Outcomes (POs):

a. An ability to apply knowledge of mathematics, science, and applied sciences
b. An ability to design and conduct experiments, as well as to analyze and interpret data
c. An ability to formulate or design a system, process or program to meet desired needs
d. An ability to function on multi-disciplinary teams
e. An ability to identify, formulate and solve engineering problems
f. An understanding of professional and ethical responsibility.

g. An ability to communicate effectively.

h. The broad education necessary to understand the impact of solutions in a global, and social context.

i. A recognition of the need for, and an ability to engage in lifelong learning

j. A knowledge of contemporary issues

k. An ability to use the techniques, skills, and modern scientific and technical tools necessary for professional practice.

l. An ability to apply the concepts of mechanical engineering to solve real world problems, as required by industries and organizations and provide reasonable solutions which are socially and ethically acceptable.
### DEPARTMENT OF MECHANICAL ENGINEERING
### SCHEME OF TEACHING AND EXAMINATION

**V SEMESTER B.E.**

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<th>Sl. No.</th>
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<th>Subject</th>
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**TOTAL** | **30** | **30** | **400** | **400** | **25**
DEPARTMENT OF MECHANICAL ENGINEERING  
SCHEME OF TEACHING AND EXAMINATION  
VI SEMESTER B.E.  

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<th>Sl. No.</th>
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**TOTAL** | **31** | **31** | **400** | **400** | **26**
### ELECTIVE -I

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<td>13ME513</td>
<td>Statistical quality Control</td>
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<td>Metal forming Theory &amp; Practice</td>
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<td>13ME613</td>
<td>Design For manufacturing</td>
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<td>13ME614</td>
<td>Rapid Prototyping Technology</td>
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<td>13ME615</td>
<td>Design Practices of Jigs &amp; Fixture</td>
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<td>13ME617</td>
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<td>Organizational Behavior &amp; Professional Ethics</td>
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FLUID MACHINERY

Sub Code : 13ME501
Credits : 04
Hrs/Week : 3+2+0+0
Total Hours : 52

Course Outcomes

Upon completion of this course, graduates will be able to
1. Understand the basic principle of energy transfer in power generating and power absorbing turbo machines.
2. Study the features and working of impulse and reaction turbines (Pelton, Francis and Kaplan turbines)
3. Know the working principle of steam (Impulse and reaction) turbines and Axial flow compressors
4. Understand the principle of operation of centrifugal compressors and pumps; also study the parameters affecting their performance.
5. Study the thermodynamic analysis of compression and expansion processes and their efficiencies (Polytropic, stage and overall efficiencies)

UNIT - I

Introduction, Energy transfer in Turbo function.
Definition of a turbo machine. Parts, Classification, Comparison with positive displacement machine. Euler Turbine equation, alternate form of Euler turbine equation, components of energy transfer, degree of reaction, general analysis of a turbine – effect of blade discharge angle, Utilization factor, Vane efficiency, relationship between utilization factor and degree of reaction, Condition for maximum utilization factor, Optimum blade speed ratio for different types of turbines.
Velocity triangles for different values of degree of reaction.
General analysis of compressors and pumps, effect of blade discharge angle, expression for degree of reaction. 12 Hours
UNIT - II

Hydraulic turbines: Classification, Pelton turbine components, design, turbine efficiency, Francis and Kaplan turbines, Runner shapes for different blade speeds, Theory of draft tube, efficiency of draft tube.  
12 Hours

UNIT- III

Steam and gas turbines: Impulse staging, need for compounding, types of compounding, condition for maximum utilization for multistage turbines, effect of blade and nozzle losses, reaction staging, reheat factor in turbines.  
Axial flow compressors: Classification, Expression for pressure ratio per stage, work done factor, radial equilibrium conditions, determination of air angle distribution with respect to blade height, using free vortex flow theory, and constant reaction theory, blade design procedure using single air foil theory.  
12 Hours

UNIT - IV

Centrifugal Compressors: Principle of operation, expression for overall pressure ratio, blade angles at impeller eye root and eye tip, slip factor and power input factor, overall pressure ratio, pressure coefficient, width of the impeller channel, compressibility effects, need for pre-whirl vanes, diffuser design, determination of diffuser inlet vane angle, surging and choking.  
Centrifugal pumps: Working principle, Terminology, Types of casing, Pump losses, Efficiencies, Work done, Pre-rotation, slip and slip coefficient, Minimum starting speed, Priming, Cavitation, NPSH. Multi stage centrifugal pumps.  
12 Hours

UNIT - V

Thermodynamics of Fluid flow and Thermodynamic analysis of compression and expansion processes: Brief discussion of stagnation
and static properties and their relations. **Compression process** – Work done overall isentropic efficiency, stage efficiency, comparison and relation between them, polytropic efficiency of compression.  

**Expansion process:** Work done, overall isentropic efficiency, stage efficiency, comparison and relation between them, polytropic efficiency of expansion.

12 Hours

**TEXT BOOKS:**


**REFERENCE BOOKS:**

1. "*Principles of Turbo Machinery*", D. G. Shepherd, The Macmillan Company (1964)

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**DESIGN OF MACHINE ELEMENTS - I**

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<tr>
<td>Total Hours</td>
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**Course Outcomes**

Upon completion of this course, graduates will have the
1. Ability to model, analyze, design, and realize a mechanical system that meets a particular need.
2. Understanding the static, dynamic, impact and fatigue strengths & their parameters for a material are measured in standardized tests.
3. Ability to design and analyze shafts with different geometrical features under various loading conditions.
4. Demonstrate the thorough knowledge of threads and fasteners.
5. Ability to identify, evaluate and compare the functions of different types of flexible power transmission systems
6. Ability to design and analyze permanent and detachable joints (riveted, welded, etc.) under concentric and eccentric loading conditions.

UNIT- I

Introduction:
Meaning of design with special reference to machine design- Definition and understanding of several of types of designs. Concept of design, Engineering Materials and their Mechanical properties. Selection of materials, General Design considerations: codes and Standards, Review of basics of mechanics of materials- Types of stresses and strains. Stress-Strain diagrams, Stress Analysis of simple components, Principal Stresses.

Design for Static Strength: Static Strength, Static loads and factor of safety; Theories of failure – Maximum normal stress theory, Maximum shear stress theory, Distortion energy theory; Failure of brittle materials, Failure of ductile materials. Stress concentration, Determination of Stress concentration factor. 

UNIT- II

Design for Fatigue Strength: Introduction- S-N Diagram, Low cycle fatigue, High cycle fatigue, Endurance limit, Endurance limit modifying factors: size effect, surface effect, Stress concentration effects;
Fluctuating stresses, Goodman, Modified Goodman and Soderberg’s relationship; stresses due to combined loading, cumulative fatigue damage. **Design for Impact strength:** Introduction, Impact stresses due to axial, bending and Torsional loading, effect of inertia.  **10 Hours**

**UNIT - III**

**Shafts and Keys:** Torsion of shafts, design for strength and rigidity with steady loading, ASME & BIS codes for design of transmission shafting, shafts under fluctuating loads and combined loads. Keys: Types of keys, Design of keys and design of splines.  **12 Hours**

**UNIT- IV**

**Threaded Fasteners:** Stresses in threaded Fasteners, Effects of initial tension, Effect of compression, Effect of fatigue loading, impact loading, shear loading, Design of eccentrically loaded bolted joints.

**DESIGN of transmission systems:** Design of Rigid & Flexible couplings, Design & Selection of flat and V belts  **10 Hours**

**UNIT- V**


**Design Data Hand Book:**

1. **Design Data Hand Book** by K. Mahadevan and Balaveera Reddy, CBS Publication

**TEXT BOOKS:**


**REFERENCE BOOKS:**

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**DYNAMICS OF MACHINERY**

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</table>

**Course Outcomes**

1. At the end of this course students will be able to apply equilibrium conditions on links subjected to external forces and determine the pin forces and torque on different links of a mechanism.

2. Analyse the work done per cycle and determine energy stored in a fly wheel and fly wheel size, when used in engine mechanism and punching operation.

3. Describe and determine the balancing of rotating masses in a system and understand balancing of reciprocating masses in multi cylinder engines.

4. Classify and differentiate the working principle of governors and perform force analysis of Porter and Hartnell governor.

5. Perform mathematical analysis of displacement, velocity and acceleration for a tangent cam operating on a radial – translating roller follower and for a circular arc cam operating a flat faced follower.
6. Understand the principle of gyroscopic couple and its effect on aeroplane, ship and automobiles.

UNIT-I

STATIC FORCE ANALYSIS: Reaction between members without friction. Analysis of engine mechanism, four bar mechanism (without friction) and other mechanisms.  

10 Hours

UNIT-II

DYNAMICS OF ENGINE MECHANISM: Turning Moment Diagrams and flywheel design.  

10 Hours

UNIT-III

BALANCING OF MACHINERY: Static and dynamic balancing: Balancing of single rotating mass in same plane and in different planes - Balancing of several rotating masses in same plane and in different planes - Balancing of reciprocating masses. Inertia effects of crank and connecting rod. Balancing of single cylinder engine, multi cylinder engine, Inline engine (primary & secondary forces), V-type engine and radial engine - Direct and reverse crank methods. Balancing of rigid and flexible rotors.  

12 Hours

UNIT-IV

GOVERNORS: Types of governors; force analysis of Porter and Hartnell governors. Controlling force, stability, sensitiveness, isochronisms, effort and power.  

8 Hours

UNIT- V

GYROSCOPE: Vectorial representation of angular motion, gyroscopic couple, Effect of gyroscopic couple on ship, plane, two wheelers and four wheelers.  

6 Hours
ANALYSIS OF CAMS: Analytical methods for Tangent cam with roller follower and Circular cam operating flat faced follower.  

6 Hours

TEXT BOOKS:

REFERENCE BOOKS:
3. *Theory of Machines* by Ballaney, Khanna Publication 2013

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METROLOGY & MEASUREMENTS

Sub Code : 13ME504
Hrs/Week : 4+0+0+S*

Credits : 04
Total Hours : 52

*Self Study to be exercised under the supervision of course instructor and to be restricted to not more than 10% of the total teaching hours.

Course Outcomes:

At the end of the course, student should be able to;
01. Appreciate various standards of measurements, their classification and various terms related to measurements.
02. Appreciate working principle, construction, and use of different comparators and angle measuring instruments.
03. Appreciate important parameters of screw threads and gears and their measurement, designing of fits according to IS: 919-1963 and design gauges to inspect the fits.
04. Explain the generalized measurement system and various elements used in different stages.
05. Explain the principle, operation and characteristics of different measuring instruments used for the measurement of different physical parameters.

UNIT-I

**Standards of measurement:** Definition and Objectives of metrology Standards of length - International prototype meter, Wave length standard, subdivision of standards, line and end standard comparison, Slip gauges, Wringing phenomena, Indian Standards (M-81, M-112), Numerical problems on building of slip gauges. Definitions and concept of accuracy, precision, calibration, threshold, sensitivity, hysteresis, repeatability, and linearity, Errors in Measurements.  12 Hours

UNIT-II

**Comparators:** Introduction to Comparators, Characteristics of and classification of comparators, Principles of mechanical, optical, electrical and electronics, and pneumatic comparators. Working of Sigma, Zeiss, LVDT and Solex comparators. **Angular measurements**, Bevel Protractor, Sine Principle and use of Sine bars, Sine center, use of angle gauges, (numerical on building of angles) Clinometers. **Interferometer:** Principle of Interferometry, autocollimator, Optical flats  10 Hours

UNIT-III


**System of limits, Fits, Tolerances and gauging:** Definition of tolerance and its Specification in assembly, concept of limits of size and tolerances,
compound tolerances, accumulation of tolerances, definition of fits, types of fits and their designation (IS 919 -1963,) Principle of interchangeability and selective assembly, limits of size, standards, concept of limits of size and tolerances, definition of fits, types of fits, hole basis system, shaft basis of system, Design of clearance, transition and interference fit. Design of gauges, principles of gauge design

10 Hours

UNIT-IV


10 Hours

UNIT-V

Measurement of Force, Torque and pressure: Principle of analytical balance, platform balance, proving ring. Torque measurement, Prony brake, hydraulic dynamometer. Pressure Measurements, Principle, use of elastic members, Bridgeman gauge, Mcloed gauge, Pirani Gauge. Temperature and strain measurement: Resistance thermometers, thermocouple, law of thermocouple, materials used for construction, pyrometer, Optical Pyrometer. Strain Measurements, Strain gauge preparation and mounting of strain gauges, gauge factor, methods of strain measurement

10 Hours

TEXT BOOKS:

REFERENCE BOOKS:
1. “Engineering Metrology” by I.C.Gupta, Dhanpat Rai Publications,
INDUSTRIAL MANAGEMENT & ENTREPRENEURSHIP

Sub Code : 13ME505
Credits : 03
Hrs/Week : 3+0+0+0
Total Hours : 39

Course Outcomes

Upon completion of this course, graduates will be able to
1. Know the history of management & different forms of business organizations.
2. Understand the managerial functions.
3. Analyze motivation, communication & leadership skills.
4. Develop entrepreneurial skills to achieve goals.
5. Plan and implement small scale industries projects applying management techniques.

UNIT – I


Forms of Business Organization: Types of ownership (Characteristics, merits and demerits of Proprietorship, Partnership, Private limited Company, Public limited Company, Public sector organizations and Co-Operative enterprises), Incorporation of joint stock company, Methods of raising capital.

7 Hours

UNIT – II

Functions of Management:
Planning [Definition, importance and characteristics of planning, Types of plans, Steps in planning] Organization [Principles of organizing, Types of organization, Characteristics, advantages and disadvantages of Line, Line and Staff, Functional, Matrix, Departmentation type of organization, Management of Change, Management of Conflict, Management by Objectives, Management by Exception, Span of control, Authority, Responsibility and Delegation, Centralization and decentralization] 

6 Hours

UNIT – III

Functions of Management:
Controlling [Nature and purpose of control, Steps in control process, Critical control points, Types of managerial control, Operations control, Requirements of good control system]

Staffing [Objectives and Functions of human resource management, Sources and Policy of recruitment, Selection and Steps in selection process, Training and development, Performance appraisal]

Leading [Communication process, barriers to effective communication, formal and informal communication, principles of effective communication, motivation, theories of motivation; Herzberg’s theory, Maslow’s theory, Mcgrager’s theory X and theory Y, leadership styles]

9 Hours

UNIT - IV

ENTREPRENEURSHIP: Concept of Entrepreneurship, Evolution of Entrepreneurship, Stages in entrepreneurial process; Role of entrepreneurs in Economic Development; Entrepreneurship in India; Entrepreneurship – its Barriers. Meaning of Entrepreneur; Functions of an Entrepreneur, Types of Entrepreneurs, Intrapreneur - an emerging Class.

Identification of business opportunities: Market Feasibility Study; Technical Feasibility Study; Financial Feasibility Study & Social Feasibility Study.

7 Hours

UNIT - V
SMALL SCALE INDUSTRIES: Definition; Characteristics; Need and rationale; Objectives; Scope; role of SSI in Economic Development. Advantages of SSI, Steps to start and SSI, Government policy towards SSI; Different Policies of SSI, Impact of Liberalization, Privatization, Globalization on SSI. Effect of WTO/GATT on SSI, Supporting Agencies of Government for SSI, Ancillary Industry and Tiny Industry (Definition Only)

INSTITUTIONAL SUPPORT: Different Schemes; TECKSOK; KIADB; KSSIDC; KSIMC; DIC Single Window Agency; SISI; NSIC; SIDBI; KSFC.

8 Hours

TEXT BOOKS:
1. Industrial and Business Management by Martand T. Telsang, S. Chand & Company Ltd.
2. Industrial Management by Earnest dale, McGraw Hill Publication

REFERENCE BOOKS:
1. Principles of Management by Koontz and O’Donnell, TMH

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FLUID MACHINERY LAB

Sub Code : 13ME506  Credits : 02
Hrs/Week : 0+0+3+0  Total Hours : 39

Course Outcomes

CO1: Determine coefficient of discharge for various flow measuring devices
CO2: Determine the forces developed due to impact of jets on vanes
CO3: Determine the performance parameters of pumps, blowers, compressors, pumps

PART – A

1. Determination of coefficient of friction of flow in a pipe.
2. Determination of minor losses in flow through pipes.
3. Determination of force developed by impact of jets on vanes.
   a) Orifice plate
   b) Flow nozzle
   c) Venturimeter
   d) Rotometer
   e) V - notch

18 Hours

PART – B

5. Performance testing of Turbines
   a) Pelton wheel
   b) Francis Turbine
   c) Kaplan Turbine

6. Performance testing of Pumps
   a) Single stage and Multi stage centrifugal pumps
   b) Reciprocating pump
7. Performance test of a two stage Reciprocating Air Compressor
8. Performance test on an Air Blower

24 Hours

Scheme for Examination:
One Question from Part A - 15 marks
One Question from Part B - 25 marks
Viva- Voce - 10 marks
Total - 50 marks

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METROLOGY & MEASUREMENTS LAB
Sub Code : 13ME507
Credits : 01
Hrs/Week : 0+0+2+0
Total Hours : 26

Course Outcomes

1. Understand basic laws of metrology for linear measuring instruments such as vernier instruments, Gear tooth vernier caliper, screw thread micrometers etc
2. For a given measurement problem students will be able to identify to choose between precision measuring instruments and comparators such as profile projectors, optical measuring devices like tool makers microscopes, sine bars etc with required accuracy
3. Obtain numerical solutions & calibrate a given measuring instrument with required accuracy by referring to standard values given by national physical laboratory for pressure temperature and strain Instruments.

PART-A: MECHANICAL MEASUREMENTS
1. Calibration of Pressure Gauge
2. Calibration of Thermocouple
3. Calibration of LVDT
4. Calibration of Load cell
5. Determination of modulus of elasticity of a mild steel specimen using strain gauges.

**PART-B: METROLOGY**

7. Measurements of angle using Sine Center / Sine bar / bevel protractor
8. Measurements of alignment using Autocollimator / roller set
9. Measurements of cutting tool forces using
   a) Lathe tool Dynamometer
   b) Drill tool Dynamometer.
10. Measurements of Screw thread Parameters using two wire or three wire method.
12. Measurements of gear tooth profile using gear tooth vernier / gear tooth micrometer.
13. Calibration of micrometer using slip gauges
14. Measurement using Optical Flats

**Scheme of Examination:**
ONE question from Mechanical Measurements (part -A) 20 Marks
ONE question from Metrology (part -B) 20 Marks
Viva –Voce 10 Marks
OPERATIONS MANAGEMENT

Sub Code : 13ME511
Credits : 03
Hrs/Week : 3
Total Hours : 39

Course Outcomes

Upon completion of this course, graduates will be able to

1) Define management, Production and Operations Management;
   Analyze Decision making in an organization setting
2) Apply different methods of forecasting and solve numerical problems.
3) Describe and analyze capacity and location planning problems.
4) Understand and apply the nature and scope of, various strategies and
   techniques of aggregate planning and Master Scheduling.
5) Discuss Material requirements planning and solve numerical
   problems.

UNIT - I

Production and Operations Management: Introduction, Functions
within business organizations, the operation management function,
Classification of production systems, Productivity, factors affecting
productivity,
Decision Making: The decision process, characteristics of operations
decisions, use of models – B.E.P and Transportation models, decision
making environments. Decision trees. 8 Hours

UNIT - II

Forecasting: Steps in forecasting process, approaches to forecasting,
forecasts based on judgment and opinion, analysis of time series data,
Regression and Correlation methods, accuracy and control of forecasts,
choosing a forecasting technique, elements of a good forecast.
UNIT - III

Capacity & Location Planning: Importance of capacity decisions, defining and measuring capacity, determinants of effective capacity, determining capacity requirement, developing capacity alternatives, evaluating alternatives, Need for location decisions, nature of locations decisions, general procedure for making locations decisions, evaluating locations decisions, facilities layout – need for layout decisions, types of processing.  

UNIT - IV

Aggregate Planning & Master Scheduling: Aggregate planning – Nature and scope of aggregate planning, strategies of aggregate planning, techniques for aggregate planning – graphical and charting techniques, mathematical techniques. The master production schedule, Master scheduling process, Master scheduling methods.

UNIT - V

Material Requirement Planning (MRP): Dependent versus independent demand, an overview of MRP – MRP inputs and outputs, MRP processing: An overview of MRP-II and ERP capacity requirement planning, benefits and limitations of MRP.

TEXT BOOKS:


REFERENCE BOOKS:
1. **Production and Operations Management**, Norman Gaither & Greg Frazier,


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**MATERIAL SELECTION FOR ENGINEERING DESIGN**

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**Course Outcomes**

**UNIT - I**

The design process: types of design, design tools, conceptual and configuration design of products, statistical and reliability aspects;

4 Hours

Families of engineering materials and mechanical properties: Ferrous and Non-ferrous metals and Alloys, Ceramics, Polymers, Composites;

4 Hours

**UNIT - II**

Effects of composition and processing on material properties; Material property charts, Basis of material selection,

4 Hours

Case studies in materials selection: design for fracture, toughness, fatigue resistance, corrosion resistance, and high temperature applications,
UNIT - III

Wear resistance; case studies for design of plastics, ceramics and composites; performance based design; 8 Hours

UNIT - IV

Manufacturing aspects of design: assembly, cost, Processes and process selection; case studies in process selection; case studies: design for casting, design for deformation processes, 10 Hours

UNIT - V

Designing for machining and joining, design for ceramic and plastic processing; case studies with multiple constraints and conflicting objective; Hybrid design. 8 Hours

TEXT BOOK:

REFERENCE BOOKS:
1. *ASM Hand book of Materials Selection and Deign, 1996*

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STATISTICAL QUALITY CONTROL

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Course Outcomes
Upon completion of this course, graduates will be able to
1. Know what is quality and to understand the evolution of quality concept over the years
2. Know the meaning of central limit theorem, To calculate the mean and std. deviation
3. Understand the concept of control charts, draw and interpret the control chart for variables
4. Define process capability and to calculate process capability for the given process
5. Draw and interpret the control chart for Attributes
6. Understand the concept of Acceptance Sampling, Reliability and Life testing

UNIT - I

INTRODUCTION: The Meaning of Quality and Quality Improvement; Statistical Methods for Quality Control and Improvement; TOTAL Quality Management: Definition, Principles of TQM, Gurus of TQM, Benefits of TQM. Principles of TQM: Leadership - Deming’s philosophy, Customers’ satisfaction - Customers perception, Feedback, Employee involvement - quality circles, Continuous Improvement - Juran’s Trilogy, PDSA cycle, Kaizen, Six sigma. 8 Hours

UNIT - II

MODELING PROCESS QUALITY: Mean, Median, Mode, Standard deviation, Calculating area, Normal distribution tables, Finding the Z score, Central limit theorem, 7 QC tools.

METHODS AND PHILOSOPHY OF STATISTICAL PROCESS CONTROL: Chance and assignable causes, Statistical Basis of the Control Charts (basic principles, choices of control limits, significance of control limits, sample size and sampling frequency, rational subgroups,
Syllabus of V & VI Semester B.E. / Mechanical Engg.

analysis of pattern on control charts, warning limits, Average Run Length-ARL).  

8 Hours

UNIT – III

CONTROL CHARTS FOR VARIABLES: Control Charts for X-Bar and R- Charts, Type I and Type II errors, the probability of Type II error. Simple Numerical Problems.

6 Hours

PROCESS CAPABILITY: The foundation of process capability, Natural Tolerance limits, \(c_p\) – process capability index, \(c_{pk}\), \(p_p\) – process performance index, summary of process measures. Numerical problems

4 Hours

UNIT - IV

Control Charts For Attributes: Binomial distribution, Poisson distribution (from the point of view of Quality control) Control Chart for Fraction Nonconforming, Control Chart for number Nonconforming, Control Charts for Nonconformities or Defects, Control Chart for Number of non conformities per unit. Numerical problems

7 Hours

UNIT – V

LOT-BY-LOT ACCEPTANCE SAMPLING FOR ATTRIBUTES: The acceptance sampling problem, single sampling plan for attributes, Double, Multiple, and Sequential sampling, AOQL, LTPD, OC curves, Numerical problems

3 Hours

RELIABILITY AND LIFE TESTING: Failure models of components, definition of reliability, MTBF, Failure rate, common failure rate curve, types of failure, reliability evaluation in simple cases of exponential failures in series, paralleled and series-parallel device configurations.

3 Hours

TEXT BOOKS:

**REFERENCE BOOKS:**


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**METAL FORMING THEORY & PRACTICE (3-0-0)**

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**UNIT - 1**


6 Hours
EFFECTS OF PARAMETERS: Temperature, strain rate, friction and lubrication, hydrostatic pressure in metalworking, Deformation zone geometry, workability of materials, Residual stresses in wrought products.  

6 Hours

UNIT - 2

8 Hours

UNIT - 3

8 Hours

UNIT - 4

7 Hours

UNIT - 5
POWDER METALLURGY: Basic steps in Powder metallurgy brief description of methods of production of metal powders, conditioning and blending powders, compaction and sintering application of powder metallurgy components, advantages and limitations. 

7 Hours

TEXT BOOKS:
2. Manufacturing Engineering and Technology by Serope Kalpakjian and Stevan R.
REFERENCE BOOKS:

2. **Principles of Industrial metal working process** - G.W. Rowe, CBS pub. 2002
4. **Theory of plasticity** by Dr. Sadhu Sing

ADVANCED STRENGTH OF MATERIALS

**Sub Code:** 13ME515  
**Credits:** 03  
**Hrs/Week:** 3  
**Total Hours:** 39

**Course Outcomes**

Upon completion of this course, graduates will be able to

1. Understand the types of stresses like principle stresses, octahedral stresses, applying boundary conditions to practical problems and the sign conventions of stresses.
2. Understand the principal strains, be thorough with Hooke’s law which gives the general relation between stress and strain and understand Saint Venant’s Principle.
3. Understand the plain stress and plane strain conditions and apply the Airy’s stress function for simple practical problems of beams.
4. Understand the analysis of thick cylinder under pressure due to shrink fit, stresses in rotating solid and hollow discs.
5. Study torsion of solid circular and elliptical bars, torsion in thin tubes and understand membrane analogy.

UNIT - I

**Stress:** Definition notation and sign convention of stress; Equilibrium equations, Stress components on an arbitrary plane; Principle stresses-maximum shear stress, octahedral stresses- boundary conditions.
UNIT - II

Strain: Definitions – strain - displacement relations - compatibility equations Principal strains- Generalized Hooke’s law.  

Uniqueness theorem: Saint Venant’s Principal- Principal of super position- Reciprocal theorem.  

UNIT - III

Two dimensional problems in Cartesian co-ordinates: Plane stress and plane strain conditions- Bi-harmonic equation- Investigation of Airy’s stress function for simple beam problems- Solution for cantilever beam under end load and simply supported under uniformly distributed load  

UNIT - IV

General equations in polar co-ordinates: Thick cylinder under pressure – Analysis of shrink fit  

Discs: Stresses in rotating hallow and solid discs  

UNIT - V

Torsion: Torsion of solid circular and elliptical bars- torsion in thin tubes, membrane analogy  

TEXT BOOK:


REFERENCES BOOKS:

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OPERATIONS RESEARCH

Sub Code : 13ME601  Credits : 04
Hrs/Week : 4+0+0+0  Total Hours : 52

Course Outcomes
Upon completion of this course, graduates will,

1. Appreciate the use of Operations Research for solving problems in real life by selecting appropriate modeling technique. Use of linear programming for formulating and solving problems.
2. Use of transportation and assignment technique to find solutions to real life problems.
3. Use sequencing technique to solve real life problems like servicing customers in a bank, performing jobs in a factory etc., replacement theory to understand machine replacement and simulation for solving a variety of real life problems.
4. Appreciate the use of queuing theory to solve real life problems like arrival and departure in an airport, customers waiting for paying electricity bills at a cash counter, patients in a hospital, who need treatment etc. and game theory for working out strategies in conflict situations.

5. Use of network analysis techniques for resource allocation. Recognize the limitations on resources needed for carrying out the activities of a project and how it can affect the scheduling of a project.

UNIT – I


12 Hours

UNIT - II

TRANSPORTATION PROBLEM: Formulation of transportation Model, Basic feasible solution using different methods, Optimality Method, Unbalanced transportation problem, Degeneracy in transportation problems, Applications of Transportation problems.

ASSIGNMENT PROBLEM: Formulation, unbalanced assignment problem, Traveling salesman problem.

10 Hours

UNIT - III

SEQUENCING: Johnson’s algorithm, n - jobs to 2 machines, n jobs 3 machines, n jobs m machines without passing sequence. 2 jobs n
machines with passing. Graphical solutions, priority rules.

**REPLACEMENT THEORY:** Replacement policy for equipment which deteriorates gradually. Replacement of items that fail suddenly.

**SIMULATION:** Introduction, process of simulation, Monte Carlo Simulation, Simulation of an inventory system, Simulation of queuing system, Advantages and disadvantages of Simulation, Applications of Simulation, Problems on Simulation. 

**UNIT – IV**

**QUEUING THEORY:** Queuing system and their characteristics. The M/M/1 Queuing system, Steady state performance analysing of M/M/1 and M/M/C queuing model.

**GAME THEORY:** Formulation of games, Two person-Zero sum game, games with and without saddle point, dominance property, Graphical solution (2x n, m x 2 game)

**UNIT – V**

**PROJECT MANAGEMENT USING NETWORK ANALYSIS:** Network construction, determining critical path, floats, scheduling by network, project duration, PERT- Estimation of project duration, variance under probabilistic models, prediction of date of completion. Crashing of networks, least cost project scheduling.

**TEXT BOOKS:**

**REFERENCE BOOKS:**
2. *Introduction to operation research*, Hiller and Liberman, Mc
Syllabus of V & VI Semester B.E. / Mechanical Engg.

5. “PERT & CPM”, L. S. Srinath

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**DESIGN OF MACHINE ELEMENTS - II**

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**Course Outcomes**

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

1. Understand the differences between straight beams and curved beams, design curved beams for different applications, analyze the stress distribution in closed rings and design power screws used in simple machine parts.

2. Design different types and cross sections of springs, compute the stresses in coil springs, design the springs for fluctuating loads and analyze the stress distribution in leaf springs.

3. Design different types of clutches and brakes.

4. Design spur, helical, worm gears and understand the nomenclature and design of bevel gears.

5. Understand the tribological consideration in design including friction, wear, lubrication and design sliding contact and rolling contact bearings for different applications.
UNIT - I

Curved Beams: Crane hook, punching press frames & C-clamps, closed rings and links.

DESIGN OF simple Machine components: Screw Jack, C-clamps, Machine vice, Levers, 12 Hours

UNIT - II

DESIGN OF SPRINGS: Types of springs - Tension and compression springs, stresses in Coil springs of circular and non circular cross sections. Springs subjected to Fluctuating load, Leaf Springs: Stresses in Leaf springs. Equalized stresses – Energy stored in springs. Torsion, Belleville springs. 10 Hours

UNIT- II

CLUCHTES & BRAKES: Design & selection: Design of single and multi plate, Design of cone clutch, Design of block, band, and expansion brakes, Principle and condition for self locking of brakes. 10 Hours

UNIT- IV

DESIGN OF GEARS: Review of gear fundamentals, interference, gear forces, Design of a spur gear pair. Helical gears: parallel axis helical gear, normal and transverse planes, helix angles, equivalent number of teeth, Design of helical gear pair.

Bevel gears: Types & Nomenclature only (No Design problems on bevel gears)

WORM GEARS: Nomenclature, thermal capacity, efficiency, design of a pair of worm gears. 14 Hours

UNIT- V

DESIGN OF BEARINGS:
Introduction to Tribological consideration in design: Friction, Wear, Lubrication. Lubrication and mountings, Oil seal and packing Sliding

**Rolling Contact Bearing:** Types, static and dynamic load capacities, equivalent bearing load, load-life relationship, bearing life, load factor, selection of bearing from manufactures catalogue. Ball and Roller bearing, Design for variable load and speed, Bearings with probability of survival other than 90 %. Bearing material and their properties:

14 Hours

**DESIGN DATA HAND BOOK:**

**TEXT BOOKS:**

**REFERENCE BOOKS:**
AUTOMOTIVE ENGINEERING

Sub Code : 13ME603
Credits : 04
Hrs/Week : 3+0+1+4
Total Hours : 52

Course Outcomes
Upon completion of this course, graduates will be able to,

1. Draw the layout and define the functions of each part of an automobile.
2. Understand the construction and working of each part of an automobile.
3. Determine the dimensions, torque transmission of parts like clutch.
4. Determine the gear ratio in the gear box.
5. Determine the deceleration, stopping distance in during braking.
6. Differentiate between different types of automobile engines.
7. Know the automotive pollutants and its control methods

UNIT- I

ENGINE COMPONENTS AND COOLING & LUBRICATION SYSTEMS:
SI & CI engines, Cylinder-arrangements and their relative merits, Liners, Piston, connecting rod, crankshaft, valves, valve actuating mechanisms, valve and port timing diagrams, Types of combustion chambers for S. I. Engine and C. I. Engines, Choice of materials for different engine components, engine positioning, cooling requirements, methods of cooling, thermostat valves, different lubrication arrangements. 10 Hours

UNIT-II

FUEL SUPPLY SYSTEMS FOR SI AND CI ENGINES: Fuel mixture
requirements for SI engines, types of carburetors, C.D. & C. C. carburetors, multi point and single point fuel injection systems, fuel transfer pumps, fuel injection pumps and injectors.  7 Hours

IGNITION SYSTEMS:
Battery Ignition systems, magneto Ignition system, Transistor assisted contacts. Electronic Ignition, Automatic Ignition advance systems, Lighting systems, starting device (Bendix drive).  3 Hours

UNIT-III
POWER TRAINS:
Clutches- Single plate, multiplate and centrifugal clutches. Gear box: Necessity for gear ratios in transmission, Constant mesh gear box, Synchronmesh gear box, over drive, fluid coupling and torque converter, Epicyclic gear box, principle of automatic transmission, calculation of gear ratios, Numerical calculations for torque transmission by clutches.  10 Hours

UNIT-IV
DRIVE TO WHEELS:
Propeller shaft, universal joints, Hotchkiss. and torque tube drives, differential, rear axle, different arrangements of fixing the wheels to rear axle, steering geometry, camber, king pin inclination, included angle, castor, toe-in & toe-out, condition for exact steering, steering gears, power steering, general arrangements of links and stub axle, over steer, under steer & neutral steer, numerical problems.  7 Hours

SUSPENSION AND SPRINGS:
Requirements, leaf spring, coil spring, Torsion bar suspension systems, independent suspension for front wheel, Air suspension system.  3 Hours

UNIT-V
BRAKES:
Types of brakes, mechanical, compressed air, vacuum and hydraulic
braking systems, construction and working of master and wheel cylinder, brake shoe arrangements, Disk brakes, Drum brakes, numerical problems related to brake torque, minimum stopping distance with brakes on front, rear and all wheels, weight transfer and heat dissipation during braking.

8 Hours

TYRES
Desirable tyre properties, Types of tyres.

1 Hour

AUTOMOTIVE EMISSION:
Automotive exhaust emissions, sources and emission control method.

3 Hours

List of proposed Experiments:

4 Hours

1. Study of Automotive - Chassis & superstructure/body and its functions. Also involves study of seat, cut section of wheel rims(Drop-center and Flat-base) & tyres(bias and radial types).
2. Study of more commonly used tools and equipment in Automotive shop
3. Study of carburettors and petrol & diesel fuel injection systems (If part is not available, Charts/video to be used at present).
4. Demonstration and study of Front axle and steering system
5. Demonstration and study of various suspension systems
6. Power train - Dismantling and assembly of single/multi cylinder Engine as available
7. Power train - Study of clutch mechanism. Demonstration and study of dry friction clutches and wet clutches - Single plate & multi-plate types
8. Power train - Demonstration and study of transmission system - Gear box
9. Power train - Demonstration and study of Universal joints, propeller shaft, final drives, differential, and rear axles
10. Demonstration and study of brake mechanism (hydraulic type) and study of disc and drum brakes
11. Field visit to Automotive Servicing Station - Study of electrical system, wheel alignment (measuring and adjustment of castor, camber, king-pin inclination, toe-in and toe-out), automotive emission control systems.

(The details of each experiment to be given out as handout to each student or may be uploaded in Intranet)

TEXT BOOKS:
2. Automobile Engineering, Kirpal Singh, Vol I and II

REFERENCE BOOKS:
4. Automotive Mechanics, Joseph Heithner 2000
5. Automobile Mechanics by N. K. Giri, Khanna publishers 2002

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CAD/CAM

<table>
<thead>
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<td>4+0+0+0+0</td>
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Course Outcomes

Upon completion of this course, graduates will,

1. Understand the basics of CAD/CAM, product cycle, CAD/ CAM process, the software functions, and transformation of geometries.
2. Provide capability to analyze and solve problems associated with curves, surfaces and solids.

3. Understand general concepts of FEM and applying it to numerical using elimination and penalty method.

4. To familiarize with fundamentals of NC/CNC/DNC, adaptive control system and understand the basics of programming.

5. Understand basics of robotics, types of configurations, end effectors, sensors and robot applications.

UNIT - I

Introduction to CAD:
Conventional design process, computer aided design, benefits of CAD.

Hardware for CAD: Graphic displays – Image generation techniques, Direct beam refresh, Direct view storage, Raster scan. Display controller & display memory,

Graphics software:
Algorithm for generation and display of simple graphical elements like lines, circles, ellipse. Transformations – Translation, Rotation and Scaling, Reflection.

10 Hours

UNIT - II

Geometric Modeling:
Types and representation of curves: Analytical curves – line, ellipse, parabola. Synthetic curves – Cubic, Bezier & B-spline curves.


Types and representation of solids – Solid representation, half spaces, Boundary Representation (B-Rep), Constructive Solid Geometry (CSG)

10 Hours

UNIT - III

Finite Element Modeling and Analysis:
General procedure of FEM. Formulation and solution of typical problems using Spring, Truss & Beam elements - Element equations, Assembly of
elements, Boundary conditions and External loads, Solution of global equations.  

10 Hours

UNIT – IV

Numerical Control:
Definition of N.C. Machine, Classification, Advantages and disadvantages of N.C. machine,

CNC programming:
Problem with conventional NC, Computer Numerical Control, Coordinate systems, point to point and contour programming. Direct Numerical Control, Adaptive Control Machining System.  

10 Hours

UNIT – V

Industrial Robotics:
Introduction to Robotics, Robot anatomy, physical configurations, Manipulator Kinematics, Technical features, programming the robot, robot programming language, end effecters, work cell design, work cell control and interlock, robotic sensor, robotic applications.  

12 Hours

TEXT BOOKS:


REFERENCE BOOKS:


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COMPUTER AIDED MODELING & ANALYSIS LAB

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Course Outcomes

At the end of this unit, student shall be able to:

1. Learn to use the different modules of ANSYS V10, such as pre-processing, processing and post-processing to perform linear static analysis.

2. Apply the concepts FEM to solve numerical problems related to trusses, 1-D bar, beams and plates and compare the theoretically obtained results with ANSYS V10 results.

3. Distinguish between Plane stress, Plane Strain and Axisymmetric as problems are solved.

4. Apply the knowledge of tools of Pro E. (Creo V2) to create models and assembly of couplings (like, Universal and Flanged) and joints (like Knuckle and Cotter).

PART A – STRUCTURAL ANALYSIS

Study of Finite Element Analysis (ANSYS)

Static Finite Element Analysis of Bars, Trusses, Beams, Plates. (8 exercises)  21 Hours

PART B – PART MODELING & ASSEMBLY

Study of solid modeling packages (PRO-E & CATIA), Modeling and assembly of Flanged coupling (protected & unprotected type), Oldham’s coupling, Knuckle joint, Socket and Spigot joint, using above two software packages  21 Hours

Scheme for Examination:
One Question from Part A - 20 marks
One Question from Part B - 20 marks
Viva - Voce - 10 marks
Total - 50 marks

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CNC & ROBOTICS LABORATORY

Sub Code : 13ME606
Credits : 02

Hrs/Week : 0+0+3+0
Total Hours : 39

Course Outcomes
At the end of this unit, student shall be able to:

1. Learn to use the different modules of ANSYS V10, such as pre-processing, processing and post-processing to perform linear static analysis.
2. Apply the concepts FEM to solve numerical problems related to trusses, 1- D bar, beams and plates and compare the theoretically obtained results with ANSYS V10 results.
3. Distinguish between Plane stress, Plane Strain and Axi-symmetric as problems are solved.
4. Apply the knowledge of tools of Pro E. (Creo V2) to create models and assembly of couplings (like, Universal and Flanged) and joints (like Knuckle and Cotter).

PART A – Programming & operation on CNC Lathe

Writing manual part programming using ISO codes, for machining simple machine parts in CNC turning machine and machining the model. (4 Exercises)

Writing manual part programming using ISO codes, for machining simple machine parts in CNC milling machine. (6 exercises).

21 Hours

PART B - Programming & operation of 6 axis articulated Robot

Different methods of Programming of Robot for pick and place application (10 exercises) 21 Hrs.
13ME611 - NON TRADITIONAL MACHINING

Sub Code : 13ME611
Credits : 03
Hrs/Week : 3
Total Hours : 39

Course Outcomes
1. At the end of the course student will have detail knowledge on Modern technology use for machining purpose.
2. By applying the principles of Non-Traditional Machining the productivity of any manufacturing firm will increase.
3. Draw backs of Conventional methods were efficiently managed by applying the Non-Traditional Manufacturing Methodology.
4. Machining time was reduced significantly.
5. Metal removal rate is faster in Non-Traditional Machining process compared to Conventional Machining Process.
6. Any known materials can me machined effectively by using this technology.

UNIT – I

INTRODUCTION: Classification, comparison between conventional and Non-conventional machining process selection.

PLASMA ARC MACHINING (PAM): Introduction, equipment, selection of gas, Mechanism of metal removal, PAM parameters, process characteristics, applications, Advantages and limitations.

LASER BEAM MACHINING (LBM): Introduction - Equipment of
LBM mechanism of metal removal, LBM parameters, Process characteristics, Applications, Advantages and limitations.

**ELECTRON BEAM MACHINING (EBM):** Principles, equipment, operations, applications, advantages and limitation of EBM.

10 Hours

**UNIT- II**

**ULTRASONIC MACHINING (USM):** Introduction, equipment, tool materials & tool size, abrasive slurry, USM process characteristics: Material removal rate, tool wear, Accuracy, surface finish, applications, advantages & disadvantages of USM.

**ABRASIVE JET MACHINING (AJM):** Introduction, Equipment, Variables in AJM: Carrier Gas, Type of abrasive, size of abrasive grain, velocity of the abrasive jet, mean number. Abrasive particles per unit volume" of the carrier gas, work material, stand off distance (SOD), nozzle design, and shape of cut. Process characteristics, Material removal rate, Nozzle wear, Accuracy & surface finish. Applications - advantages and disadvantages of AJM.

9 Hours

**UNIT- III**

**ELECTRICAL DISCHARGE MACHINING (EDM):** Introduction, mechanism of metal removal, dielectric fluid; spark generator, EDM tools (electrodes) Electrode feed control, Electrode manufacture, Electrode wear, EDM tool design, choice of machining operation, electrode material selection, uncle;; sizing and length of electrode, machining time. Flushing; pressure flushing, suction flushing, side flushing, pulsed flushing synchronized with electrode movement, EDM process characteristics: metal removal rate, accuracy, surface finish. Heat Affected Zone. Application, EDM applications, electrical discharge grinding, wire EDM.

9 Hours
UNIT – IV
ELECTROCHEMICAL MACHINING (ECM): Introduction, study of ECM machine, elements of ECM process: Cathode tool, Anode work piece, source of DC power, Electrolyte, chemistry of the process, ECM Process characteristics - Material removal rate, Accuracy, surface finish, ECM Tooling: ECM tooling technique & example, Tool & insulation materials, Tool size Electrolyte flow arrangement; Electrochemical Grinding, Advantages, Limitations. 9 Hours

UNIT – V
CHEMICAL MACHINING (CHM): Introduction, elements of process, chemical, blanking process: Preparation of work piece, preparation of masters, masking with photo resists, etching for blanking, accuracy of chemical blanking, applications of chemical blanking, chemical milling (contour machining): process steps -masking, Etching, process characteristics of CHM: material removal rate, accuracy, surface finish, Hydrogen embrittlement, advantages & application of CHM.

8 Hours

TEXT BOOKS:

REFERENCE BOOKS:
2. Modern Machining Process, Aditya 2002
4. Metals Handbook:Machining - Volume 16 Joseph R. Davis (Editor), American Society of Metals (ASM)
MANAGEMENT INFORMATION SYSTEM

Sub Code : 13ME612       Credits : 03
Hrs/Week : 3              Total Hours : 39

UNIT - I

FOUNDATION CONCEPTS: Foundations of Information Systems in Business Information System and Technologies, Business applications, developments and management, competing with Information Technology using Information Technology for strategic advantage. 7 Hours

UNIT - II

REVIEW OF INFORMATION TECHNOLOGIES: Computer Hardware – computer systems, end user and enterprise computing, computer peripherals, input, output, and storage technologies, Computer Software- application software, end user application, system software, computer system management. 7 Hours

UNIT - III

DATA RESOURCE MANAGEMENT: Managing Data Resources, Technical foundations of Database Management, Telecommunication and Networks – overview of telecommunications and networks, technical telecommunications alternatives. 5 Hours

UNIT - IV

BUSINESS DECISION: E –Business Decision Supports Systems for decision support, executive support systems, group decision support system, Artificial Intelligence Technologies in Business 5 Hours


UNIT - V


MANAGING GLOBAL SYSTEMS: Growth of International Information Systems, Organizing International Information Systems, Managing Global systems, Off/Outsourcing, Global Value chain, Case Studies. 3 Hours

TEXT BOOKS:


REFERENCE BOOKS:


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DESIGN FOR MANUFACTURING

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UNIT - I

Selection of materials and processes: Phases of design - General Requirements: material and process selection, effect of material properties and manufacturing process on design-- The material selection process. DFM approach, DFM guidelines.  

UNIT - II

Product design for manual assembly, automatic assembly and robotic assembly Computer aided DFMA. Process capability, mean, variance, skewness, kurtosis, Process capability metrics, $C_p$, $C_{pk}$ Cost aspects, feature tolerances.  

UNIT - III

Geometric tolerances, surface finish, review of relationship between attainable tolerance grades and different machining process, cumulative effect of tolerances, sure fit law, normal law and truncated normal law. Selective assembly.  

UNIT - IV
Redesign of castings based on parting line considerations, minimizing core requirements, redesigning cast members using weldments, use of welding symbols. Operation sequence for typical shaft type of components, preparation of process drawings of different operations. Tolerance worksheets and centrality analysis, examples.  

UNIT - V

Design features to facilitate machining, datum features - functional and manufacturing, component design machining considerations, redesign for manufacture, examples.  

REFERENCE BOOKS:

Rapid Prototyping Technology

Sub Code : 13ME614  
Credits : 03  
Hrs/Week : 3  
Total Hours : 39

UNIT - I


10 Hours
UNIT - II

SELECTIVE LASER SINTERING: Type of machine, Principle of operation, process parameters, Data preparation for SLS, Applications.
FUSION DEPOSITION MODELLING: Principle, Process parameter, Path generation, Applications. 8 Hours

UNIT - III


CONCEPTS MODELERS: Principle, Thermal jet printer, Sander's model market, 3-D printer. Genisys Xs printer HP system 5, object Quadra systems. 8 Hours

UNIT - IV

RAPID TOOLING: Indirect Rapid tooling, Silicone rubber tooling, Aluminum filled epoxy tooling, Spray metal tooling, Cast kirksite, 3Q keltool, etc. Direct Rapid Tooling Direct. AIM. RAPID TOOLING: Quick cast process, Copper polyamide, Rapid Tool, DMILS, Prometal, Sand casting tooling, Laminate tooling soft Tooling vs. hard tooling. 8 Hours

UNIT - V

SOFTWARE FOR RP: STL files, Overview of Solid view, magics, mimics, magic communicator, etc. Internet based software, Collaboration tools.

RAPID MANUFACTURING PROCESS OPTIMIZATION: factors influencing accuracy. Data preparation errors, Part building errors, Error in finishing, influence of build orientation. 8 Hours
TEXT BOOKS:


REFERENCE BOOKS:


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DESIGN PRACTICES OF JIGS & FIXTURE

Sub Code : 13ME615
Hrs/Week : 3+0+0+0

Credits : 03
Total Hours : 39

UNIT 1

UNIT 2
Jigs-Drill bushes, Different types of Jigs-Plate latch, channel, box, post, angle plate, angular post, turnover, pot jigs. Automatic drill jigs, Rack & Pinion Operated jigs, Air operated Jigs and Components. Design and development of Jigs for given components.

UNIT 3

UNIT 4

Design concepts of the following elements of progressive and combination dies, Selection of standard die sets. Strip layout and development. Design and development of Compound, Progressive and Combination dies.

UNIT 5

Term project
(Not for end-semester examination; to be considered for internal assessment only).

TEXTBOOKS:

REFERENCE BOOKS
3. 'Design Data Book', PSG College of Technology.

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DESIGN OF THERMAL SYSTEMS

Sub Code : 13ME616
Credits : 03
Syllabus of V & VI Semester B.E. / Mechanical Engg.

Hrs/Week : 3  
Total Hours: 39

UNIT - I

8 Hours

UNIT - II

System Simulation  
8 Hours

UNIT - III

Optimization, Lagrange Multipliers, Search Methods  
8 Hours

UNIT - IV

Dynamic Programming, Geometric Programming  
8 Hours

UNIT - V

Linear Programming, Mathematical Modeling- Thermodynamic Properties, Steady state Simulation of Large Systems  
10 Hours

TEXT BOOK:


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RENEWABLE SOURCES OF ENERGY

Sub Code : 13ME617  
Credits : 03

Hrs/Week : 3  
Total Hours: 39

UNIT - I
Man and Energy, Worlds and India’s production and reserves of energy, present and future power position, energy alternatives. Solar Energy:

Solar Energy Option:
- Liquid flat plate collector, general performance analysis with numerical problems, design considerations effect of various parameters on performance, testing procedure.
- Concentrating collectors – Introduction, cylindrical, parabolic collector, Compound parabolic collector, Central receiver collector.

UNIT - II


UNIT - III


UNIT - IV

Geothermal Energy – Introduction, types of geothermal resources, methods of harnessing, geothermal energy applications, environmental problems and prospects in India.

Tidal Power- Introduction, causes for tide formation, power of tide, tidal power plants, advantages and limitations.
Ocean Thermal Energy – Introduction to O.T.E.C., open and closed cycle OTEC systems, prospects in India.  

**3 Hours**

**UNIT - V**

Wave Energy – Introduction, power of wave energy, conversion devices.  
Energy planning, Energy conversion opportunities and measures. Energy Audit – Scope, type and case studies.

**9 Hours**

**TEXT BOOKS:**
1. Renewable Energy Sources by Twidal & Weirs.  

**REFERENCE BOOKS:**

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**INTRODUCTION TO AIRCRAFT DESIGN**

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**Course Outcomes**

At the end of this elective, student shall be able to:

1. Get an exposure to the Aerospace Industry.
2. Understand the Basics of Aircraft Systems and Aircraft Structures.
4. Understand the applicability of Design aspects in Aircraft Design.
5. Relate the theoretical knowledge with the design of Aircraft Structures.

UNIT – I

Chapter 1 - Aircraft industry overview
Evolution and History of Flight, Types Of Aerospace Industry, Aerospace Manufacturing,
Aerospace industry trends, Structure of an airliner.

Chapter 2 - Aircrafts Classification and Structure
Basic components of an Aircraft, Structural members, Aircraft Axis System, Aircraft Motions, Forces on the airplane, Control surfaces, Types of Aircrafts - Lighter than Air/Heavier than Air Aircrafts.
Aircraft materials: Introduction, Requirements, Material Properties and Selection criteria of Aluminium, steel, titanium, Introduction to composite, need and use of composites, challenges and key enablers of composites.

UNIT – II

Chapter 3 - Basic Principles of Flight
Properties of Atmosphere, Air speed and Ground Speed, Bernoulli’s Equation, Measurement of air speed, Types of air speeds, Airflow over wing section, Pressure Distribution over a wing section, Center of Pressure and its effects, Definitions of lift, drag and angle of attack, Generation of Lift, Factors affecting lift, Lift curve, Drag, Types of Drag, Drag Curve, Lift/Drag Ratio Curve, Pitching moment, Stalling.
Aerofoil Nomenclature, Types of Aerofoil, Wing Section- Aerodynamic Center, Aspect Ratio, High lift devices (flaps and slats), Effect of flaps and slats on lift, drag and angle of attack.
Significance of speed of Sound, Mach Numbers, Sonic and Supersonic Flight and its effects.
UNIT - III

Chapter 4 - Basics of Flight Mechanics


Maneuvers: Aerobatics – Loop, spin, roll, inverted loop.

UNIT – III

Chapter 6 - Aircraft Systems

Types of Aircraft Systems, Classification, Engine Control Systems, Types of engines- Turbo jet, Turbo fan and Turbo prop, Fuel systems, Hydraulic systems – open and closed loop hydraulic system.

Landing gear systems, Ice and rain protection systems, Cabin Pressurization and Air Conditioning Systems, Steering and Brakes Systems, Auxiliary Power Unit, Environmental control systems (ECS), Brief overview of Electrical and Electronic Systems and Avionics.

UNIT – IV

Chapter 7- Aircraft Design Configuration: Conventional Design Configurations: Based on Power Plant Location, Wing vertical location, intake location, Tail Unit Arrangements, Landing Gear Arrangements.

Unconventional Design Configurations: Biplane, Variable Sweep, Canard Layout, Twin Boom Layouts, Span loaders, Blended Body Wing Layout, STOL and STOVL Aircraft, Stealth Aircraft. Advantages and disadvantages of these Configurations.

TEXT BOOKS:

REFERENCE BOOKS:

2. Introduction to Flight by Dave Anderson
3. Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration by Ian moir, Allan Seabridge

Web resources

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GAS DYNAMICS & JET PROPULSION

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UNIT - I

UNIT - II

FLOW THROUGH DUCTS: Flow through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) - Variation of flow properties - Use of tables and charts - Generalised gas dynamics.

9 Hours

UNIT - III

NORMAL AND OBLIQUE SHOCKS: Governing equations - Variation of flow parameters across the normal and oblique shocks - Prandtl – Meyer relations - Use of table and charts - Applications.

9 Hours

UNIT - IV

JET PROPULSION : Theory of jet propulsion - Thrust equation - Thrust power and propulsive efficiency - Operation principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines – Aircraft combustors.

9 Hours


6 Hours

TEXT BOOK:

REFERENCE BOOKS:
3. Hans Vanohain and Jack D Mattingly, ”Elements of Gas Turbine Propulsion”, TMH.

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PROJECT MANAGEMENT

Sub Code : 13ME622
Credits : 03
Hrs/Week : 3
Total Hours : 39

UNIT - I


8 Hours

UNIT - II

Network Scheduling: Critical Path Method, Program Evaluation & Review Technique-Planning and Scheduling of Activity Networks-
Assumptions in PERT Modelling-Time-cost Trade-offs. 9 Hours

UNIT - III
Linear Programming and Network Flow Formulations-PERT/COST Accounting. Scheduling with limited resources: 8 Hours

UNIT – IV
Resource Planning-Resource Allocation-Project Schedule Compression-Project Scheduling Software. 8 Hours

UNIT - V

REFERENCE BOOKS:

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MACHINE TOOL DESIGN
Sub Code : 13ME623 Credits : 03
Hrs/Week : 3 Total Hours : 39
UNIT - 1

PRINCIPLES OF MACHINE TOOL DESIGN: General requirements of Machine Tool design, Engineering design process applied to Machine Tool, Classification of Machine Tools, Working and Auxiliary motions, Layout of Machine Tool. 8 Hours

UNIT - 2

MACHINE TOOL DRIVES AND MECHANISMS: Drives – Electric drives: Induction motor, Servo motor, Selection of AC and DC servo motors, Hydraulic transmission, Regulations of speed and feeds, Stepped regulations, Standardization of speed and feed, Stepless regulation of speed and feeds, Servo drives. 8 Hours

UNIT - 3

DESIGN OF MACHINE TOOL STRUCTURES: Functions, Requirements, Design criteria Material used – Static and Dynamic Stiffness – Profile and Basic Design procedure for Machine Tool Structures, Design of Beds, Columns, Housing, Bases, Tables, Cross–rails, Arms Saddle, Carriages. 7 Hours

UNIT – 4

DESIGN OF GUIDE WAYS AND POWER SCREWS: Functions and Classification of guide ways (V-guide, Flat guide ways), Design of slideways, Antifriction guide ways, Combination guide ways, Protecting devices for slideways, Selection of Power Screws and Recirculating Ball Screws. 8 Hours

UNIT - 5

DESIGN OF SPINDLE AND SPINDLE BEARINGS: Function – Requirements and Materials for Spindle Compliance and Machining Accuracy, Design of Spindles – Antifriction Bearing, Hydrodynamic and Hydrostatic bearing, Air lubricated bearings. INTRODUCTION TO CNC MACHINES AND SPECIAL PURPOSE MACHINE (SPMS): Difference between Conventional and CNC Machine Tools. Features of
CNC machines and its advantages, Purpose of SPMs with typical examples of automobile components.

**7 Hours**

**TEXT BOOKS:**


**REFERENCE BOOKS:**


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**FINITE ELEMENT METHODS**

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**Course Outcomes**

Upon completion of this course, Students should be able to,

1. Define and understand the concept of FEM along with its applications.
2. Apply the principle of minimum potential energy for various structural problems and implement weighted residual methods
for determining deformation and deflection of structural systems and also solve problems using numerical integration methods.

3. Express displacement functions of various basic and higher order 1D, 2D and 3D elements along with shape functions for those particular elements

4. Implement the steps required for FEM to obtain appropriate solution to a variety of physical systems (Bars, truss) and obtain engineering design parameters using different boundary condition handling methods.

5. Determine the deflection and stress at various points on different types of beams and formulate 2D structural problems (plates) using FEM.

UNIT - I
Introduction: Definition of FEM, General Description of FEM, Engineering applications of FEM, Discretization process, Types of Elements – 1D, 2D, 3D and Axisymmetric elements, location of nodes, node numbering scheme, boundary conditions, half band width, stiffness matrix of bar elements by direct method, properties of stiffness matrix, preprocessing, post processing. Displacement of 3D Elastic body, Differential equations of equilibrium of stresses at a point, strain displacement relations, stress – strain relations for plane stress and plane strain. 8 Hours

UNIT - II
Principle of minimum potential energy: Rayleigh – Ritz method, Galerkins Method, Numerical Integration. 8 Hours

UNIT- III
Displacement models, Pascal Triangle - displacement functions for higher order quadrilateral & triangular elements, Shape functions, Derivation of Shape function for 1D linear element, quadratic element, CST element, Convergence & its types. 8 Hours
UNIT - IV

Finite element formulation of 1D linear element, Numerical problems on bars, stepped bars - solution of displacements, reactions and stresses by using elimination approach, penalty approach. Stress and strain in plane truss by direct stiffness method, Numerical problems. 8 Hours

UNIT- V


TEXT BOOKS:

REFERENCE BOOKS:
1. *Introduction to the Finite Element Method*, C. S. Desai and J.F. Abel
2. *Finite Element Analysis – Theory & Programming*, Krishnamoorthy C.S
5. *An Introduction to the Finite Element Method* J. N. Reddy

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COMPUTATIONAL FLUID DYNAMICS

Sub Code : 13ME625
Credits : 03
Hrs/Week : 3
Total Hours : 39

UNIT - I

INTRODUCTION: Computational Fluid Dynamics, Advantages, Applications, Future of CFD.

CFD SOLUTION PROCEDURE: Problem set up-pre-process, Numerical solution – CFD solver, Result report and visualization-post-process. 10 Hours

UNIT - II

GOVERNING EQUATIONS FOR CFD: Introduction, the continuity equation, the momentum equation, the energy equation, the additional equations for turbulent flows, generic form of the governing equations for CFD, boundary conditions.

CFD TECHNIQUES: Introduction, Discretisation of governing equations, Finite difference method, Finite volume method, converting governing equations to algebraic equation system, Numerical solutions. 9 Hours

UNIT - III


PRACTICAL GUIDELINES FOR CFD: Introduction, grid generation, boundary conditions, turbulent modeling. 9 Hours

UNIT - IV

APPLICATIONS OF CFD: Introduction, CFD as a design tool, indoor air flow distribution, CFD as a research tool, CFD applied to heat transfer coupled with fluid flow, buoyant free standing fire, flow over vehicle platoon, air/particle flow in human nasal cavity, high speed flows. 8 Hours
UNIT - V

ADVANCED TOPICS IN CFD: Introduction, advances in numerical methods and techniques – incompressible flows, compressible flows, moving grids, multigrid methods, parallel computing, immersed boundary methods. Advances in computational methods – DNS, LES, RANS-LES coupling for turbulent flows, multiphase flows, combustion, fluid-structure interaction, physiological fluid dynamics and other numerical approaches. 6 Hours

TEXT BOOKS:


REFERENCE BOOKS:

ORGANIZATIONAL BEHAVIOR & PROFESSIONAL ETHICS

Sub Code : 13ME626
Credits : 03
Hrs/Week : 3
Total Hours : 39

UNIT - I


8 Hours

UNIT - II

LEARNING: Definition, Theories of Learning, Individual Decision Making, classical conditioning, operant conditioning, social learning theory, continuous and intermittent reinforcement. PERCEPTION: Definition, Factors influencing perception, attribution theory, selective perception, projection, stereotyping, Halo effect.

8 Hours

UNIT - III

MOTIVATION: Maslow's Hierarchy of Needs theory, Mc-Gregor's theory X and Y, Hertzberg's motivation Hygiene theory, David McClelland’s three needs theory, Victor Vroom's expectancy theory of motivation. THE GROUPS: Definition and classification of groups, Factors affecting group formation, stages of group development, Norms, Hawthorne studies, group processes, group tasks, group decision making.

9 Hours

UNIT - IV

CONFLICT & STRESS MANAGEMENT: Definition of conflict, functional and dysfunctional conflict, stages of conflict process. Sources of stress, fatigue and its impact on productivity. Job satisfaction, job rotation, enrichment, job enlargement and reengineering work process.

8 Hours
UNIT - V

PRINCIPLES OF COMMUNICATION: Useful definitions, communication principles, communication system, role of communication in management, barriers in communication, how to overcome the barriers, rule of effective communication. 9 Hours

TEXT BOOKS:


REFERENCE BOOKS:

EMPLOYABILITY SKILL DEVELOPMENT

Sub Code : 13IL001/002
Hrs/Week : 1+0+0+0

UNIT - I
Analytical Aptitude Skill: concept of analytical skill, definition-logical thinking and testing of Analytical Aptitude

UNIT - II
Quantitative Aptitude skill-Concept-definition-Preliminary requirement for development of quantitative skill- testing of quantitative skill.

UNIT - III
Verbal and ability skill – Knowledge and Vocabulary and grammar-comprehension-Verbal Reasoning skill

REFERENCE BOOKS:

Examination pattern:
This course is a mandatory learning course without credit. Continuous internal examination (CIE) consists of 2 internal exams (20 marks each) and tasks (10 marks). There is no semester end examination (SEE). The student will be awarded PP or NP grade as per autonomous regulations.

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Syllabus of  V & VI Semester B.E. / Mechanical Engg.