**SCHEME OF EXAMINATION**

**B.TECH. 2nd Year Mechanical Engineering (Auto) -3rd Semester**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Code** | **Subject Name** | **Teaching Schedule**  **(Hrs)** | | | | **Examination Schedule (Marks)** | | | **Total**  **Marks** | **Duration of Exam** |
| **L** | **T** | **P/D** | **Total** | **Sessional** | **Theory** | **Practical/**  **Viva-Voce** |  |
| 1 | HUM 201 E/ MATH-201E | Basics of Economics & Management / Mathematics-III | 3 | 1 | - | 4 | 50 | 100 | - | 150 | 3 |
| 2 | ME 201 E | Thermodynamics | 3 | 1 | - | 4 | 50 | 100 | - | 150 | 3 |
| 3 | ME 203 E | Strength of Materials-I | 3 | 1 | - | 4 | 50 | 100 | - | 150 | 3 |
| 4 | ME 205 E | Machine Drawing | 2 | - | 4 | 6 | 50 | 100 | - | 150 | 4 |
| 5 | ME 207 E | Kinematics of Machine | 3 | 1 | - | 4 | 50 | 100 | - | 150 | 3 |
| 6 | ME 209 E | Production Technology | 3 | 1 | - | 4 | 50 | 100 | - | 150 | 3 |
| 7 | ME 211 E | Kinematics of Machine Lab | - | - | 3 | 3 | 50 | - | 50 | 100 | 3 |
| 8 | ME 213 E | Thermodynamics Lab | - | - | 3 | 3 | 50 | - | 25 | 75 | 3 |
| 9 | ME 215 E | Strength of Materials Lab | - | - | 3 | 3 | 50 | - | 25 | 75 | 3 |
|  | TOTAL |  | 17 | 5 | 13 | 35 | 450 | 600 | 100 | 1150 | -- |

**Note: Students will be allowed to use Non-Programmable scientific calculator. However, sharing of calculator will not be permitted. Duration of theory as well as practical exams time is three hrs for all courses except ME-205E for which it is 4 hrs.**

**SCHEME OF EXAMINATION**

**B.TECH. 2nd Year Mechanical Engineering (Auto) -4th Semester**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Code** | **Subject Name** | **Teaching Schedule**  **(Hrs)** | | | | **Examination Schedule (Marks)** | | | **Total**  **Marks** | **Duration of Exam** |
| **L** | **T** | **P/D** | **Total** | **Sessional** | **Theory** | **Practical/**  **Viva-Voce** |  |
| 1 | MEA 202 E | Automotive Technology | 3 | 1 | - | 4 | 50 | 100 | - | 150 | 3 |
| 2 | MEA 204 E | Hydraulic and Pneumatic System | 3 | 1 | - | 4 | 50 | 100 | - | 150 | 3 |
| 3 | MEA-206 E | Automotive Materials and  Metallurgy | 4 | - | - | 4 | 50 | 100 | - | 150 | 3 |
| 4 | ME 206 E | Strength of Materials – II | 3 | 1 | - | 4 | 50 | 100 | - | 150 | 3 |
| 5 | ME 210 E | Dynamics of Machine | 3 | 1 | - | 4 | 50 | 100 | - | 150 | 3 |
| 6 | MEA 212E | Motor Vehicle Technology | 3 | 1 | - | 4 | 50 | 100 | - | 150 | 3 |
| 7 | MEA 214E | Motor Vehicle Technology Lab | - | - | 3 | 3 | 50 | - | 50 | 100 | 3 |
| 8 | ME 216 E | Dynamics of Machine Lab | - | - | 3 | 3 | 25 | - | 25 | 50 | 3 |
| 9 | MEA 218 E | Automotive Technology Lab | - | - | 3 | 3 | 25 | - | 25 | 50 | 3 |
| 10 | MEA 220 E | Automotive Materials and  Metallurgy Lab | - | - | 2 | 2 | 25 |  | 25 | 50 | 3 |
|  | TOTAL |  | 19 | 5 | 11 | 35 | 425 | 600 | 125 | 1150 | -- |

**SCHEME OF EXAMINATION**

**B.TECH. 3rd Year Mechanical Engineering (Auto) -5th Semester**

|  |  |  |  |  |  |  |  |  |  |  |  |
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| **S. No** | **Code** | **Subject Name** | **Teaching Schedule**  **(Hrs)** | | | | **Examination Schedule (Marks)** | | | **Total**  **Marks** | **Duration of Exam** |
| **L** | **T** | **P/D** | **Total** | **Sessional** | **Theory** | **Practical/**  **Viva-Voce** |
| 1 | MEA 301 E | Microprocessors and Applications | 3 | 1 | - | 4 | 50 | 100 | - | 150 | 3 |
| 2 | MEA 303 E | Basics of Automobile Engineering | 3 | 1 | - | 4 | 50 | 100 | - | 150 | 3 |
| 3 | MEA 305 E | Numerical /Methods and Optimization Technique | 3 | 1 | - | 4 | 50 | 100 | - | 150 | 3 |
| 4 | ME 305 E | Heat Transfer | 3 | 1 | - | 4 | 50 | 100 | - | 150 | 3 |
| 5 | ME 309 E | Machine Design-I | 2 |  | 5 | 7 | 50 | 100 | - | 150 | 3 |
| 6 | ME 311 E | Steam Generation and Power | 3 | 1 | - | 4 | 25 | 100 | - | 125 | 3 |
| 7 | ME 313 E | Thermal Engineering Lab | - | - | 2 | 2 | 25 | - | 25 | 50 | 3 |
| 8 | MEA 315 E | Numerical /Methods and Optimization Technique Lab | - | - | 2 | 2 | 25 | - | 25 | 50 | 3 |
| 9 | ME 317 E | Heat Transfer Lab | - | - | 2 | 2 | 25 | - | 25 | 50 | 3 |
| 10 | ME 321 E | Machine Design-1 (Viva-Voce) | - | - | - | - | - | - | 25 | 25 | 3 |
| 11 | ME 323 E | Vocational Training | - | - | - | - | 50 | - | - | 50 |  |
|  | TOTAL |  | 17 | 5 | 11 | 33 | 400 | 600 | 100 | 1100 |  |

**SCHEME OF EXAMINATION**

**B.TECH. 3rd Year Mechanical Engineering (Auto) -6th Semester**

|  |  |  |  |  |  |  |  |  |  |  |  |
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| **S. No** | **Code** | **Subject Name** | **Teaching Schedule**  **(Hrs)** | | | | **Examination Schedule (Marks)** | | | **Total**  **Marks** | **Duration of Exam** |
| **L** | **T** | **P/D** | **Total** | **Sessional** | **Theory** | **Practical/**  **viva-voce** |
| 1 | ME 302 E | Refrigeration and Air Conditioning | 3 | 1 | -  - | 4 | 50 | 100 | - | 150 | 3 |
| 2 | ME 306 E | Mechanical Vibration | 3 | 1 | - | 4 | 50 | 100 | - | 150 | 3 |
| 3 | HUT 302E | Fundamentals of Management | 3 | 1 | - | 4 | 50 | 100 | - | 150 | 3 |
| 4 | ME 308 E | Computer Aided Design and Manufacturing | 4 | 1 | - | 5 | 50 | 100 | - | 150 | 3 |
| 5 | ME 310 E | Machine Design-II | 2 | - | 6 | 8 | 50 | 100 | - | 150 | 4 |
| 6 | MEA 312E | IC Engines, Emissions and Pollution Control | 3 | 1 | - | 4 | 50 | 100 | - | 150 | 3 |
| 7 | ME 312 E | Refrigeration and Air Conditioning Pr. | - | - | 2 | 2 | 25 | - | 25 | 50 | 3 |
| 8 | ME 314E | Tribology & Mechanical Vibration Lab | - | - | 2 | 2 | 50 | - | 25 | 75 | 3 |
| 9 | ME 316 E | Computer Aided Design and  Manufacturing Lab |  | - | 2 | 2 | 50 | - | 25 | 75 | 3 |
| 10 | ME 318 E | Machine Design-II (Viva –Voce) | - | - | - | - | - | - | 50 | 50 | 3 |
|  | TOTAL |  | 18 | 5 | 12 | 35 | 425 | 600 | 125 | 1150 |  |

**SCHEME OF EXAMINATION**

**B.TECH. 4th Year Mechanical Engineering (Auto) -7th Semester**

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| **S. No** | **Code** | **Subject Name** | **Teaching Schedule**  **(Hrs)** | | | | **Examination Schedule (Marks)** | | | **Total**  **Marks** | **Duration of Exam** |
| **L** | **T** | **P/D** | **Total** | **Sessional** | **Theory** | **Practical/**  **Viva-Voce** |
| 1  1 | ------------ | Departmental Elective-I | 4 | 1 | - | 5 | 50 | 100 | - | 150 | 3 |
| 2 | ------------ | Departmental Elective-II | 3 | 1 | - | 4 | 50 | 100 | - | 150 | 3 |
| 3 | MEA 401E | Automotive Chassis & Components | 3 | 1 | - | 4 | 50 | 100 | - | 150 | 3 |
| 4 | MEA 403E | Automotive Electricals & Systems | 3 | 1 | - | 4 | 50 | 100 | - | 150 | 3 |
| 5 | MEA 405E | Automotive Transmissions | 4 | 1 | - | 5 | 50 | 100 | - | 150 | 3 |
| 6 | ME 409E | Project-1 | - | - | 7 | 7 | 100 | - | 100 | 200 | 3 |
| 7 | MEA 411E | Automotive Transmissions Lab |  | - | 2 | 2 | 25 | - | 25 | 50 | 3 |
| 8 | ME 413E | In Plant Training Report | - | - | - | - | 125 | - | - | 125 | - |
| 9 | MEA 413E | Automotive Chassis & Components Lab | - | - | 2 | 2 | 50 | - | 50 | 100 | 3 |
| 10 | MEA 415E | Automotive Electricals & Systems Lab |  |  | 2 | 2 | 25 | - | 25 | 50 | 3 |
|  | TOTAL |  | 1 7 | 5 | 13 | 35 | 575 | 500 | 200 | 1275 |  |

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**DEPARTMENT ELECTIVE-I**

ME 419E **Advanced Manufacturing Technology**

**ME 421E Finite Element Method**ME 423E Applied Numerical Techniques and Computer Programming

ME 425EGas Dynamics

ME 427E Machine Tool Design

**DEPARTMENT ELECTIVE-II**

ME 435E **Renewable Energy** Resourses

**ME 437E Maintenance Engineering**ME 439E Cryogenic Engineering

ME 441EComputational Fluid Dynamics

ME 443E Mechatronics Engineering

**SCHEME OF EXAMINATION**

**B.TECH. 4th Year Mechanical Engineering (Auto) -8th Semester**

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| **S. No** | **Code** | **Subjects Name** | **Teaching Schedule**  **(Hrs)** | | | | **Examination Schedule (Marks)** | | | **Total**  **Marks** | **Duration of Exam** |
| **L** | **T** | **P/D** | **Total** | **Sessional** | **Theory** | **Practical/**  **viva-voce** |
| 1 | ------------ | Departmental Elective-III | 3 | 1 | - | 4 | 50 | 100 | - | 150 | 3 |
| 2 | MEA 402E | Measurement and Instrumentation | 4 | 1 | -  - | 5 | 50 | 100 | - | 150 | 3 |
| 3 | ME 406E | Operation Research | 3 | 1 | - | 4 | 50 | 100 | - | 150 | 3 |
| 4 | MEA 406E | Automotive Electronics & Microcontrollers | 4 | 1 | - | 5 | 50 | 100 | - | 150 | 3 |
| 5 | MEA 408E | Auto Fuel and Lubricant | 3 | 1 | - | 4 | 50 | 100 | - | 150 | 3 |
| 6 | MEA 410 E | Measurement and Instrumentation Lab | - | - | 2 | 2 | 50 | - | 25 | 75 | 3 |
| 7 | ME 410 E | Project –II | - | - | 9 | 9 | 100 | - | 100 | 200 | 3 |
| 8 | ME 411 E | Seminar | 2 | - | - | 2 | 25 | - | - | 25 | - |
| 9 | ME 412 E | Comprehensive Viva - Voce | - | - | - | - | 50 | - | - | 50 | 3 |
| 10 | ME 414 E | General Fitness & Professional Aptitude | - | - | - | - | - | - | 75 | 75 | 3 |
|  | TOTAL |  | 19 | 5 | 11 | 35 | 475 | 500 | 200 | 1175 |  |

**DEPARTMENT ELECTIVE-III**

ME 420E **Non Conventional Manufacturing**

**ME 422E Industrial Robotics**ME 424E Manufacturing Management

ME 426ETotal Quality Management

ME 428E Piping Engineering

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|  |  |  | **B. Tech. (Third Semester) Mechanical Engineering(Auto)** |  |  |
|  | **Basics of Economics & Management** | | | | |
|  |  |  | **HUM 201 E** |  |  |
|  |  |  | Sessional : 50 Marks | : |  |
| L | T | P | Theory : 100 Marks | : |  |
| 3 | 1 | - | Total : 150 Marks | : |  |
|  |  |  | Duration of Exam 3 Hrs. | : |  |

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

**UNIT-I**

Meaning of Industrial Economics, production function, its types, least cost combination, law of variable proportions, law of returns: increasing, constant & diminishing.

Fixed & variable costs in short run & long run, opportunity costs, relation between AC & MC,U-shaped short run AC curve.

Price & output determination under monopoly in short run & long run, price discrimination, price determination under discrimination Monopoly, comparison between Monopoly & perfect competition.

**UNIT-II**

Meaning of management, characteristics of management, management Vs administration, management-Art, Science& Profession, Fayol’s principles of management, Human relations approach, functions of management

**UNIT – III**

**Planning & organizing:** planning, steps in planning, planning premises, difference between planning policy & strategy, authority & responsibility, centralization & decentralization.

**UNIT – IV**

**Staffing, Directing & Controlling-**Manpower planning, recruitment & selection, styles of leadership, communication process and barriers, control process and steps in controlling.

**TEXT BOOKS**:

1. “Modern Economic Theory” Dewett, K.K., S. Chand & Co.

2. “Economic Analysis” K.P. Sundharam & E.N. Sundharam (Sultan Chand & Sons).

3. “Micro Economic Theory” M.L. Jhingan (Konark Publishers Pvt. Ltd.).

4. “Principles of Economics” M.L. Seth (Lakshmi Narain Aggarwal Educational Publishers – Agra).

5. “An Introduction to Sociology”, D.R. Sachdeva & Vidya Bhusan.

6. “Society – An Introductory Analysis”, R.M. Maclver Charles H. Page.

7. “Principles and Practices of Management : R.S. Gupta; B.D. Sharma; N.S. Bhalla; Kalyani.

**REFERENCE BOOKS**

1. “Organization and Management: R.D. Aggarwal, Tata McGraw Hill.

2. Business Organization and Management: M.C. Shukla

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|  |  |  | **B. Tech. (Third Semester) Mechanical Engineering Auto** |  |  |
|  | **Mathematics-III** | | | | |
|  |  |  | **MATH 201 E** |  |  |
|  |  |  | Sessional | : | 50 Marks |
| L | T | P | Theory | : | 100 Marks |
| 3 | 1 | - | Total | : | 150 Marks |
|  |  |  | Duration of Exam. | : | 3 Hrs. |

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

**UNIT – I**

Fourier series: Euler’s Formulae, Conditions for Fourier expansions, Fourier expansion of functions having points of discontinuity, change of interval, Odd & even functions, Half-range series. Fourier Transforms: Fourier integrals, Fourier transforms, Fourier cosine and sine transforms. Properties of Fourier transforms, Convolution theorem, Perseval’s identity, Relation between Fourier and Laplace transforms, Fourier transforms of the derivatives of a function, Application to boundary value problems.

**UNIT-II**

Functions of a Complex Variables: Functions of a complex variable, Exponential function, Trigonometric, Hyperbolic and Logarithmic functions, limit and continuity of a function, Differentiability and analyticity. Cauchy-Riemann equations, Necessary and sufficient conditions for a function to be analytic, Polar form of the Cauchy-Riemann equations, Harmonic functions, Application to flow problems, Conformal transformation, Standard transformations (Translation, Magnification & rotation,inversion & reflection, Bilinear).

**UNIT-III**

Probability Distributions : Probability, Baye’s theorem, Discrete & Continuous probability distributions, Moment generating function, Probability generating function, Properties and applications of Binomial, Poisson and normal distributions.

**UNIT-IV**

Linear Programming : Linear programming problems formulation, Solution of Linear Programming Problem using Graphical method, Simplex Method, Dual-Simplex Method.

**Text Book:**

Higher Engg. Mathematics: B.S. Grewal

Advanced Engg. Mathematics: E. Kreyzig

**References:**

1. Complex variables and Applications: R.V. Churchil; Mc. Graw Hill

2. Engg. Mathematics Vol. II: S.S. Sastry; Prentice Hall of India.

3. Operation Research: H.A. Taha

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|  |  |  | **B. Tech. (Third Semester)Mechanical Engineering(Auto)** |  |  |
|  |  |  | **Thermodynamics** |  |  |
|  |  |  | **ME 201 E** |  |  |
|  |  |  | Sessional | : | 50 Marks |
| L | T | P | Theory | : | 100 Marks |
| 3 | 1 | - | Total | : 150 Marks | |
|  |  |  | Duration of Exam. : 3 hrs. | | |

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

**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.

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.

**Unit III**

Entropy: Clausius Inequality and Entropy, Principle of Entropy Increase, Temperature Entropy 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.

**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.

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

**B. Tech. (Third Semester) Mechanical Engineering (Auto)**

**Strength of Materials –I**

**ME 203 E**

L T P Sessional : 50 Marks

3 1 - Theory : 100 Marks

Total : 150 Marks

Duration of Exam. : 3 Hrs.

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

**Unit 1**

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.

Compound stresses & strains: Concept of surface and volumetric strains, two dimensional stress system, conjugate shear stress at a point on a plane, principle stresses & strains and principal- planes, Mohr’s circle of stresses, Numerical.

**Unit II**

Shear Force & Bending Moments : Definitions, SF & BM diagrams for cantilevers, simply supported beams with or without over-hang and calculation of maximum BM & SF and the point of contraflexture under (i) concentrated loads, (ii) uniformly distributed loads over whole span or a part of it, (iii)combination of concentrated loads and uniformly distributed loads, (iv) uniformly varying loads and (v) application of moments, relation between the rate of loading, the shear force and the bending moments, Problems.

Torsion of circular Members : Torsion of thin circular tube, Solid and hollow circular shafts, tapered shaft, stepped shaft & composite circular shafts, combined bending and torsion, equivalent torque, effect of end thrust. Numericals.

**Unit III**

Bending & shear Stresses in Beams: Bending stresses in beams with derivation & application to beams of circular, rectangular, I,T and channel sections, composite beams, shear stresses in beams with derivation combined bending torsion & axial loading of beams. Numericals.

Columns & Struts: Column under axial load, concept of instability and buckling, slenderness ratio, derivation of Eulers formulae for the elastic buckling load, Eulers, Rankine, Gordom’s formulae Johnson’s empirical formula for axial loading columns and their applications, eccentric compression of a short strut of rectangular & circular sections, Numerical.

**Unit IV**

Slope & Deflection : Relationship between bending moment, slope & deflection, Mohr’s theorem, 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.

Fixed Beams: Deflections, reactions and fixing moments with SF & BM calculations & diagrams for fixed beams under ( I) concentrated loads, (ii) uniformly distributed load and (iii) a combination of concentrated loads & uniformly distributed load.

**Text Books:**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1. | Strength of Materials – G.H.Ryder - Third Edition in S I units 1969 Macmillan India | | | | | | | | |
| 2. | Strength | of | Materials | – | Andrew | Pytel | and | Fredinand | L.Singer |
|  | Fourth Edition, Int. Student Ed. Addison – Wesley Longman | | | | | | |  |  |

**Reference Books :**

1. Strength of Materials – Popov, PHI, New Delhi.
2. Strength of Materials – Sadhu Singh, Khanna Publications
3. Strength of Materials A Rudimentary Apprach – M.A. Jayaram, Revised Ed.2001, Sapna Book House, Bangalore
4. Strength of Materials – U.C.Jindal
5. Strength Materials – I. Kripal Singh

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|  |  |  | **B. Tech. (Third Semester)Mechanical Engineering (Auto)** |  |  |
|  |  |  | **Machine Drawing** |  |  |
|  |  |  | **ME 205 E** |  |  |
| L | T | P | Sessional | : | 50 Marks |
| 2 | - | 4 | Theory | : | 100 Marks |
|  |  |  | Total | : | 150 Marks |
|  |  |  | Duration of Exam | : | 4 hrs. |

**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.**

1. **The questions from Unit I and Unit II will carry 20 marks each. Question from Unit III will carry 60 marks.**

**UNIT I**

Introduction to BIS Specification SP : 46 – 1988 Code of Engineering drawing – Limits, fits and Tolerance ( Dimensional and Geometrical tolerance ) , Surface finish representation.

Gear : Gear terminology, I.S. convention , representation of assembly of spur gears, helical gears, bevel gears , worm and worm wheel.

**UNIT II**

Orthographic view from isometric views of machine parts / components. Dimensioning , Sectioning. Exercises on Coupling , Crankshaft , pulley , piston and Connecting rod , Cotter and Knuckle joint. Riveted Joint and Welded Joint.

**UNIT III**

Assembly drawing with sectioning and bill of materials from given detail drawings of assemblies : Lathe Tail stock , machine vice , pedestal bearing , Steam stop valve , drill jigs and milling fixture.

**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

**Reference Books :**

|  |  |  |
| --- | --- | --- |
| 1. | A Text Book of Machine Drawing | : Laxmi narayana 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.**

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|  |  |  | **B. Tech. (Third Semester) Mechanical Engineering (Auto)** |  |  |
|  |  |  | **Kinematics of Machine** |  |  |
|  |  |  | **ME 207 E** |  |  |
| L | T | P | Sessional | : 50 Marks | |
| 3 | 1 |  | Theory | : 100 Marks | |
|  |  |  | Total | : 150 Marks | |
|  |  |  | Duration of Exam. | | : 3 Hrs. |

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

**UNIT I**

Kinematics, introduction to analysis and synthesis of mechanisms, Kinematics’ pairs, Degree of freedom, Dynamitic chain mechanism, Machine, Four-bar chain, inversions, Single and double slider crank chain, Quick return mechanisms, Introduction to function generation, Path generation and rigid bodied guidance.

Velocity determination; Relative velocity methods, Instantaneous center method Acceleration determination, Kennedy’s Space cent rode and body cent rode,

**UNIT II**

Centripetal and tangential accelerations, Acceleration determination by graphical method using velocity polygons, Cariole’s component of acceleration, Klein’s and other constructions.

Analytical methods to find velocity and acceleration of four –link mechanism, slider crank mechanism, freumdenstein’s equation, Coordinate a angular displacements of input and output links (Path generation function generation), Least square technique, Rigid body guidance.

**UNIT III**

Pantograph, straight-line motion mechanisms (Peculiar, Hart, Scott Russell, Grasshopper, Watt, Kemp’s Tchybishev, Parallel linkages) Indicator mechanisms (Simplex Crosby , Thomson, etc ) Automobile steering gears (Davis and Ackerman),Hooks joint (universal coupling), Double hooks joints.

Types of friction, Laws of dry friction, Motion along inclined plane Screw threads, Wedge, Pivots and collars, Plate and cone clutches, Antifriction bearings, friction circle and friction axis, bearings and lubrication. Motion along inclined plane and screws, Pivots and Collars Thrust Bearings lubrication

**UNIT IV**

Types of cams and followers, various motions of the follower, Construction of cam profiles, Analysis for velocities and accelerations of tangent and circular arc cams with roller and flat –faced followers.

Open and crossed belt drives, velocity ratio, slip , material for belts, crowning of pulleys, law of belting, types of pulleys, length of belts ratio 0f tensions, centrifugal tension, power transmitted by belts and ropes, 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 Mechanism and Machines: Jagdish Lal, Metropolitan Book Co.
3. Mechanism synthesis and analysis: A.H. Soni, McGraw Hill Publications.
4. Mechanism: J.S. Beggs.
5. Mechanics of Machines: P.Black, Pergamon Press.
6. Theory of Machines: P.L.Ballaney, Khanna Publisher.

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|  |  |  | **B. Tech. (Third semester)Mechanical Engineering (Auto)** |  |
|  |  |  | **Production Technology** |  |
|  |  |  | **ME 209 E** |  |
| L | T | P | Sessional | : 50 Marks |
| 3 | 1 | - | Theory | : 100 Marks |
|  |  |  | Total | : 150Marks |
|  |  |  | Duration of Exam. : 3 Hrs. | |

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

**UNIT I**

**Metal cutting & Tool life**

Basic tool geometry, single point tool nomenclature, chips-various types and their characteristics, mechanism of chip formation, theoretical and experimental determination of shear angle, orthogonal and oblique metal cutting, metal cutting theories, relationship of velocities, forces and power consumption.

Effect of operating parameters life tool geometry, cutting speed, feed depth of out, coolant, materials etc on forces temp. tool life, surface finish etc., tool life relationship, tailor equation of tool life , tool material and mechanism.

**UNIT II Economics of metal machining & Multi edged tools**

Element of machining cost, tooling economics, machines economics and optimization. Broach tools-types materials and applications, geometry of twist drills, thrust torque and power calculation in drills, form tools-application.

**UNIT III**

**Metal forming & Jigs and Fixtures**

Metal blow condition, theories of plasticity conditions of plane strains, friction condition in metal working, wire drawing-extension of rods, theory of forging, roiling of metals and elementary rolling theory, no slip angle and forward slip.

Tool engineering, types of tools, usefulness, principles of lactation, locating and clamping devices, Jigs bushes, drilling Jigs, milling fixtures, turning fixtures, boring and broaching fixtures, different materials for Jigs and fixtures, economic of jigs and fixtures.

**UNIT IV**

**Metrology**

Measurements, linear and angular simple measuring instruments various clampers, screw gauge, sine bar, auto- collimator, comparator-mechanical, electrical, optical, surface finish and its measurement, micro and macro deviation, factors influencing surface finish and evaluation of surface finish.

**Suggested reading:**

1. Manufacturing science: Ghosh and Malik, E.W. Press
2. Principles of metal cutting: Sen and Bhattacharya, New Central Book.
3. Metal cutting principles: Shaw, MIT Press Cambridge
4. Manufacturing analysis: Cook, Adisson-Wesley
5. Modern machining processes: Pandey and Shan, Tata McGraw Hill Publications

**B. Tech. (Third Semester) Mechanical Engineering (Auto)**

**Kinematics of Machine Lab**

**ME 211 E**

|  |  |  |  |  |  |  |  |
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| L |  | T | P | Sessional | : | 50 Marks | |
| - | - |  | 3 | Practical | : | 50 Marks | |
|  |  |  |  | Total | : 100Marks | | |
|  |  |  |  | Duration of Exam : | | | 3 Hrs. |

List of experiments

1. To determine the modulus of rigidity of the material of a closed coil helical spring and the stiffness of a spring
2. To determine the value of coefficient of friction for a given pair of surfaces using friction apparatus
3. To determine the modulus of rigidity of horizontal shaft
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
   1. θ v/s X (displacement of slider).
   2. θ v/s velocity.
   3. θ v/s Acceleration and to compare the values of velocities

(Take angles θ =45˚, 90˚, 135˚, 225˚, 270˚ &335˚, ω = 1 rad/s)

1. To determine the value of coefficient of friction between the screw and nut of the jack, while:
   1. Raising the load
   2. Lowering the load
2. 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.
3. To determine the coefficient of friction between belt and pulley and plot a graph between log10 T1/T2 v/s, θ.
4. To determine the displacement, velocities, & accelerations of the driven shaft of a Hooke’s joint for a constant speed of the driver shaft.
5. To determine velocity & acceleration of slider in slider-crank mechanism and plot the following:
   1. θ v/s x (displacement of slider)
   2. θ v/s velocity and
   3. θ v/s acceleration.

Compare the values of velocities & acceleration with those obtained theoretically.(Assume ω=I rad/sec.)**.**

1. Study of the inversions of the single slider crank mechanism.
2. To verify the law of moment using Bell- crank lever.

**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.**

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|  |  |  |  | **B. Tech. (Third Semester) Mechanical Engineering(Auto)** | |  |
|  |  |  |  | **Thermodynamics Lab** |  |  |
|  |  |  |  | **ME 213 E** |  |  |
| L |  | T | P | Sessional | : | 50 Marks |
| - | - |  | 3 | Practical | : | 25 Marks |
|  |  |  |  | Total | : | 75 Marks |
|  |  |  |  | Duration of exam | : | 3 Hrs. |

**List of Experiments**

1. Study of 2 stroke petrol and diesel engine models.
2. Study of 4-stroke petrol/diesel engine model.
3. Study of boilers.
4. Study of Babcock-Wilcox boiler (Model).
5. Study of locomotive boiler (Model).
6. Study of Lancashire boiler (Model).
7. To study the Red wood viscometer and measure the viscosity of fluid.
8. To measure the flash point of the given fuel
9. To study the Nestler’s boiler.
10. To study various parts of the vertical steam engine.

11 To study the diesel engine and make a trial on it.

**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.**

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|  |  |  |  | **B. Tech. (Third Semester) Mechanical Engineering(Auto)** |  |  |
|  |  |  |  | **Strength of Materials Lab** |  |  |
|  |  |  |  | **ME 215 E** |  |  |
| L |  | T | P | Sessional | : | 50 Marks |
| - | - |  | 3 | Practical | : | 25 Marks |
|  |  |  |  | Total | : | 75 Marks |
|  |  |  |  | Duration of Exam : 3 Hrs. | | |

**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 erichsen sheet metal testing machine & perform the erichsen 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 test.
7. To perform compression & bending tests on UTM.
8. To perform the sheer test on UTM.
9. To study the torsion testing machine and perform the torsion test.
10. To draw shear Force, Bending Moment Diagrams for a simply Supported Beam under Point and Distributed Loads.
11. To determine Mechanical Advantage and Efficiency of Single and Double Purchase Winch Crab.
12. To determine Mechanical Advantage and Efficiency of Worm and Worm Wheel.
13. To determine Mechanical Advantage, Efficiency of Simple and Compound Screw Jack.
14. To find Moment of Inertia of a Fly Wheel.

**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.**

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|  |  |  | **B. Tech. (Fourth Semester) Mechanical Engineering (Auto)** | |
|  |  |  | **Automotive Technology** |  |
|  |  |  | **MEA 202 E** |  |
| L | T | P | Sessional | : 50 Marks |
| 3 | 1 | - | Theory | : 100 Marks |
|  |  |  | Total | : 150 Marks |
|  |  |  | Duration of Exam | : 3 Hrs |

**UNIT-I**

**BRAKING SYSTEM:** Fundamentals, frictional forces, braking terms - stopping distance, braking efficiency, brake fade, weight transfer, brake torque, work done. Safe deceleration, road adhesion, Forces acting on vehicle when on a level road, while cornering; Calculation of normal Reaction when all wheels are braked; Numerical; Principle, construction working of Parking brakes, Hydraulic brakes, pneumatic brakes, compressed air brakes, air hydraulic brakes, Drum brakes -Principle, leading and trailing shoes twin leading shoes; Hydraulic brakes - brakes shoes, brake lining, brake drums, back plate; Conventional and tandem master cylinder, wheel cylinder, component parts and working; Disc brakes: Types swinging ; sliding caliper, two and four cylinder caliper, principle, double disc; Construction and working; Advantages over drum brakes; Properties of friction lining & pad material, hydraulic brake oil; Procedure for bleeding of brakes, trouble and diagnosis; Electronic ABS system - Layout, working details.

**UNIT-II**

**SUSPENSION SYSTEM**: Vehicle dynamics and suspension system Requirements. Springs -types, coil, leaf, torsion bar, rubber and pneumatic; Laminated - classification, fully elliptic, Semi-elliptic, transverse, three quarter, elliptic. Design features - grading, nipping, Constant and variable rating, cambering, uniform stress distribution, inter leaf inserts; Types: Conventional and independent suspension system: component parts and working details; Shackles, rubber bushes, metal bushes, advantages of coil springs; Torsion bar suspension system, Hydro elastic suspension, Air suspension : component parts and working; Design of laminated springs; Numericals; Hydraulic dampers: Shock Absorbers : construction and working details; Mc -Phearson strut, Independent rear suspension, Suspension Service.

**UNIT-III**

**FRONT AXLE AND STEERING SYSTEM**: Frontaxles : types, Elliot and Lemoine, Hub assembly, calculation of bearing loads; Numericals; Front wheel alignment - Need caster, camber, KPI, toe -in, toe-out adjustments; Centre-point steering; Steering mechanism - Ackermann & Davis; Condition for true rolling; Over steer, under steer, slip angle; Turning circle radius; Steering systems: Function and requirements; Steering linkages, steering components - column, steering gearbox: rack and pinion, re-circulating ball, Cam and peg, Worm and roller, worm and sector : Construction and working details; Power steering : Hydraulic and electronic- working and component parts details; Four wheel steering; Effects of wrong steering geometry on tyres

.**TWO AND THREE WHEELED VEHICLES**: Idea of two and four stroke SI, CI and CNG engines used in two and three wheelers. Component parts and working of: fuel system : Mikuni and zenith carburetors; lubrication system; cooling system; magnetic coil; capacitive discharge ignition (CDI) system, AC generator; clutch system; transmission   
system; starting system : kick and battery; drive train systems; Engine tuning data; Frames : types; backbone, tubular and double cradle type; Component parts of brake, suspension and steering systems; Panel meters and controls on handle bar, connection of brake, clutch and accelerator cables.

**UNIT-IV**

**AUTOMOTIVE SAFETY:** Types of automotive body work-monologue, semi-monocoque tube frame, space frame. Body design for safety, engine location, concept of crumple zone, safety sandwich construction; Definitions: Front floor side, reinforcement C-pillar, seat cross beam, acoustical cross beam, Body style: Sedan, Hard top, coupe and limousine. Roadster, convertible and cabriolet, Station wagon, hatch back; Collapsible steering column, tilt able steering, seat adjustment, collision warning device, air bags (SRS) circuit, head lamps, fog lamps, speedometer, odometer, GPS, seat belt system; Auto Safety and Crash Testing: NCAP (New Car assessment rating), Frontal: Impact tests, offset, side impact, roll-over, roadside hardware, old Vs new full width frontal tests, Head restraints rating.

**MODERN FUEL INJECTION TECHNOLOGY:** Gasoline MPFI and diesel CRDI systems; Petrol and diesel engine emission norms - EURO V and BS - III, Construction and function of : ECM, ALDL, CALPAK, manifold vacuum sensor, oxygen sensor, VSS, TBI, TPS, MAF, CTS, MAP, ECM input and output diagram; Computer controlled carburetor systems : Air fuel ratio control, throttle body injection systems, idle air control (IAC) motor, injectors; Fuel system components, operation. Electronic diesel injection pump and control system, Pressure valve and injection lines. Injection nozzles, glow plug circuits.

**TEXT BOOK**

Kohli, P. L., “Automotive Chassis & Body”. Tata McGraw Hill, 1987

**REFERENCE BOOK**

Sethi, H. M., “Automotive Technology”, Tata McGraw Hill, 2003

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|  |  |  | **B. Tech. (Fourth Semester) Mechanical Engineering (Auto)** | |
|  |  |  | **Hydraulic & Pneumatic System** |  |
|  |  |  | **MEA 204 E** |  |
| L | T | P | Sessional | : 50 Marks |
| 3 | 1 | - | Theory | : 100 Marks |
|  |  |  | Total | : 150 Marks |
|  |  |  | Duration of Exam | : 3 Hrs |

**UNIT-I**

**BASIC CONCEPT AND PROPERTIES**: Fluids, distinction between solid and fluid: units and Dimensions: Properties of fluids: density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapour pressure, capillary and surface tension - Fluid statics: concept of fluid static pressure, absolute and gauge pressure measurements by manometers and pressure gauges, problems.

**FLUID KINEMATICS AND FLUID DYNAMICS**: Fluid Kinematics : Flow visualization, lines of flow, types of flow -velocity field and acceleration, continuity equation (one and three dimensional differential forms) : Equation of streamline, stream function : velocity potential function, circulation, flow net, equations of motion- Euler’s equation along a streamline, Problems.

**UNIT-II**

**DIMENSIONAL ANALYSIS**: Dimensional numbers, their application, Buckingham’s π theorem, applications, similarity laws and models numerical problems.

**INCOMPRESSIBLE FLUID FLOW**: Viscous flow, Navier Stoke’s equation (statement only) :Shear stress, pressure gradient relationship laminar flow between parallel plates ; Laminar flow through circular tubes (Hagen Poiseulle’s), Hydraulic and energy gradient ; flow through pipes, Darcy-Weisback’s equation, pipe roughness, friction factor, Mody’s diagram, minor losses, flow through pipes in series and in parallel, power transmission,

**UNIT-III**

**HYDRAULIC TURBINES**: Impact of jet on flat, curved and moving plates, Fluid machines, definition and classification, exchange of energy, Euler’s equation for turbo machines, Construction of velocity vector diagram’s, head and specific work, component of energy transfer, degree of reaction, performance curves.

**HYDRAULIC PUMPS**: Pumps, definition and classifications, Centrifugal pump: classifications, working principles, velocity triangles, specific speed, efficiency and performance curves; reciprocating pump: classification, working principles, indicator diagram, work saved by air vessels and performance curves; cavitations in pumps rotary pumps: working principles of gear and vane pumps.

**UNIT-IV**

**COMPRESSOR AND FANS**: Definition, Classification difference, efficiency, performance curves special application in Auto mobile Industries, working and construction of reciprocating, volumetric efficiency, performance curves, inter-cooling, two stage compression optimum inter-cooling pressure, applications of compressors and fans in automobile industry.

**Text Books:**

1. Fluid Mechanics – Streeter V L and Wylie E B, Mc Graw Hill

2. Mechanics of Fluids – I H Shames, Mc Graw Hill

**References Books:**

1. Introduction to Fluid Mechanics and Fluid Machines – S.K. Som and G. Biswas,

TMH

2. Fluid Mechanics and Fluid Power Engineering – D.S. Kumar, S.K. Kataria and Sons

3. Fluid Mechanics and Machinery – S.K. Agarwal, TMH, New Delhi

4. Fluid mechanics and Hydraulic machine by S.S rattan, Khanna publisher

5. Heat Engineering – V P Vasandani and D S Kumar, Metropolitan Book Co Pvt Ltd

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|  |  |  | **B. Tech. (Fourth Semester) Mechanical Engineering(Auto)** | |
|  |  |  | **Automotive Materials and Metallurgy** |  |
|  |  |  | **MEA 206 E** |  |
| L | T | P | Sessional | : 50 Marks |
| 4 | - | - | Theory | : 100 Marks |
|  |  |  | Total | : 150 Marks |
|  |  |  | Duration of Exam | : 3 Hrs |

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

**UNIT I**

Atomic structure of metals & crystal system, crystallographic notation of atomic planes, polymorphism and allotropy, solidification of crystallization (i) nuclear formation (crystal growth) (ii) crystal imperfection Elementary treatment of theories of plastic deformation, phenomenon of slip twinning, dislocation, identification of crystallographic possible slip planes and direction in FCC, BCC, C.P., recovery, re-crystallization, preferred orientation causes and effects on the property of metals.

**UNIT 11**

General principles of phase transformation in alloys, phase rule and equilibrium diagrams, Equilibrium diagrams of (i) Binary system in which the components form a mechanical mixture of crystals in the solid state and are completely mutually soluble in both liquid state. (ii) systems whose components have complete mutual solubility in the liquid state and limited solubility in the solid state in which the solid state solubility deceases with temperature(iii) alloys whose components have complete mutual solubility in the liquid state and limited solubility in solid state (iv) system whose components are subject to allotropic change. Iron carbon equilibrium diagram and their Phase transformation

**UNIT III**

Engineering materials and their properties, classification. Classification of ferrous and non-ferrous materials. Classification of cast iron-properties and their applications. Effects of alloying elements on properties of steel, carbon steel, low alloy steels, stainless steel, tool steels and die steels. Alloys of Ni, Al, Cu, Mg; properties and their applications. Classification of composite materials and their properties and applications. Heat treatment and surface treatment: Heat treatment of steel – Annealing, Normalising, Hardening and tempering with their types and application to automotive components, surface hardening techniques, Induction, flame and chemical hardening, coating of wear and corrosion resistance, Electroplating. Phosphating, Anodizing, hot dipping, thermal spraying, hard facing and thin film coatings.

**UNIT IV**

Selection of materials: Cryogenic wear, corrosion, fatigue, creep and oxidation resistance application. criteria of selecting materials for automotive components viz cylinder block, Cylinder head, piston, piston ring, Gudgeon pin, connecting rod, crank shaft, crank case, cam, cam shaft, engine valve, gear wheel, clutch plate, axle, bearings, chassis, spring, body panel - radiator, brake lining etc.Application of non-metallic materials such as composite, ceramic and polymers in automobile.

**References:**

1. Khanna.O.P., " Material Science and Metallurgy ", Dhanapal Rai & Sons,

2. Kapoor, " Material Science and Processes ", New India Publishing House,

3. Raghavan.V., Physical Metallurgy, Principle and Practice, Prentice Hall,

4. Bawa.H.S., Materials Metallurgy, McGraw-Hill,.

5. Avner S.H". Introduction to Physical Metallurgy" McGraw-Hill, New York,

6. Dieter, G.E., Mechanical Metallurgy, McGraw-Hill, New York, 1996.

7. Heat treatment of metals B. Zakharv

**B. Tech. (Fourth semester) Mechanical Engineering (Auto)**

**Strength of Materials-II**

**ME 206 E**

Sessional : 50Marks

L T P Theory : 100 Marks

3 1 - Total : 150 Marks

Duration of Exam: 3Hrs.

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

**Unit I**

Strain Energy & Impact Loading: Definitions, expressions for strain energy stored in a body when load is applied (i) gradually, (ii) suddenly and (iii) with impact, strain energy of beams in bending, beam deflections, strain energy of shafts in twisting, energy methods in determining spring deflection, Castigliano’s & Maxwell’s theorems, Numerical. Theories of Elastic Failure: Various theories of elastic failures with derivations and graphical representations, 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**

Unsymmetrical Bending: Properties of beam cross section, product of inertia, ellipse of inertia, slope of the neutral axis, stresses & deflections, shear center and the flexural axis Numericals. Thin Walled Vessels : Hoop & Longitudinal stresses & strains in cylindrical & spherical vessels & their derivations under internal pressure, wire would cylinders, Numericals.

**UNIT III**

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

**UNIT IV**

Bending of Curved Bars : Stresses in bars of initial large radius of curvature, bars of initial small 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. Springs: Stresses in open coiled helical spring subjected to axial loads and twisting couples, leaf springs, flat spiral springs, concentric springs, Numericals.

**Text Books:**

1. Strength of Materials – G.H.Ryder, Third Edition in SI Units 1969 Macmillan, India. 2. Mechanics of Materials – (Metric Edition) : Ferdinand P. Beer and E. Russel Johnston,

Jr. Second Edition, McGraw Hill.

**Reference Books :**.

1. Book of Solid Mechanics – Kazmi, Tata Mc Graw Hill
2. Strength of Materials – D.S. Bedi - S. Chand & Co. Ltd.
3. Advanced Mechanics of Solids and Structures – N. Krishan Raju and D.R.Gururaje-Narosa Publishing House.
4. Strength of Materials – Andrew Pytel and Fredinand L. Singer Fourth Edition, Int. Student Ed. Addison – Wesley Longman.

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**B. Tech. (Fourth Semester) Mechanical Engineering (Auto)**

**Dynamics of Machine**

**ME 210 E**

L T P Sessional: 50 Marks

3 1 - Theory : 100 Marks

Total : 150 Marks

Duration of Exam: 3 Hrs.

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

**UNIT I**

Static force analysis, Static equilibrium, free by diagram, Analysis of static forces in mechanism. D’Alembert’s principal, Equivalent offset inertia force, Dynamics of reciprocation parts, Piston effort, Crank effort, Equivalent dynamical systems, and Inertia force in reciprocating engines by graphical and analytical method. Turning moment and crank effort diagrams for single cylinder and multi-cylinder engines, coefficient of fluctuation of energy, coefficient of fluctuation of speed, flywheel and its function.

**UNIT II**

Types of gears, terminology, condition for correct gearing, cyclical and involutes profiles of gear teeth, pressure angle, path of contact, arc of contact, Interference, undercutting, minimum number of teeth, number of pairs of teeth in contact, helical, spiral, worm and worm gear, bevel gear. Gear trains; simple, compound, reverted, and epicyclical, Solution of gear trains, sun and planet gear, bevel epicyclical gear, compound epicyclical gear, pre-selective gear box, differential of automobile, torque in gear taints.

**UNIT III**

Types of brakes, friction brakes, external shoe brakes, band brakes, band and block brakes, internal expanding shoe brake, dynamometers; absorption, and tensional. Types of governors; watt, Porter, Proell, spring loaded centrifugal, Inertia,, Sensitiveness, Stability, Isochronism’s, Hunting, Effort and power of governor, controlling force, Static and dynamic balancing of rotating parts, balancing of I. C. Engines, balancing of multi-cylinder engine; V-engines and radial engines, balancing of machines.

**UNIT IV**

Gyroscope, Gyroscopic couple and its effect on craft, naval ships during steering, pinching and rolling, Stability of an automobile (2-wheeers), Introduction, open and closed lop control, terms related to automatic control, error detector, actuator, amplification, transducers, lag in responses, damping, block diagrams, system with viscous damped output, transfer functions, relationship between open –loop and closed loop transfer function.

**Suggested reading:**

1. Theory of machines: S. S. Rattan, Tata McGraw Hill Publications.
2. Theory of Mechanism and Machines: Jagdish Lal, Metropolitan Book Co.
3. Mechanism synthesis and analysis: A.H. Soni, McGraw Hill Publications.
4. Mechanism: J.S. Beggs.
5. Mechanics of Machines: P.Black, Pergamon Press.
6. Theory of Machines: P.L.Ballaney, Khanna Publisher.

**B. Tech. (Fourth Semester) Mechanical Engineering (Auto)**

**Motor Vehicle Technology**

**MEA 212 E**

L T P Sessional : 50 Marks

3 1 - Theory : 100 Marks

Total : 150 Marks

Duration of Exam. : 3 Hrs.

**UNIT-I**

**I.C ENGINES (INTRODUCTION):**

Working and difference between SI and CI Engines, Two and four stroke cycles, Theoretical heat cycles, ideal and actual Otto and diesel cycle, mixed cycle; Numerical, Working of two and four stroke SI and CI engines, Scavenging methods of two-stroke petrol engines, Comparison of two and four stroke cycle engines, Auto engines classifications-arrangement of cylinders, valves and camshaft, Types of fuels used, engine speed, methods of cooling, engine balance, Principle of combustion, detonation and pre-ignition-differences, Valve timing diagrams - SI and CI, two and four stroke engines.

**ENGINE PERFORMANCE:** Bore and stroke, swept and clearance volume, compression ratio, effect of C.R, engine torque, mean effective, bmep, bhp, Ihp, fhp, Engine efficiencies - air standard, mechanical, thermal, indicated thermal, brake thermal, volumetric, requirements of high volumetric efficiency, Factors.; Specific fuel consumption, Numerical

**UNIT-II**

**ENGINE COMPONENT PARTS:** Cylinder block Types, Crankcase, liners: wet and dry, Gaskets, Timing covers, oil pan, cylinder head; SI engines combustion chambers: types and comparison, CI engine combustion chambers: Direct and Indirect injection, Intake & exhaust ports, lubricating passages, Intake & Exhaust valves and mechanisms, Camshafts, Side & overhead, advantages and disadvantages, Valve seat and conical angles, Valve seat insert, Valve springs, locks, Rocker-shaft, rocker arm, push rod, Cam followers-types, Timing of valves, Intake and exhaust manifold, Mufflers-types, Crankshaft :Nomenclature; Flywheel-functions; Oil seals; Engine Bearings : Thrust, ball, taper roller, needle, split, journal; Bearing materials, properties; Connecting rod; Piston : function, types, materials, piston rings: types, design details, Piston Pins, Component material chart :All engine components.

**CHASSIS AND BODY:** Types - unitized and separate body and chassis, Advantages, Designs: chassis frame; Chassis side and cross member, sections and joints; Body: requirements, main parts, Material composition, Body shape-aerodynamic design, CD for different types of vehicles; Vehicle component’s attachments, Front and Rear wheel drive component locations: advantages and disadvantages; Rear mounted engine and rear wheel drive : advantages; Definitions : wheel base, wheel track, minimum radius, front and rear overhang, ground clearance, gradeability, laden and unladen weight; Car seat and seat belt mounting and adjustment.

**UNIT-III**

**CLUTCH SYSTEM:** Principle, requirements, operation, components of conventional single plate clutch, diaphragm clutch, multiple plate wet clutch, centrifugal clutch; Fluid coupling-characteristics, principle, velocity diagrams, efficiency and torque capacity curves; Comparison of conventional and diaphragm clutch and fluid coupling. Clutch operating systems: rod, cable, hydraulic; Clutch Plate: requirements, construction, material, linings : required properties, types; Numerical; Clutch faults and diagnosis, Clutch pedal free play.

**REAR AXLES AND TYRES:** Axle Casing, types, rear axle shafts - stresses and load taken, semi floating, ¾ floating and fully floating; Comparative data : axles; Automobile wheel :loads, torques and stresses, types of wheels, requirements, specifications, Types of rims, Advantages of smaller wheels; Requirement of tyres. Types : conventional, radial and tubeless, Inner tubes; Merits of tubeless tyres over pneumatic tyres; Pneumatic tyres: constructional details: plies, tread designs, characteristics, aspect ratio, inflation pressure : comfort, braking, cornering, cost, fuel consumption, tyre materials; Tyre specifications; Points to increase tyre life : load, vehicle handling, speed, wheel balancing, tyre rotation, wheel alignment Procedure: Tyre retreading.

**UNIT-IV**

**GEAR BOX, PROPELLER SHAFT AND DIFFERENTIAL:** Necessity of gearbox, types of gear wheels, function, construction and working details of sliding mesh, constant mesh, synchromesh and epicyclic gearbox: application and advantages; Overdrive, torque converter: principle and performance curves; Automatic gearbox; Gear selector mechanisms, synchronizing rings : materials and construction, Continuously variable transmission(CVT), Numericals, Gear box lubrication, Grade of oil, topping : up procedure, leakage prevention : static and dynamic seals; Final drive :Hotch Kiss and Torque tube; Propeller shaft : requirement, construction, maintenance, critical speed vibration, double propeller shaft, Maruti half shafts; Universal Joints : types, rubber doughnut, hookes, constant velocity (Birfield), speed variation of hookes coupling, coupling with driven shaft; Numericals, Differential: requirements, principle, construction and working; Bevel gears, hypoid gear, worm and warm wheel, Differential lock, limited slip differential, double reduction. Numericals

TEXT BOOK: Crouse, W.H, “Automobile Technology”, Tata Mc Graw Hill

REFERENCE BOOKS

Sethi, H. M, “Automotive Technology”, Tata McGraw Hill, 2003

Gupta R. B, “Automobile Engineering”, Dhanpat Rai & Sons, 1998

**B. Tech. (Fourth Semester) Mechanical Engineering (Auto)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | **Motor Vehicle Technology Lab** |  |  |
|  |  |  |  | **MEA 214 E** |  |  |
| L |  | T | P | Sessional :50 Marks |  |  |
| - | - |  | 3 | Practical :50 Marks |  |  |
|  |  |  |  | Total :100 Marks  Duration of Exam : 03 Hrs. |  |  |
|  |  |  |  |  | | |
|  |  |  |  |  | | |

**List of Experiments:**

1. Identify, write specifications and draw sketches of
   1. General Tools
   2. Measuring Tools
   3. Special Tools used in an automobile workshop and Practice to use them.
2. Identify various assemblies and sub assemblies of an automobile chassis. Draw layout and Explain function of each unit.
3. Study of 4 stroke C.I and S.I engines. Draw Sketches and explain the function of each Component.
4. Study of 2 stroke S.I engine. Draw Sketch and explain the function of each component.
5. Study the Cooling System of an Automotive Engine sketch the various components and explain function of each.
6. Identification of components of single plate, multi plate clutch system. Draw sketch and explain function of each component.
7. Identifications of components of sliding mesh constant mesh and synchromesh gear box.
8. Draw power flow diagrams at various speeds. Identify and give functions of each component of differential and rear axle assembly.
9. Study construction of different types of Automobile wheels and tyres and draw their Sketches.
10. Study the propeller Shaft, Slip joint and universal Joints of a Vehicle. Draw sketches and Label various components parts.

**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. (Fourth Semester) Mechanical Engineering (Auto)**

**Dynamics of Machine Lab**

**ME 216E**

L T P Sessional : 25 Marks

- - 3 Practical : 25 Marks

Total : 50 Marks

Duration of Exam : 03 Hrs.

**LIST OF EXPERIMENT**

1. To determine experimentally, the moment of inertia of a flywheel and axle

compare with theoretical values.

1. To find out critical speed experimentally and to compare the whirling speed of a shaft with theoretical values.
2. To find experimentally the Gyroscopic couple on motorized gyroscope and compare with applied couple.
3. To perform the experiment of balancing of rotating parts and finds the unbalanced couple and forces.
4. To determine experimentally the unbalance forces and couples of reciprocating parts.
5. To calculate the torque on a planet carrier and torque on internal gear using epicyclic gear train and holding torque apparatus.
6. To study the different types of centrifugal and inertia governors and demonstrate any one.
7. To study the automatic transmission unit.
8. To study the differential types of brakes.
9. To find out experimentally the corolis component of acceleration and compare with theoretical values.

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

**B. Tech. (Fourth Semester) Mechanical Engineering (Auto)**

**Automotive Technology Lab**

**MEA 218E**

L T P Sessional : 25 Marks

- - 3 Practical : 25 Marks

Total : 50 Marks

Duration of Exam : 03 Hrs.

**LIST OF EXPERIMENTS**

1. Study and function of each component of Drum,Disc, Girling Multiplate Disc and ABS brake system.
2. Study of mechanical, hydraulic and pneumatic brake system.
3. Identification and function of each component of front and rear Suspension System.
4. Study of manual and power assisted steering mechanism.
5. Evaluate steering systems and steering linkage geometry.
6. Study and function of each component of different types of front axles with hub.
7. Layout of A.C system of a car. Identify and give functions of its each unit.
8. Study of 3-wheeler chassis frame and power transmission system and comparison of their various parameters.
9. Study the carburetor of motor cycle/ scooter. Set mixture screw for idle running
10. Study motor cycle drive train system and adjust
    1. Clutch play
    2. Gears Play
    3. Front & rear brakes
11. Study capacitive discharge ignition system for engine of a motor cycle/scooter.
12. Study of MPFI System for a gasoline engines along with sensors and catalytic converter.
13. Study of diesel injection system, reciprocating F.I.P, rotary pumps and injectors used in TDI and CRDI system

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

**B. Tech. (Fourth Semester) Mechanical Engineering (Auto)**

**Automotive Materials and Metallurgy Lab**

**MEA 220E**

L T P Sessional : 25 Marks

- - 2 Practical : 25 Marks

Total : 50 Marks

Duration of Exam : 3 Hrs

1. Study of different Engineering materials and their mechanical properties.

2. To study the microstructures of the following materials i) Hypo Eutectoid & Hyper Eutectoid steels.

ii) Hypoeutectic cast iron and hyper eutectic cast iron. iii) Grey and white cast iron

iv) Non – ferrous metals i.e. Al. Mg. Cu. Ni. Son. And their alloys.

3. Study of iron carbon diagram and its engineering applications.

4. Annealing of steel, effect of annealing temperatures and time on hardness.

5. Study of microstructure and hardness of steel at different rates of cooling.

6. Hardening of steel, effect of quenching minimum and agitation of the medium on hardness.

7. Effect of carbon percentage on the hardness of steel.

8. Hardenability test by Jominy’s End quench test.

9. Normalizing tempering of steel components.

10. To study the case hardening processes i.e. carburizing, Nitriding, cyaninding etc.

11. To study and construct the T-T- T diagram for steels

**B. Tech. (Fifth Semester) Mechanical Engineering (Auto)**

**Microprocessors and Applications**

**MEA 301 E**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| L | T | P/D | Total | Sessional: 50 Marks |
| 3 | 1 | - | 4 | Theory : 100 Marks |
|  |  |  |  | Total : 150 Marks  Duration of Exam: 03 Hrs |

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

**UNIT - I**

**Introduction To Microprocessors And Microcontrollers:** Introduction to Microprocessors and Microcontrollers, Number Systems and Binary arithmetic, Microprocessor Architecture (8085 and 8086) and Microcomputer Systems, memory map and addressing, memory classification, review of logic device for interfacing, Memory Interfacing, Overview of 8085 Instruction Set, stacks and Interrupts.

**UNIT - II**

**The 8051 Architecture:** 8051 Microcontroller hardware, oscillator and clock, Prog. Counter and Data Pointer, Registers and Program Status word, Internal Memory RAM, Stack and Stack Pointer, Special Function Registers, Internal ROM. Input / Output Pins, Ports and Circuits, External Memory, Counters and Timers, Serial Data Input and Output, Interrupts.

**UNIT - III**

**Assembly Language & Programming The 8051:**Assembly Language programming, Programming the 8051, Moving Data, Logical Operations, Arithmetic Operations, Branching Operations, Interrupts.

**UNIT – IV**

**Microcontroller 8051 design:** Microcontroller specification and Design, External Memory and Memory space decoding, Memory – mapped I/O, Memory Access times, Timing Subroutines, Lookup Tables for 8051, Serial Data Transmission.

**Interfacing Peripheral Devices To 8051 And Applications**: Interfacing A/D Converters and D/A Converters, 8255, 8259. Application to interfacing Scanned Displays, Matrix Keyboard, Memory Design, Data Acquisition System Design.

**Text Books:**

1. K.J. Ayala, “The 8051 Microcontroller, Architecture, Programming & Applications”, Thomsom Delmer Learning.

2. RS Gaonkar, “Microprocessors Architecture, Programming and Applications”, Penram International.

**Reference Books:**

1. M.A. Mazidi. & J.G Mazidi, “The 8051 Microcontroller & Embedded Systems”, Pearson Education.

2. B.Ram, “Fundamentals of Microprocessors and Microcomputers”, Dhanpat Rai and Sons.

**B. Tech. (Fifth Semester) Mechanical Engineering (Auto)**

**Basics of Automobile Engineering**

**MEA 303 E**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| L | T | P/D | Total | Sessional: 50 Marks |
| 3 | 1 | - | 4 | Theory : 100 Marks |
|  |  |  |  | Total : 150 Marks  Duration of Exam: 03 Hrs |

**Unit-I**

**Introduction:** Classification of two wheelers, and four wheeled vehicles, application & capacity, study of main specifications. Parts of an automobile – engine, functions & layout, - frames, axles, frameless construction, steering system, suspension system, braking system, power train & drives, clutch, gear box, final drive, Propeller shaft, differential, U joints, vehicle body, wheels, tyres & tubes. Selection of engine for two wheeler & four wheeled vehicles, constructional & working details of two stroke & four stroke petrol & diesel engines.

**Unit -II**

**Clutches and transmission:**Necessity of clutch, working of clutch, types of clutches- single plate, multiple plate, automatic diaphragm clutch assembly, constructional & working details, friction disc, clutch lining materials. Transmission: Introduction, functions of transmission, necessity of transmission, manual transmission, sliding mesh gearbox, constant mesh gear box, synchromesh gear boxes, awareness of automatic transmission, their constructional & working details. Fuel System : Ignition system, starting system, charging system, lightning system, cooling system, lubrication system. Introduction to M.P.F.I, CRDi, D.T.S.S.I

**Unit-III**

**Steering system and suspension system:** Steering system requirements, front axle details & geometry, Castor, Camber, Toe in, Toe out, steering geometry, steering linkages, different types of steering gear boxes, their constructional & working details. Need of suspension system, types of suspension, constructional detail & characteristics of leaf, coil springs. Introduction to independent suspension, front & rear suspension systems of vehicle, shock absorbers. Wheels: Wheel requirements, types of wheels, their constructional & working details, rims & their types.

**Unit-IV**

**Braking Systems:** Classification of brakes, drum brakes and disc brakes, constructional & working details, Introduction to hydraulic brake & parking brake, vacuum assisted Hydraulic Brakes, compressed air assisted hydraulic brakes, leading & trailing brake shoes; self energizing brakes; working of master cylinder, wheel cylinders, tandem master cylinders, Characteristics of brake fluid. Introduction to ABS. Tyres: Introduction, types of tyres, tyre selection, ordinary, radial tyres tubeless tyres, their constructional details and their comparison & application, wheel balancing.

**Text Books:**

1. Automobile Engineering Vol 1 by Dr. Kripal Singh, Standard Publishers Distributors Delhi.
2. Automotive Technology by Sethi, TMH, New Delhi.
3. Automobile Engineering by K.K Ramalingam, Scitech Publication, Chennai – 2001.
4. Automotive Chassis & body by P.L Kohli, TMH, New Delhi.

**Reference Books:**

1. Motor Vehicle by Newton Steeds and Garrot, Butterworths, London – 2000.
2. Mechanism of the Car by Judge A.W, Chapman and Halls Ltd., London – 1986.
3. Automobile Engg. By K.K Jain, R.B. Asthana, TMH – 2002.
4. Automobile Engg (Vol-1) by Dr. Kripal Singh, Standard Publisher Distributors

**B. Tech. (Fifth Semester) Mechanical Engineering (Auto)**

**Numerical / Methods and Optimization Technique**

**MEA 305 E**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| L | T | P/D | Total | Sessional: 50 Marks |
| 3 | 1 | - | 4 | Theory : 100 Marks |
|  |  |  |  | Total : 150 Marks  Duration of Exam: 03 Hrs |

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

**Unit-I**

**Interpolation and Curve Fitting :** Errors in numerical computation, Interpolation problems, Lagrange’s interpolation Divided Differences And Newton’s Divided Difference Interpolation, Finite Differences, Newton Forward and Backward Interpolation, Least Square Approximations of Degree One and Two , Linearization of Approximations by the Curves Of The Type , and

**Unit -II**

**Non Linear Equations** Intermediate value theorem. Bisection method, fixed point method and its convergence, false position method, secant method, Newton Raphson method and its convergence, modified Newton Raphson method (multiple roots)

Simultaneous linear equations: Direct methods: Guass elimination method (matrix approach), gauss Jordon method iterative methods: gauss Jacobi’s method, Guass Sedial method and their convergence. Eigen values by power and inverse power method

**Unit-III**

**Numerical Differentiation and Integration :** Numerical differentiation formulae (i) differences tables (ii) operator method (iii) undetermined parameter method. Order of numerical differentiation rules and their errors. General numerical quadrature formula, Newton cote’s formulae (closed and open type)

**Unit-IV**

**Numerical Solution of Ordinary Differential Equations :** Taylor series method , Euler and modified Euler method, Range kutta method of order two, classical method , Simplex Method and Dual Simplex Method Linear programming: Formulation of linear programming problems, solving linear programming problem using Graphical method. Simplex method and Dual simplex method

**Text books:**

1. Fundamentals of numerical techniques and computations (using C):R. S Goel and Poonam Sethi, Manav Rachna Publishing House Pvt Ltd.
2. Numerical methods in Engineering & Science: B.S. Grewal, Khana Publishers.
3. Numerical Methods for scientific and Engineering Computation : M.K Jain , R.K Jain, S.R.K. Iyengar, New Age International Publishing House.

**Reference Books:**

1. Numerical Analysis: B.S Goel and S.K Mittal, Pragati Prakashan
2. Linear Programming: C.P. Sethi and S.K. Mittal, Pragati Prakashan.

**B. Tech. (Fifth Semester) Mechanical Engineering (Auto)**

**Heat Transfer**

**ME 305 E**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| L | T | P/D | Total | Sessional: 50 Marks |
| 3 | 1 | - | 4 | Theory : 100 Marks  Total : 150 Marks |
|  |  |  |  | Duration of Exam: 03Hrs |

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

**UNIT I**

Definition of heat; Modes of Heat Transfer; Basic Laws of heat transfer, Electrical Analogy of heat conduction; Conduction through composite Walls; Overall heat transfer coefficient. The general conduction equation in Cartesian, cylindrical and spherical coordinates Steady one dimensional heat conduction without internal heat generation; The plane slab; 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; Fins of uniform cross section; Governing equation; Temperature distribution and heat dissipation rate; Efficiency and effectiveness of fins.

**UNIT II**

Free and forced convection; Newton’s law of cooling, Convective heat transfer Coefficient; Nusselt number; Dimensional analysis of free and forced convection; Analytical solution to forced convection problems; The concept of boundary layer; Hydrodynamic and thermal boundary layer; Momentum and Energy equations for boundary layer; Exact solution for laminar flow over an isothermal plate using similarity transformation; The integral approach; Integral momentum and energy equations; Solution of forced convection over a flat plate using the integral method. Analysis of free convection; governing equations for velocity and temperature fields. Relation between fluid friction and heat transfer, Reynolds analogy Dimensionless numbers; Reynolds, Prandtl Nusselt , Grashoff and Stanton Numbers and their significance, Heat transfer with change of phase; Nusselt theory of laminar film Condensation.

**UNIT III**

Theories of thermal radiation; Absorption, Reflection and transmission, Monochromatic and total emissive power; Black body concept; Planck’s distribution law; Stefan Boltzman law; Wien’s displacement law; Lambert’s cosine law; Kirchoff’s law; Shape factor; Heat transfer between black surfaces.

**UNIT IV**

Introduction; Classification of heat exchangers; Logarithmic mean temperature Difference; Area calculation for parallel and counterflow heat exchangers; Effectiveness of heat exchangers; N T U method of heat exchanger design; Applications of heat exchangers.

**Reference and Text books:**

A Text book of Heat Transfer by S.P Sukhatme, university press Heat transfer by Holman, TMG

Heat and Mass transfer by D.S Kumar

**B. Tech. (Fifth Semester) Mechanical Engineering (Auto)**

**Machine Design- 1**

**ME 309 E**

L T P/D Total Sessional: 50 Marks

2 - 5 7 Theory : 100 Marks

Total : 150 Marks

Duration of Exam: 03 Hrs

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

**UNIT I**

Properties: Chemical, Physical, Mechanical and Dimensional; Ferrous metals, Non-ferrous metals, Plastics, Composite materials etc.; Selection of Engineering Materials. Design methodology; Design criterion based on fracture; Deformation and elastic stability design stresses; Factor of safety; Significant stress and significant strength; Stresses-concentration; Causes and mitigation; Endurance limit; Effect of concentration; Notch sensitivity; Size and surface finish; Goodman diagram; Gerber’s parabola and Soderberg line.

**UNIT II**

Supports and retainment of rotating assemblies; manufacturing considerations of design, design of castings and weldments.Riveted joints for boiler shell according to I. B. R.; riveted structural joint; and riveted joint with eccentric loading; Types of welded joints; strength of welds under axial load; Welds under eccentric loading; Designation of various types of bolts and nuts, Design of bolted joints, Bolts of uniform strength, Bolted joints with eccentric loads, Design of Keys, Cotter joint and knuckle joints.

**UNIT III**

Design of shafts subjected to pure torsion; Pure bending load; Combined bending and torsion; Combined torsion; Bending and axial loads.

Introduction, hand and foot levers, cranked lever, lever for a lever safety valve, Bell crank lever. Miscellaneous levers.

**UNIT IV**

Types of shaft couplings, Design of sleeve or muff coupling; Flange coupling and bush type flexible couplings.Introduction, Design of circular, oval shaped and square flanged pipe joints. Function, types of power screws, stresses in screws, design calculations.

**References and text books:**

Design of machine element By Bhandari

Machine design by Malvee and Hartmann, CBS publication Machine design by Sharma and Aggarwal

PSG Design Data Book by PSG College of Engg PSG Publication

Machine Design an integrated Approch Robert l Norton, prentice hall

Fundamental of machine component design R.C Juvinnal, Johan wiley& sons

**B. Tech. (Fifth Semester) Mechanical Engineering (Auto)**

**Steam Generation and Power**

**ME 311 E**

L T P/D Total Sessional : 25 Marks

3 1 - 4 Theory : 100 Marks

Total : 125 Marks

Duration of Exam: 03 Hrs

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

**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

**B. Tech. (Fifth Semester) Mechanical Engineering­ (Auto)**

**Thermal Engineering Lab**

**ME 313 E**

L T P/D Total Sessional : 25 Marks

- - 2 2 Practical : 25 Marks

Total : 50 Marks

Duration of Exam: 03 Hrs

**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.

1. To study
   * 1. Lubrication and cooling systems employed in various I. C. Engines in the Lab
     2. Braking system of automobile in the lab
2. To study a Carburetor.
3. To study (I) the Fuel Injection System of a C. I. Engine. (II) Battery Ignition system of a
   1. I. Engine
4. To study Cooling Tower.
5. To study multi Cylinder four strokes vertical Diesel Engine test RIG With Hydraulic Dynamometer.

**Note: Total Ten experiments must be performed**. **At least eight experiments should be performed from the above list. Remaining two experiments may either be performed from the above list or outside the list.**

**B. Tech. (Fifth Semester) Mechanical Engineering (Auto)**

**Numerical/Methods and Optimization Technique lab**

**MEA 315 E**

L T P/D Total Theory : 25 Marks

- - 2 2 Sessional : 25 Marks

Total : 50 Marks

Duration of Exam: 03 hours

**List of Experiments:-**

1. Write Programs in ‘C’ Language: to deduce error envolved in polynomial equation.

2. Write Programs in ‘C’ Languagefor finding out the unknown values with the help of given set of observations using Newton’s Forward Interpolation formula.

3. Write Programs in ‘C’ Languagefor finding out the unknown values with the help of given set of observations using Newton’s Backward Interpolation formula.

4. Write Programs in ‘C’ Languagefor finding out the unknown values with the help of given set of observations using Langranges Interpolation formula.

5. Write Programs in ‘C’ Languagefor finding the root of an equation of the form f(x)=0 using Bisection method.

6. Write Programs in ‘C’ Languagefor finding the root of an equation of the form f(x)=0 using false position.

7. Write Programs in ‘C’ Language for finding the root of an equation of the form f(x) =0 using Iteration method.

8. Write Programs in ‘C’ Languagefor finding the root of an equation of the form f(x) =0 using Newton- Raphson method.

9. Write Programs in ‘C’ Language to fit a straight line for a given set of data points.

10. Write Programs in ‘C’ Language to fit a second-degree parabola for a given set of data points.

11. Write Programs in ‘C’ Language to find out a numerical integration using Trapezoidal rule.

12. Write Programs in ‘C’ Language to find out a numerical integration using Simpson’s 1/3 rule.

13. Write Programs in ‘C’ Language to find out a numerical integration using Simpson’s 3/8 rule.

14. Write Programs in ‘C’ Language to Compute the solution of differential equation by Taylor’s series Method.

15. Write Programs in ‘C’ Language to compute the solution of differential equation by Euler’s modified method.

**Note: Every student needs to do minimum 10 numbers of experiments in a semester.**

**B. Tech. (Fifth Semester) Mechanical Engineering (Auto)**

**Heat Transfer Lab**

**ME 317 E**

L T P/D Total Sessional : 25 Marks

- - 2 2 Practical : 25 Marks

Total : 50 Marks

Duration of Exam: 03 Hrs

**List of Experiments**

1. Determination of thermal conductivity of a metal rod
2. Determination of thermal conductivity of an insulating powder
3. Determination of thermal conductivity of a liquid using Guard plate method
4. Determination of thermal resistance of a composite wall
5. Temperature distribution of a pin fin in free-convection
6. Temperature distribution of a pin fin in forced-convection
7. Forced convection heat transfer from a cylindrical surface
8. Determination of Electiveness of a Heat exchanger
9. Determination of Stefan-Boltzman constant
10. Performance of Solar still
11. Determination of critical heat flux
12. Performance of solar water heater
13. Measurement of solar radiation using solar integrator.

**Note: Total Ten experiments must be performed. At least eight experiments should be performed from the above list. Remaining two experiments may either be performed from the above list or outside the list.**

**B. Tech. (Sixth Semester) Mechanical Engineering (Auto)**

**Refrigeration and Air Conditioning**

**ME 302 E**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| L | T | P/D | Total | Sessional : 50 Marks |
| 3 | 1 | - | 4 | Theory : 100 Marks  Total : 150 Marks |
|  |  |  |  | Duration of Exam: 03 hours |

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

**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; Vapor 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 Vapor 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 NH3 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.

**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 Pv 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.

**References and Text books**

1. Refrigeration and air-conditioning by C.P arora
2. Basic Refrigeration and air-conditioning by Annanthana and Rayanan, TMG
3. Refrigeration and air-conditioning BY Arora and Domkundwar, Dhanpat rai

**B. Tech. (Sixth Semester) Mechanical Engineering (Auto)**

**Mechanical Vibration**

**ME 306 E**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| L | T | P/D | Total | Sessional : 50 Marks |
| 3 | 1 | - | 4 | Theory : 100 Marks |
|  |  |  |  | Total : 150 Marks  Duration of Exam: 03Hrs |

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

**UNIT I**

Kinematics of simple vibrating motion, Simple harmonic motions, Vectorial representation of harmonic motion. Degree of freedom, Equations of motions, general solution of free vibration, Phase plane method

**UNIT II**

Damped free vibration, undamped and damped forced vibrations, Vibrating isolation, Vibrating instruments. Undamped free vibration ,Principle modes , Influence coefficients, Coordinate coupling, Orthogonality, Vibration absorbers.

**UNIT III**

Geometric method, Stability of equilibrium points, Method of harmonic balance. Influence coefficients, Dunkerleys equation, Matrix iteration, Holzer method, Rayleigh method, and Rayleigh-Ritz method.

**UNIT IV**

Transverse vibration of strings, Longitudinal vibrations of bars, Lateral vibration of beams, Torsional vibration of circular shafts, Whirling of shafts. Introduction, Method of Laplace transformation and response to an impulsive output, response to step-input, pulse-input, and phase plane method.

**REFERENCE AND TEXT BOOKS: -**

1. Mechanical vibration - By G.K. Grover; Nemchand Chand and Sons
2. Mechanical Vibration – By Thomson; Prentice Hall
3. Mechanical Vibration - By Den Hartog; Mc Graw Hill
4. Introductory course to mechanical vibrations – By Rao and Gupta; Wiley Eastern

**B. Tech. (Sixth Semester) Mechanical Engineering (Auto)**

**Fundamentals of Management**

**HUT 302E**

L T P/D Total Sessional : 50 Marks

3 1 - 4 Theory : 100 Marks

Total : 150 Marks

Duration f Exam: 3 hours

**NOTE:** The question paper shall have eight questions in all organized into four sections, each section having two questions from each of the four units. The candidate shall have to attempt five questions in all, selecting at least one question from each unit.

**UNIT-I**

**Financial Management**: Introduction of Financial Management, Objectives of Financial Decisions, Status and duties of Financial Executives.Financial Planning – Tools of financial planning. Management of working capital, Factors affecting requirements of working capital. Capital Structure decisions. Features of appropriate capital structure. Sources of finance.

**UNIT-II**

**Personnel Management:** Personnel Management – Meaning, Nature and Importance; Functions of Personnel Management – (a) Managerial Functions and (b) Operative functions. Job Analysis: Meaning and Importance; Process of Job Analysis; Job Description and Job specification. Human Resource Development-Meaning and concept.

**UNIT-III**

**Production Management:** Production Management: Definition and Objectives Plant location: Ideal plant location. Factors affecting plant location. Plant Layout: Ideal plant layout, factors affecting plant layout. Work Measurement: Meaning, Objectives and Essentials of work measurement. Production Control: Meaning and importance of production control and steps involved in production control.

**UNIT-IV**

**Marketing Management** : Nature, scope and importance of marketing management. Modern Marketing concepts. Role of marketing in economic development. Marketing Mix. Marketing Information System. Meaning, nature and scope of International Marketing.

**Text Books:**

1. Operations Management – SCHOROEDER, MGH, New York.

2. Production Operations Management – CHARY, TMH, New Delhi.

**Reference Books:**

1. Production Operations Management – ADAM & EBERT, PHL, New Delhi

2. Operational Management –MONKS, McGraw Hill, Int.

3. Production & Operations Management – I. Hill, Prentice Hall, Int.

4. Production Planning & Inventory Control – NARASIMHAM etal, PHL, New Delhi

5. Production & Operation Management- Panneerselvam, PHI, New Delhi

**B. Tech. (Sixth Semester) Mechanical Engineering (Auto)**

**Computer Aided Design and Manufacturing**

**ME 308 E**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| L | T | P/D | Total | Sessional : 50 Marks |
| 4 | 1 | - | 5 | Theory : 100 Marks |
|  |  |  |  | Total : 150 Marks  Duration of Exam: 03 Hrs |

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

**UNIT I**

Introduction to CAD/CAM, Historical Development, Industrial look at CAD/CAM, Introduction to CIM Basic of Geometric & Solid modeling, Coordinate systems, Explict, Implict, Intrinsic and parametric equation Part families, Part classification and coding, product flow analysis, Machine cell Design, Advantages of GT

**UNIT II**

Introduction, Transformation of points & line, 2-D rotation, Reflection, Scaling and combined transformation, Homogeneous coordinates, 3-D scaling, shearing, rotation, reflection and translation, combined transformations, Orthographic and perspective projections Algebric and geometric forms, tangent & normal blending functions, reparametrization Straight line, conics, cubic splines, bezier curves and B-spline curves

**UNIT III**

Algebraic and geometric forms, tangent & twist vectors, normal blending function, reparametrization, Sixteen point form, four Curve form, Plane surface, ruled surface Surface of revolution, tabulated cylinder Bi -cubic surface, bezier surface, B-spline surface Solid models and representation scheme B-rep & CSG, sweep representation ,Cell decomposition, spatial occupancy enumeration

**UNIT IV**

Introduction, fixed programmable and flexible automation, 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

**Suggested Reading:**

CAD/CAM theory & practice (Ibrahim Zeid) CAD/CAM (Groover & Zimmer)

Numerical control and computer aided manufacturing by RAO and Tiwari, TMG

**B. Tech. (Sixth Semester) Mechanical Engineering (Auto)**

**Machine Design-II**

**ME 310 E**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| L | T | P/D | Total | Sessional : 50 Marks | Theory: 100Marks |
| 2 | - | 6 | 8 | Theory : 100 Marks | Sessional: 50 marks |
|  |  |  |  | Total : 150 Marks  Duration of Exam: 04 Hrs | Duration of Exam: 04 hours |

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

**UNIT I**

Classification of Gears; Selection of type; Law of Gearing, Standard system of Gear tooth, Various Failure modes, Interference, undercutting & minimum no. of teeth Force Analysis ,Beam strength of Gear tooth, Effective load on tooth, Estimation of module based on beam strength and wear strength, Gear lubrication, materials; Design Procedure, Gear Box design Terminology, Force Analysis, Virtual no. of teeth, Beam strength, Effective load, Wear strength Terminology, force analysis, beam strength & wear strength, effective load on gear tooth Terminology, properties, force analysis, friction, material selection

**UNIT II**

Design of flat belts &Pulleys, Design /selection of V belts &Pulleys, Design/selection of wire ropes, Design/selection of chains Single &multiple Plate clutch, Cone clutch External shoe brake, Internal shoe brakes

**UNIT III**

Coil Springs, Leaf Springs Hydro dynamically lubricated bearings, Selection of ball bearings, Selection of roller bearings, Selection of taper roller bearings Mechanism Design, Design of cam & Follower

**UNIT IV**

Design of Cylinder, Design of Piston, Design of Crank shaft, Design of connecting rod Design of Crane Hook Design of Flywheels

|  |  |  |  |
| --- | --- | --- | --- |
| **SUGGESTED READING:** |  |  |  |
| Design of Machine Elements | Bhandari | TMH | |
| Machine Design | Sharma Aggarwal |  | Katson Publishers |
| PSG Design Data Book | PSG College of Engg | | PSG Publication |

Machine Design an integrated Approach Robert l Norton, prentice hall

Fundamental of machine component design R.C Juvinnal, Johan wiley& sons

**B. Tech. (Sixth Semester) Mechanical Engineering (Auto)**

**IC Engines, Emissions and Pollution Control**

**MEA 312 E**

L T P/D Sessional: 50 Marks

3 1 4 Theory : 100 Marks

Total : 150 Marks

Duration of Exam: 03 hours

**UNIT - I**

**I.C. Engines:** Working of Two stroke and Four stroke SI and CI Engines. Valve Timings. Actual indicated diagrams. Combustion calculations. Carburetion and Fuel Injection. Supercharging. Lubrication and cooling methods. Governing methods. Engines performance & Testing. Combustion in S.I. and C.I. Engines: Normal & Abnormal Combustion. Pre-ignition. Detonation. Knocking. Comparison of knocking in S.I. and C.I. Engines. Rating of Fuels.

**UNIT - II**

**Engine Fuels:** Types of Hydrocarbon, Gasoline, Diesel specifications, Alternate Fuels – Properties of CNG, LPG, Alcohol, Bio- Fuel as vehicular Fuels. Emission and Air Pollution: Automotive emissions and their role in air pollution, photochemical smog, Chemistry of smog formation. Combustion in homogeneous mixtures, emission formation, Incomplete combustion. Formation of Hydrocarbons (HC), carbon monoxide and oxides of nitrogen. Aldehyle. Emissions of unregulated toxic pollutants such as benzene; 13butadiene etc. Influence of engine design and operating parameters on S.I. engine exhaust emissions. Hydrocarbon Evaporation Emissions: Various sources and method of their control, canisters for controlling evaporative emission control system for S.I. engines, blow-by control closed PCV system, reduction of exhaust emissions, various methods. Fules system design.

**UNIT - III**

**Exhaust Treatment devices:** Air injection into exhaust system. Thermal reactors, Catalytic converters- construction, efficiency, effect of equivalence ratio, additives on efficiency of 3-Way converter.; Advances in Converter design, plasma Catalyst Stratified charged engines. Gasoline Direct injection, Various Methods for stratification;, Honda CVCC engine.

**Diesel engine emissions:** Source of emissions during combustion, effect of Air injector timing on performance and formation. D.I and I.D.I. engines emissions. Diesel smoke, PM and RSPM emission. Methods of reducing emission, Exhaust gas re-circulation, smoke emission from diesel engines, Particulate Traps, Continuous Regeneration Traps (CRT). Methods for control of NOx

**UNIT - IV**

**Emission from CNG and LPG Engines.Emission Instruments:** Non – dispersive infrared analyzer. Gas chromatography. Flame Ionisation Detector. Chemiluminescent analyzer. Emission Standards: Ambient Air Quality Standards, Mass emission standards, Air pollution cost benefit analysis.

Text Books:

1. R.P. Sharma and M.L. Mathur, “Internal Combustion Engine”, Dhanpat Rai Publications

2. V. Ganeshan, “Internal Combustion Engine”, Tata McGraw Hill

Reference Books:

1. Angli M Course., “Automotive Engines”, CBS Publications

2. Harper, “Fuel Systems Emission Control”, CBS Publications

**B. Tech. (Sixth Semester) Mechanical Engineering (Auto)**

**Refrigeration and Air Conditioning Pr.**

**ME 312 E**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| L | T | P/D | Total | Sessional : 25Marks |
| - | - | 2 | 2 | Practical : 25 Marks |
|  |  |  |  | Total : 50 Marks  Duration of Exam: 03 Hrs |

**List of Experiments**

1. Study & Performance of basic vapour compression Refrigeration Cycle.
2. To find COP of water cooler.
3. To study the walk in cooler.
4. To study and perform experiment on vapour absorption apparatus.
5. Perform the experiment & calculate various. Performance parameters on a blower apparatus.
6. To find the performance parameter of cooling tower.
7. To study various components in room air conditioner.
8. To find RH of atmosphere air by using sling Psychometric and Psychometric.
9. To find performance of a refrigeration test rig system by using different expansion devices.
10. To study different control devices of a refrigeration system.
11. To study various compressor.
12. To find the performance parameters of Ice Plant.

**Note: Total Ten experiments must be performed. At least eight experiments should be performed from the above list. Remaining two experiments may either be performed from the above list or outside the list.**

**B. Tech. (Sixth Semester) Mechanical Engineering (Auto)**

**Tribology & Mechanical Vibration Lab**

**ME 314 E**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| L | T | P/D | Total | Sessional : 50Marks | Practical: 25Marks | Practical: 25Marks |
| - | - | 2 | 2 | Practical : 25 Marks | Sessional: 50 Marks | Sessional: 50 marks |
|  |  |  |  | Total : 75 Marks  Duration of Exam: 03 Hrs | Total : 75 Marks  Duration of Exam: 03 hours | Duration of Exam: 03 hours |

**LIST OF EXPERIMENT:**

1. To study undamped free vibrations of equivalent spring mass system and determine the natural frequency of vibrations
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 to 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.

**Note: At least eight experiments should be performed from the above list. Remaining one experiments may either be performed from the above list or outside the list.**

**B. Tech. (Sixth Semester) Mechanical Engineering (Auto)**

**Computer Aided Design & Manufacturing Lab**

**ME 316 E**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| L | T | P/D | Total | Sessional : 50Marks | Practical: 25Marks |
| - | - | 2 | 2 | Practical : 25 Marks | Sessional: 50 Marks |
|  |  |  |  | Total : 75 Marks  Duration of Exam: 03 Hrs | Total : 75 Marks  Duration of Exam: 03 hours |

**List of Experiments**

Note: Practical will base on course no. ME 308 E

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **B. Tech. (Seventh Semester) Mechanical Engineering(Auto)** |  |  |  |
|  | **Automotive Chassis & Components** |  |  |  |
|  | **MEA 401E** |  |  |  |
| L | T Total Sessional |  | : | 50 Marks |
| 3 | 1 4 Theory |  |  | 100 Marks |
|  | Total |  | : | 150 Marks |
|  | Duration of Exam |  | : | 3 Hrs |

**UNIT I**

**Front Axle & Steering System**

Types of front axles. Constructional details. Materials. Front wheel geometry viz. Castor, Camber, King pin inclination,Toe. Wheel Alignment. Cornering force and Side thrust. Steering geometry. Ackerman and Davis steering system. Different types of steering gear boxes. Steering linkages and their layouts. Power and power assisted steering. Steering of crawler tractors. Multi axle steering systems.

**Driveline and Differential**

Effects of driving thrust and torque reactions. Hotch kiss drive, torque tube drive and radius rods. Transverse rods. Propeller shaft. Universal joints. Constant velocity universal joints. Drive Shaft. Front wheel drive. Different types of final drives. Spiral bevel gear and hypoid gear final drives. Double reduction and twin speed final drives. Differential principles. Constructional details of a differential gear unit. Non-slip and Limited slip differential. Differential locks - Differential housings. Comparison of front wheel, rear wheel and all wheel drive arrangement.

**UNIT II**

**Drive axles**

Construction of rear axles. Types of loads acting on rear axles. Fully floating, three quarter floating, and semi floating rear axles. Rear axle housing. Construction of different types of axle housing, multi axled vehicles. Construction details of multi drive axle vehicles. Dead axles.

**Suspension system**

Need of suspension system, Types of suspension, Suspension springs, Constructional details and characteristics of leaf, coil and torsion bar springs, Independent suspension, Types: Mc Pherson strut, Double wishbone, Five link type, etc, Rubber suspension, Pneumatic suspension, Shock absorbers.

**UNIT III**

**Wheels and Tyres**

Types of wheels – wire spoke, disc – solid and split type, alloy type, offset, onset & zero set, denomination of rim. Tyres - construction, structure, denomination and function of tyres, types of tyres, comparison of radial and bias ply tyres. Tubes – construction and types, Tubeless tyres. Tyre inflation, effects of tyre pressure on tyre performance. Tyre wear patterns and their causes. Wheel Balancing – need, procedure.

**UNIT IV**

**Braking system**

Weight transfer during braking and stopping distances. Classification of brakes - drum brakes and disc brakes. Constructional details. Theory of braking. Brake split and proportioning. Mechanical, hydraulic and pneumatic brakes - Servo brake, power and power-assisted brakes - Different types of brake retarders like eddy current and hydraulic retarder. Skidding of wheels on braking and remedies

- Anti lock braking systems.

**Text Books:**

1. Automobile Engineering Vol-1 by Kirpal Singh..

References:

1. Steed W., " Mechanics of Road vehicles ", Illiffe Books Ltd., London.

2. Newton Steeds & Garrot, " Motor vehicles ", Butterworths, London.

3. Judge A.W., " Mechanism of the car ", Chapman and Halls Ltd., London.

4. Giles.J.G., " Steering, Suspension and tyres ", Iliffe Book Co., London.

5. Crouse W.H., " Automotive Chassis and Body ", McGraw Hill. Newyork

6. Heldt P.M., " Automotive chassis ", Chilton Co., New York

**B. Tech. (Seventh Semester) Mechanical Engineering (Auto)**

**Automotive Electricals & Systems**

**MEA 403 E**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| L | T | P/D | Total | Sessional : 50 Marks | Theory: 100 Marks |
| 3 | 1 | - | 4 | Theory : 100 Marks | Sessional: 50 marks |
|  |  |  |  | Total : 150 Marks  Duration of Exam: 03 Hrs | Total : 150 Marks  Duration of Exam: 03 hours |

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least**

**two questions from each unit, and students will be required to attempt only 5 questions,**

**selecting at least one from each unit.**

**UNIT I**

**Introduction**

Earth returns and insulated return systems, 6, 12, and 24-volt systems. Positive & negative earth systems. Fusing of circuits, relays, switches, low and high voltage automotive cables, wiring diagram for typical automotive wiring systems, maintenance and servicing.

elll ELLS

**Batteries**

Principles of lead acid cells and their characteristics - construction and working of lead acid battery, types of batteries, testing of batteries, effect of temperature on: capacity and voltage, battery capacity, voltage, efficiency, charging of batteries, sulphation and desulphation, maintenance and servicing, Battery failures & checking, Maintenance free Batteries, High energy and power density batteries for electric vehicles.

**UNIT II**

**Charging system**

Principle of generation of direct current. Shunt generator characteristics. Armature reaction. Third brush regulation. Cut-out. Voltage & current regulators, compensated voltage regulator. Alternators - principle, constructional and working aspects, bridge rectifiers. Principle of Magneto, Flywheel Magneto, Maintenance and servicing. Trouble shooting in charging systems.

**Starting system**

Condition at Starting – starting torque and power requirements, behavior of starter during starting. Series motor and its characteristics. Principle & construction of starter motor. Working of different starter drive units, care & maintenance of starter motor. Starter switches. Safety mechanism. Maintenance, servicing and trouble shooting.

**UNIT III**

**Ignition system**

Types, construction & working of battery & coil and magneto ignition systems. Relative merits, Ballast Resistor, Ignition coil, Distributor, Contact breaker Point, centrifugal and vacuum advance mechanisms, Limitations of conventional ignition systems, Transistorized Ignition systems, Spark plugs - construction, different types, plug fouling, maintenance, servicing and fault diagnosis, Electronic Ignition system. Programmed ignition, distributor less ignition.

**Lighting system**

Principle of automobile illumination, headlamp construction and wiring, reflectors – types, signaling devices- flashers, stop lights, fog lamps, auxiliary lighting-engine, passenger, reading lamp. Regn-plate lamps. Automatic illumination system. Head light levelling devices. Study of a modern headlight system with improved night vision.

**UNIT IV**

**Electrical Equipment and Accessories**

Oil pressure gauge, fuel level gauge, engine temperature gauge, electrical fuel pump, speedometer, odometer, trip meter, engine rpm meter, Headlamp & Windshield washer and wiper, heaters and defrosters, horns, stereo/radio, power antennae. Central locking, power window winding. Sun/Moon Roof. Motorized rear view mirrors, reverse warning, Bumper collision warning. Other accessories in modern vehicles.

**Fuel cell**

Thermodynamic aspects; types-hydrogen and methanol, power rating and performance. Various components and working of fuel cell. Heat dissipation.

**Drive Motors and controllers:**

Drive arrangements in Hybrid and Electric vehicles. Drive motors: types and construction. Controlling of motor operations. Motor-generator in hybrid vehicles and its controls.

**Books**

1. "Automotive Electrical Equipment ", P.L. Kohli, Tata McGraw-Hill Co. Ltd. New Delhi, 1975.

2. “Principles of Electricity and electronics for the Automotive Technician”, Chapman, Thomson Asia,

2000.

3. "Modern Electrical Equipment of Automobiles", A.W. Judge. Chapman & Hall, London.

4. "Automobile Electrical and Electronic Equipments ", A.P. Young. & L. Griffiths, English Languages Book

Society & New Press, 1990.

5. "Storage Batteries ", G.W. Vinal. John Wiley & Sons Inc., New York, 1985.

6. "Automobile Electrical Equipment ", W.H. Crouse. McGraw Hill Book Co. Inc., New York,

7. "Electrical Ignition Equipment ", F.G. Spreadbury, Constable & Co Ltd., London, 1962.

8. “Basic Automotive Electrical Systems”, C.P.Nakra, Dhanpat Rai

9. Fuel Cells by Bockris and Srinivasan; McGraw Hill

10. Automobile Engineering Vol –II by Kirpal Singh

**B. Tech. (Seventh Semester) Mechanical Engineering (Auto)**

**Automotive Transmissions**

**MEA 405 E**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| L | T | P/D | Total | Sessional | : 50 Marks | | Theory | : 100 marks | |
| 4 | 1 |  | 5 | Theory | : 100 Marks | | Sessional | : 50 marks | |
|  |  |  |  | Total : 150 Marks  Duration of Exams. : 03 Hrs | |  | | | Duration of Exams. : 03 hours | |

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least**

**two questions from each unit, and students will be required to attempt only 5 questions,**

**selecting at least one from each unit.**

**UNIT I**

**Introduction**

Need for Transmission system. Tractive Effort and Resistances to Motion of a vehicle. Requirements of transmission system. Classification of Transmission systems. Single, Two or Four Wheel drive systems. Multi axle drives. Chain, Shaft and Electric drives. Location of transmission system. Different transmissions in scooter, car, MUVs and transport vehicles of Indian make.

**Clutch**

Principle of operation, Constructional details, torque capacity and design aspects. Different types of clutches. Operation of single plate: helical spring and diaphragm type, and multiplate clutch. Centrifugal and Automatic Clutch. Dry and Wet type of clutch. Friction lining materials. Over-running clutch. Modes of operating a clutch – mechanical, hydraulic and electric.

**UNIT II**

**Gear box**

Determination of gear ratios for vehicles. Performance characteristics in different speeds. Different types of gear boxes – sliding, constant and synchromesh type. Need for double declutching and working of synchronizing unit. Power and economy modes in gearbox. Transfer box. Transaxles. Overdrives. Gear shifting mechanisms – mechanical link and wire types

**UNIT III**

**Hydrodynamic drive**

Fluid coupling- principle of operation, constructional details. Torque capacity. Performance characteristics, Reduction of drag torque. Torque converter-Principle of operation, constructional details, performance characteristics, converter coupling, multistage torque converters and Polyphase torque converters.

**Hydrostatic drive**

Hydrostatic drive - Various types of hydrostatic systems - Principles of hydrostatic drive system, Advantage and limitations, Comparison of hydrostatic drive with hydrodynamic drive - Construction and working of typical Janny hydrostatic drive.

**UNIT IV**

**Electric drive**

Electric drive Principle of early and modified Ward Leonard Control system. Advantage & limitations. Performance characteristics. Study of drive system in an electric and hybrid vehicle.

**Automatic transmission applications**

Chevrolet "Turboglide" Transmission, Powerglide Transmission Toyota "ECT-i" Automatic Transmission with Intelligent Electronic controls system, Hydraulic Actuation system.

**References:**

1. Heldt.P.M., " Torque converters ", Chilton Book Co.

2. Newton and Steeds, " Motor vehicles ", llliffe Publishers.

3. Judge.A.W., " Modern Transmission systems ", Chapman and Hall Ltd.

4. SAE Transactions 900550 & 930910.

5." Hydrostatic transmissions for vehicle applications", I Mech E Conference,1981-88.

6. Crouse. W.H., Anglin., D.L., " Automotive Transmission and Power Trains construction ", McGraw-Hill.

7. Automobile Engineering Vol-1 by Kirpal Singh*.*

**B. Tech. (Seventh Semester) Mechanical Engineering (Auto)**

**Project I**

**ME 409 E**

P/D Total Sessional : 100 Marks

7 7 Practical : 100 Marks

Total : 200 Marks

Duration of Exams. : 03 Hrs

The students expected to take up a project under the guidance of teacher from the college. The project must be based on Mechanical Engineering Auto problems, which can be extended up to the full academic session. 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. (Seventh Semester) Mechanical Engineering (Auto)**

**Automotive Transmission Lab**

**MEA 411 E**

P/D Total Sessional : 25 Marks

2 2 Practical : 25 Marks

Total : 50 Marks

Duration of Exam: 3 Hrs

**List of Experiments :-**

1. Study of a layout of transmission system for a front wheel drive, rear wheel drive and

a four wheel drive arrangement

2. Trouble shooting in different types of friction clutches

3. Study of layout of gears and shafts in a manual type gearbox and a transaxle.

4. Trouble shooting in manual type of gearbox and a transaxle

5. Study of layout in a manual & automatic gearbox for a two wheeler

6. Trouble shooting in gearbox of two wheeler of previous experiment

7. Study of layout of an automatic gearbox.

8. Study of gear shifting controls in an automatic gearbox

9. Trouble shooting in an automatic gearbox

10. Study of performance of an automatic gearbox.

11. Study of a manual and electric Transfer Case.

12. Trouble shooting in Transfer Case of previous experiment.

13. Study of an electric drive in an Electric vehicle

**Note: At least eight experiments should be performed from the above list. Remaining one experiment may either be performed from the above list or outside the list.**

**B. Tech. (Seventh Semester) Mechanical Engineering (Auto)**

**In Plant Training Report**

**ME 413 E**

|  |  |  |
| --- | --- | --- |
| **P/D** | **Total** | Sessional : 125 Marks |
| **-** | **-** | Duration of Exams. : 03 Hrs |

Student will submit summer training (about 8 weeks’ industrial training) report for his/her assessment.

**B. Tech. (Seventh Semester) Mechanical Engineering (Auto)**

**Automotive Chassis & Components Lab**

**MEA 413 E**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| L | T | P/D | Total | Sessional : 50 Marks |
| - | - | 2 | 2 | Practical : 50 Marks |

Total : 100 Marks

Duration of Exam: 03 Hrs

**LIST OF EXPERIMENT**

1. Study of layout of a chassis and its different components, of a vehicle.

2. Trouble shooting in different types of steering systems - mechanical and power and

Various steering linkages.

3. Measurement of steering geometry angles – Wheel Alignment.

4. Study of impact of steering geometry angles on vehicle

5. Study of different types of wheels (rims) and tyres and their defects

6. Conducting Wheel balancing of a given wheel assy.

7. Trouble shooting in Propeller Shafts and Drive shafts including constant velocity joints.

8. Trouble shooting in different types of dead axles (front or rear)

9. Trouble shooting in different types of live axles and Differential systems.

10. Trouble shooting in suspensions of following types:

a. Leaf Spring

b. Double Wishbone with Torsion Bar or Coil Spring c. McPherson Strut Type

d. Five Bar Link type

e. Air Suspension system

f. A shock absorber (damper)

**Trouble shooting in braking system in master and wheel cylinder, drum and disc**

**brakes, overhauling and adjusting of system and its testing on brake tester**

**B. Tech. (Seventh Semester) Mechanical Engineering (Auto)**

**Automotive Electricals & Systems Lab**

**MEA 415 E**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| L | T | P/D | Total | Sessional : 25Marks |
| - | - | 2 | 2 | Practical : 25 Marks |
|  |  |  |  | Total : 50 Marks  Duration of Exam: 03 Hrs |

**List of Experiments**

1. To understand the layout of complete wiring system of an automobile.

2. Perform the various tests for checking the battery condition.

3. To understand and test the charging circuit and charging motor.

4. To conduct performance test on a dynamo, alternator & starter motor.

5. To understand & test the starting circuit and trouble shooting in it.

6. Understand and test the conventional ignition system, setting of contact breaker points and spark plug gap.

7. Understand the working and testing of an Electronic Ignition system

8. Understand and test the lighting circuit of a car.

9. Conduct headlamp focusing as per the procedure.

10. Study the working of different accessories of a modern car

11. To study the layout / working of a Fuel Cell powered electric car.

**Elective I and II Seventh Semester**

**(Mechanical Engineering Auto)**

**DEPARTMENT ELECTIVE-I**

ME 419E **Advanced Manufacturing Technology**

**ME 421E Finite Element Method**ME 423E Applied Numerical Techniques and Computer Programming

ME 425EGas Dynamics

ME 427E Machine Tool Design

**DEPARTMENT ELECTIVE-II**

ME 435E **Renewable Energy** Resourses

**ME 437E Maintenance Engineering**ME 439E Cryogenic Engineering

ME 441EComputational Fluid Dynamics

ME 443E Mechatronics Engineering

Elective – I and II will be offered as departmental elective for Mechanical Engineering (Auto) students.

**B.Tech. (Seventh Semester) Mechanical Engineering (Auto)**

**Advanced Manufacturing Technology**

**ME 419 E**

L T P/D Total Sessional : 50 Marks

4 I - 5 Theory : 100 Marks

Total : 150 Marks

Duration of Exams. : 03 Hrs

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least**

**two questions from each unit, and students will be required to attempt only 5 questions,**

**selecting at least one from each unit.**

**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**

Introduction, Polymers, Polymerization, Addition of Polymers, Plastics, Types of plastics, Properties of Plastics, Processing of Thermoplastic Plastics, Injection Moulding, Extrusion Process, Sheet forming processes, Processing of Thermosetting Plastics,Compression Moulding, Transfer 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**

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**

Introduction, Product Application, Limitation of Die Casting, Die Casting Machines,Molten metal Injection systems, I 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.

**B. Tech. (Seventh Semester) Mechanical Engineering (Auto)**

**Finite Element Method**

**ME 421 E**

L T P/D Total

4 1 - 5 Sessional : 50 Marks

Theory : 100 Marks

Total : 150 Marks

Duration of Exams. : 03 Hrs

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least**

**two questions from each unit, and students will be required to attempt only 5 questions,**

**selecting at least one from each unit.**

**UNIT I**

Basic Concept, Historical background, Engineering applications, general description, Comparison with other methods. Need for weighted-integral forms, relevant" mathematical concepts and formulae, weak formulation of boundary value problems, variational methods, Rayleigh-Ritz method, and weighted residual approach.

**UNIT II**

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 isoparametric elements, natural coordinates, Langrange and Hermite polynomials.

**UNIT III**

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**

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 functionvorticity 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. 3. An Introduction to the Finite Element Method -By J.N.Reddy, McGraw Hill

**B. Tech. (Seventh Semester) Mechanical Engineering (Auto)**

**Applied Numerical Techniques and Computer Programming**

**ME 423 E**

L T P/D Total

4 1 - 5 Sessional : 50 Marks

Theory : 100 Marks

Total : 150 Marks

Duration of Exams. : 03 Hrs

**NOTE:**

**1. The Instructor of the course may cover the use of software MATHEMATICA, in**

**the tutorial class.**

**2. In the semester examination, the paper setter will set 8 questions in all, at least**

**two questions from each unit, and students will be required to attempt only 5**

**questions, selecting at least one from each unit.**

**Unit I**

Interpolation and Curve Fitting : Lagrangian Polynomials, Divided differences, Interpolating

with a cubic spline, Bezier Curves and B-Spline Curves, Polynomial approximation of surfaces, Least Square approximations, Flow Chart for Computer Programmes.

**Unit II**

Solving Non-Linear Equations: Bisection Method, Linear Interpolation Methods, Newton’s Methods, Muller’s Methods, Fixed-point Iteration Method, Flow Chart for Computer Programmes.

Solving Sets of Equations: The Elimination Method, Gauss and Gauss Jordan Methods, Other

Direct Methods, Iterative Methods, The Relaxation Methods, Flow Chart for Computer Programmes.

**Unit III**

Numerical Differentiation and Integration: Derivatives from difference tables. High Order

Derivative, Extra-polation Techniques. The Trapezoidal Rule, Simpson’s Rules. Flow Chart

for Computer Programmes. Numerical Solution of Ordinary Differential Equations: The Taylor-Series Method, Euler and modified Euler-Methods, Range-Kutta Methods, Miline’s Method. The adams-Moulton Method, Convergence Criteria, Errors and error Propagation. Flow Chart for Computer Programmes.

**Unit IV**

Boundary-Value and Characteristic- Value Problems: The Shooting Method, Rayleigh-Ritz

Method, Collocation Method, Galerkin Method, The Power Method for Eigenvalues by

Iteration. Flow Chart for Computer Programmes. Numerical Solution of Partial Differential Equations: (A) P.D.equation representation as a difference equation, Iterative Methods for Laplace’s Equation. The Possion Equation, Derivative Boundary Conditions. ( B) The Crank- Nicolson Method for Parabolic Partial Differential Equations. Flow Chart for Computer Programmes.

**Text Books :**

1. Applied Numerical Analysis by Curtis f. Gerald and Patrick O. Wheatley – Published

by Addison Wesley.

2. Introductory Methods of Numerical Methods – S.S. Sastry, PHI, New Delhi.

**Reference Books:**

1. MATHEMATICA – A system for doing mathematics by Computer by Wolfram,

Stephen – Published by Addition – Wesley.

2. Applied Numerical Methods by Camahan, Brice,Et.al, Published by Wiley, New York.

3. Numerical Solution of partial differential equations by Smith, G.D. Published by Oxford University Press London.

4. Iterative Methods for the solution of Equations by J.F. Traub – Published by Prentice Hall.

5. Numerical Methods in Engineering and Science by B.S. Grewal- Published by Khanna Publishers.

6. Numerical Methods in Engineering by M.G. Salvadori and M.L. Baron- Published by Prentice Hall India.

**B. Tech. (Seventh Semester) Mechanical Engineering (Auto)**

**Gas Dynamics**

**ME 425E**

L T P Total

4 1 - 5 Sessional : 50 Marks

Theory : 100 Marks

Total : 150 Marks

Duration of Exams. : 03 Hrs

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**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least**

**two questions from each unit, and students will be required to attempt only 5 questions,**

**selecting at least one from each unit.**

**Unit - I**

Introduction, units, thermodynamics concepts for control mass analysis flow dimensionality and average velocity comment on entropy-pressure energy equation. The stagnation concept, stagnation pressure, energy equation, momentum equation problems. Introduction, Objectives, speed of propagation of pressure front, Mach Number, sonic velocity, field due to a moving source of disturbance, mach cone mach, angle equation for a perfect gas in terms of mach. number. h. s.& t. s. diagram problems.

**UNIT II**

Introduction, adiabatic flow with and without losses, the reference concept, isentropic tables,

Conversant & divergent nozzles, diffuser performance, frictional effects on nozzle flow problems. Introduction, shock analysis-general fluid, working equations for perfect gas, normal-shocks tables, shocks in nozzles, supersonic wind tunnel operation, thermodynamic directions of a normal shock, Rankins-Hugoniat relation, strength of shock, operation of nozzles, problems.

**UNIT III**

Introduction, normal shocks tangential velocity superposition -oblique shocks, oblique-shocks, analysis, oblique-shock tables and charge, boundary conditions of flow direction, boundary condition of pressure equilibrium, introduction to Prandtl Mayer expansion, problems. Introduction, analysis for general fluid, working equations for a perfect gas, reference state and fanno tables, application, correlation with shocks, friction chocking, Rayleigh flow. Analysis for a general fluid, working equations for a perfect gas reference state and Rayleigh tables, applications, correlation with shocks, thermal shocking, and summary problems

**UNIT IV**

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, numerical.

**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.

**B. Tech. (Seventh Semester) Mechanical Engineering (Auto)**

**Machine Tool Design**

**ME 427 E**

L T P/D Total

4 1 - 5 Sessional : 50 Marks

Theory : 100 Marks

Total : 150 Marks

Duration of Exams. : 03 Hrs

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least**

**two questions from each unit, and students will be required to attempt only 5 questions,**

**selecting at least one from each unit.**

**UNIT I**

Definition and classification, Corking and auxiliary motion in m/c tools, parameters of working motion, machine tool drive, selection of electric motor, hydraulic and mechanical transmission and their elements, general requirement of m/c tool design. Engineering design process for m/c tool, and techno-economical consideration for design of new m/c tool. Aims, stepped and stepless speed regulation, design of speed and feed gear box, m/c tool drives using multiple speed motors, gear box kinematics design, gearing diagram, no. of teeth, no. of teeth on gears in the gear train, classification speed and feed boxes, numerical problems.

**UNIT II**

Function and requirements, design criteria, criteria of selection of materials, static arid dynamic stiffness, profiles for m/c tool structure, stiffness, design procedure for m/c tool structure, numerical problems. Function and types, profiles, material and clearance in slide ways, analysis of design of slide ways for wear and stiffness design of hydrostatic guide ways, aerostatic slide ways and antifriction guide or sliding friction power screws for wear, strength, friction bucking stability design of rolling friction, power screw for stiffness, numerical problems.

**UNIT III**

Function and requirements, material for spindle, effect of m/c tool compliance on machining accuracy, design of spindles for bending, permissible deflection strength, optimum spacing for spindle support, antifriction and different types of sliding bearings and their general characteristic, air lubricated bearing, numerical problems.

**UNIT IV**

Equivalent Elastic System (EES), general procedure for accessing dynamic stability of EES cutting process closed loop system dynamic characteristics of elements, systems, EES and culling process, stability analysis, forced vibration of machine tools. Function requirements and classification, control system for forming and auxiliary motion, manual control systems, ergonomic considerations, automatic control systems and adaptive control system.

**Text Books:**

􀂙 Machine Tool Design & Numerical Control by N.K. Mehta, Published by TMH.

􀂙 Production Technology by R.K. Jain, Published by Khanna Publishers.

**References Books:**

1. Design of M/c Tool by S.K. Basu, Allied Publisher, New Delhi.

2. Principles of M/c Tool by Ballacharya A. and Sen. G.C., Published by New Central

Book Agency, Calcutta.

3. Machine Tool Design -Vol-IV- by Acherkean N., Published by Mir Publication.

4. Design principles of Metal Cutting Machine Tools by Koenigsberyer F.,

Published by Pergrnan Press, Oxford.

**DEPARTMENT ELECTIVE-II**

**B. Tech. (Seventh Semester) Mechanical Engineering (Auto)**

**Renewable Energy Resourses**

**ME 435 E**

L T P Total

3 1 - 4 Sessional : 50 Marks

Theory : 100 Marks

Total : 150 Marks

Duration of Exams. : 03 Hrs

.**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least**

**two questions from each unit, and students will be required to attempt only 5 questions,**

**selecting at least one from each unit.**

**UNIT-I**

Introduction and Essential of Fluid Mechanics and Meat Transfer Fundamentals and scientific principles of renewable energy resources, technical and social implications, Bernoulli's, equation, conservation of momentum, viscosity, turbulence, friction and pipe flow, heat circuit analysis and terminology, conductive, convective and radiative heat transfers, properties of transparent materials, heat transfer by mass transport, multimode heat transfer and circuit analysis, problems.

**UNIT-II**

Extraterrestrial solar radiation, components of radiation, geometry of earth and sun, geometry of collector arid the solar beam, effects of earth's atmosphere, measurements of solar radiation, calculation of heat balance for a solar collector, type of water heaters, selective surfaces, crop heaters, space heating, space cooling, water desalination, solar ponds, solar concentrators, electric power system, problems. Introduction, the silicon p-n junction, photon absorption solar radiation input,

photovoltaic circuit properties and loads, limits to cell efficiency, solar cell construction type and adaptations of photovoltaic, other types of photoelectric and thermo electric generation, problems.

**UNIT III**

Principles of hydro power, assessing the resource for small installations, an impulse turbine, reaction turbines, hydro electric systems, the hydraulic rain pump, wind turbine types and terms, linear momentum and basic theory, dynamic matching, steam tube theory, characteristics of the wind, power extraction by a turbine, electricity generation, mechanical power, problems. Introduction, tropic level photosynthesis, photosynthesis at the plant level, thermodynamic considerations, photosynthesis, molecularlevel photosynthesis, synthetic photosynthesis, bio fuel classification, bio-mass production for energy farming, direct combustion for heat, pyrolysis (destructive distillation), alcoholic fermentation, anaerobic digestion for bio-gas, agrochemical fuel extractions, problems.

**UNIT IV**

Introduction, wave motion, wave energy and power, ;wave patterns, devices, the causes of tides, enhancement of tides flow power, tidal range power, world range power sites, problems. Principles of Ocean Thermal Energy Conversion (OTEC), heal exchangers, pumping requirements, other practical considerations, introduction to geothermal energy, geophysics, dry rock and hot aquifer analysis, harnessing geothermal resources, problems.

**Text Books:**

1. Renewable Energy Rsources by John W. Twidell and Anthony D. Weir, published by

E.& F. N. Spon Ltd. London.

**B. Tech. (Seventh Semester) Mechanical Engineering (Auto)**

**Maintenance Engineering**

**ME 437 E**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| L | T | P/D | Total | Sessional | : 50 Marks | | Theory | : 100 marks | |
| 3 | 1 |  | 4 | Theory | : 100 Marks | | Sessional | : 50 marks | |
|  |  |  |  | Total : 150 Marks  Duration of Exams. : 03Hrs | |  | | | Duration of Exams. : 03 hours | |

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least**

**two questions from each unit, and students will be required to attempt only 5 questions,**

**selecting at least one from each unit.**

**UNIT I**

Evolution of maintenance, objective of maintenance, maintenance policies and philosophies, maintenance concept, maintenance management & terotechnology, relationship with other functional areas, importance of maintenance, elements of good maintenance, economics of maintenance, training and safety aspects in maintenance. Classification of maintenance programs, corrective preventive and predictive maintenance, comparison of maintenance programs, preventive maintenance-concept, functions, benefits, limitations.

**UNIT II**

Objectives, what to monitor, when to monitor, principles of CBM, condition based maintenance techniques, manual inspections, performance monitoring, vibration monitoring, current monitoring, coil debris/spectroscopy, thermography and corrosion monitoring, steps in implementation of CBM, benefits of CBM. RCM logic, maintenance and RCM, benefits of RCM, total productive maintenance (TPM), introduction, key supporting elements of TPM, methodology, evaluation and benefits.

**UNIT III**

Purpose and challenges: Techniques, visual aids-boroscopes, endoscopes, fiber optics scanners, magnetic particles inspection, liquid penetrants, eddy current, ultrasonic radiography, selection of NDT technique, metrits/demerits and applications of various techniques. Basic ingredients, basic steps in maintenance management, maintenance planning and control system, documentation, maintenance-productivity areas for improvement

**UNIT IV**

Techniques for improvement of operational reliability, safety and availability of machines and production systems, maintainability criteria, checklist to assess the maintainability of a system, maintainability programs, objectives, key issues in availability improvements program, fault diagnosis, Pareto principle Ishikawa diagram. Data processing systems for integrated maintenance, maintenance information and reporting systems.

**Text Books:**

1. Maintenance Planning and Control by Higgin L.R., McGiaw Hill Book Co1,1900

2. Maintenance Planning and Control by Kelly Anthony, East West Press Private Ltd, New Delhi, 1991.

3. Maintainability principle and practices by Blanchard B.S. and Lowey E.E.

McGrawHill Book co.

4. Practical NOT by Raj B. Jaya Kumar T and Thavasimulyi K., Narora Publishing

House, New Delhi, 1996.

5. Engineering Maintenance Management by Niebel Benjamin W. Marcel Dekher,1994.

**B. Tech. (Seventh Semester) Mechanical Engineering (Auto)**

**Cryogenic Engineering**

**ME 439 E**

L T P/D Total

3 1 - 4 Sessional : 50 Marks

Theory : 100 Marks

Total : 150 Marks

Duration of Exams. : 03 Hrs

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least**

**two questions from each unit, and students will be required to attempt only 5 questions,**

**selecting at least one from each unit.**

**UNIT I**

Definition of cryogenics, physical properties of various cryogenic fluids and industrial

application

**UNIT II**

Types of insulations, vacuum insulation: gas filled powders and fibrous materials, solid

forms, comparison of various insulating materials.

**UNIT III**

Mechanical properties; Specific heat; Thermal expansion; Electrical resistance; Thermal

conductivity; Emissivity; Reflectivity and Absorptive; Thermo-electric e. m. f.

**UNIT IV**

Types of insulated storage containers, transport techniques, various design considerations, safety aspects of cryogenic systems, flammability hazards, high-pressure gas hazards etc., design and fabrication of transfer line, transfer through non-insulated lines, liquid line indicators, valves for cryogenic "liquids, pumping of cryogenic liquids, other allied equipment.

**Reference and Text Books:**

1. Cryogenic Systems - by IJaiion

2. Refrigeration and Air Conditioning- By Spark and Dilio

**B. Tech. (Seventh Semester) Mechanical Engineering (Auto)**

**Computational Fluid Dynamics**

**ME 441 E**

L T P/D Total

3 1 - 4 Sessional : 50 Marks

Theory : 100 Marks

Total : 150 Marks

Duration of Exams. : 03 Hrs

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least**

**two questions from each unit, and students will be required to attempt only 5 questions,**

**selecting at least one from each unit.**

**UNIT I**

Methods of prediction: comparison of experimental investigation Vs theoretical calculation; Mathematical description of physical phenomena; significance of governing differential equations; the general form of governing differential equation. Classification of problems: Physical classification: Equilibrium problems and Marching problems; Mathematical classification: Elliptic, parabolic and hyperbolic partial differential equations; Nature of co-ordinates; one way and two-way co-ordinates; Proper choice of co-ordinates.

**UNIT II**

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

**UNIT III**

Steady one- dimensional Conduction, The inter-face conductivity, Non linearity, Source-Term

Linearization, Types of Boundary Conditions. Unsteady one-dimensional Conduction: Explicit, Crank-Nicolson and Fully Implicit scheme's Discretisation of two and threedimensional problems, Stability analysis.

**UNIT IV**

Steady one dimensional convection and diffusion, The up wind scheme, Generalized Formulation, Discretisation equation for two and three dimensional problems, The outflow Boundary condition, false Diffusion. Basic difficulty, Vorticity Based methods, Representation of the continuity equation,

the staggered grid: the momentum equations, the pressure velocity corrections, and SIMPLE algorithm.

**Reference and Text Books:**

1. Computational Fluid Dynamics - By Anderson, McGraw-Hill

2. Numerical Heat Transfer and fluid flow - By Patankar, McGraw-Hill

**B. Tech. (Seventh Semester) Mechanical Engineering (Auto)**

**Mechatronics Engineering**

**ME 443E**

L T P Total

3 1 - 4 Sessional : 50 Marks

Theory : 100 Marks

Total : 150 Marks

Duration of Exams. : 03 Hrs

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least**

**two questions from each unit, and students will be required to attempt only 5 questions,**

**selecting at least one from each unit.**

**UNIT I**

What is Mechatronics? A measurement system with its constituent elements, open and closed loop systems, sequential controllers, micro processor based controllers, the Mechatronics approach. A review of displacement, position velocity, motion, force fluid pressure, liquid flow, liquid level, temperature, light sensors/along with performance terminology, selection of sensors, input data by switches, signal conditioning, brief review of operational amplifier, projection, filtering, wheat stone bridge, digital signals, multiplexers, data acquisition, digital signal processing, pulse modulation, data presentation systems, displays, data presentation elements, magnetic recording, data acquisition systems, testing £ calibration, problems.

**UNIT II**

Pneumatic and hydraulic systems, directional control valves, valve symbols, pressure control valves, cylinder sequencing, process control valves, rotary actuators, mechanical systems -types of motion, kinematic chains, cams, gear trains, Ratchet & Pawl, belt and chain drives, bearings, mechanical aspects of motor selection, electrical systems, mechanical and solid state switches, solenoids, D.C. & A.C moto4rs, stepper motors, problems.

**UNITIII**

Continuous and discrete process- lag, steady state error, control modes, two step mode, proportional mode-electronic proportional controllers, derivative control- proportional plus derivative control, integral control-proportional plus integral control, PID controlleroperational amplifier PID circuits, digital controllers -implementing control modes, control system performance, controller tuning, process, reaction method and ultimate cycle method, velocity control, adaptive control, problems.

Scale, a pick and place robot, automatic camera, engine management system and bar code recorder.

**UNIT IV**

A review of number systems and logic gates, Boolean algebra, Karnaugh maps, sequential logic basic structure of programmable logic controllers, input/output processing, programming mnemonics; timest, internal relays and counters, master and jump controls, data handling, analog input/output, selection of a PLC, PROBLEMS. Control, microcomputer structure, micro-controllers, applications, programming languages, instruction sets, assembly language programs, subroutines, Why C Language? A review of program structure, branches, loops, arrays, pointers, examples of programs, interfacing, input/output, interface requirements. Peripheral interface adapters, serial communication

interface, examples of interfacing, problems.

**Text Book**:

1. Mechatronics by W. Bolton, published by Addition Wesley.

**B. Tech. (Eighth Semester) Mechanical Engineering (Auto)**

**Measurement and Instrumentation**

**MEA-402E**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| L | T | P | Total | Sessional | : 50 Marks |
| 4 | 1 |  | 5 | Theory | : 100 Marks |
|  |  |  |  | Total : 150 Marks  Duration of Exam: 3 Hrs. | |

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least**

**two questions from each unit, and students will be required to attempt only 5 questions,**

**selecting at least one from each unit.**

**UNIT-I**

**Basic Statistical Concepts:** Types of Measured Quantities (Discrete and Continuous), Central Tendency of Data,Mode, Median, Arithmetic Mean, Best Estimate of true Value of Data, Measures of Dispersion, Range, Mean Deviation, Variance, Standard Deviation, Normal Distribution, Central Limit Theorem, Significance Test, Method of Least Squares, Graphical Representation and Curve Fitting of Data.

**Instruments and Their Representation**: Introduction, Typical Applications of Instrument Systems, Functional Elements of a Measurement System, Classification of Instruments, Standards and Calibration

**UNIT-II**

**Static and Dynamic Characteristics of Instruments**: Range and span, accuracy and precision, calibration, hysteresis and dead zone, sensitivity and linearity, threshold and resolution; speed of response, lag, fidelity and dynamic error, dead time and dead zone. Zero, first and second order systems and their response to step, ramp and sinusoidal input signals.

**Errors in Measurement**: Sources of errors, systematic and random errors; statistical analysis of test-data, probable error and probability tables, ejection of test data; curve fitting, error propagation; Design and planning of experiments and report writing.

**UNIT-III**

**Sensors and Transducer**: Introduction, Analog and Digital Transducers, Electromechanical; Potentiometric,Inductive and reluctance type, Electromagnetic, Electrodynamic, Eddy Current, Magnetostrictive, Variable Inductance, Linearly Variable Differential Transformer, Variable Capacitance, Piezo-Electric Transducer and Associated Circuits, Unbonded and Bonded Resistance Strain Gages. Strain Gage Bridge circuits, Temperature Compensation, Balancing and Calibration, Opto-Electrical Transducers, Photo Conductive Transducers, Photo

Voltaic Transducers, Digital Transducers, Frequency domain transducer, Vibrating string transducer, Data Acquisition Systems, Data processing, Data Display and Storage. Modern Automotive Instrumentation, Study of automotive sensors and actuators

**UNIT-IV**

**Position, displacement, and velocity Measurement**: Introduction, Relative motion Measuring

Devices, Electromechanical, Optical, Photo Electric, Moire-Fringe, Pneumatic, Absolute Motion Devices. **Force, Acceleration and Torque Measurement** : Seismic Devices, Spring Mass & Force Balance Type, Calibration, Hydraulic Load Cell, Pneumatic Load Cell, Elastic Force Devices, Separation of Force Components, Electro Mechanical Methods, Strain Gage, Torque Transducer, Toque Meter.

**Pressure Measurement**: Moderate Pressure Measurement, Monometers, Piezo Transducer, Dynamic Effects of Connecting Tubing, High Pressure Transducer, Low Pressure Measurement, Calibration and Testing,

**Flow Measurement**: 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.

**Text Books** :

1. Measurement systems Application and Design. Ernest 0. Doebelin, Tata McGraw Hill Edition (Fourth Edition) 2002.

2. Measurement and Instrumentation in Engineering, Francis S. Tse and Ivan E. Morse, Marcel Dekker.

3. Principles of Measurement and Instrumentation – Alan S. Morris, Prentice Hall of India.

4. Mechanical Measurements: T.G. Beckwith, W.L. Buck and R.D. Marangoni

Addison Wesley.

5. Instrumentation, Measurement and Analysis – B.C. Nakra and K.K. Chaudhary, Tata McGraw Hill

6. Mechanical Measurements by D. S. Kumar, Kataria & Son

7. Instrumentation devices & systems : Rangan, Mani, Sarma

8. A course in mechanical instrument & instrumentation: A.k.Sawhney

**B-Tech. (Eighth Semester) Mechanical Engineering (Auto)**

**Operation Research**

**ME 406 E**

L T P/D Total Sessional: 50 Marks

3 1 4 Theory: 100 Marks

Total: 150 Marks

Duration of Exams: 03 hours

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least**

**two questions from each unit, and students will be required to attempt only 5 questions,**

**selecting at least one from each unit.**

**UNIT I**

Development of operations Research, characteristics and scope of operations Research, operations Research in Management, Models in operations Research, Model Formulation, Types of athematical models, Limitations of operations Research. L.P. models, simplex method, the algebra of simplex method. (Minimization and Minimization problems), The big M method, post optimality analysis, essence of duality theory, Application of sensitivity analysis.

**UNIT II**

Introduction to model, matrix terminology, Formulation and solution of Transportation model (least cost method, Voyel's Approximation method), Least time transportation problem,Assignment problems.Introduction to net work logic, Numbering of events (Fulkersen Rule), PERT calculations -

Forward path, back-ward path. Slack, probability, comparison with PERT, Critical path, Floats. Project cost, crashing the net work, updating (PERT and CPM).

**UNIT III**

Introduction, applications of simulation, advantages and limitations of simulation technique, generation of random numbers, Time-flow mechanism, simulation languages. 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 Definition of arguments models, comparison with transport model, Mathematical representation of assignment model, Formulation and solution of argument models, variation of the argument model, Alternate optimal solutions

**UNIT IV**

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.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.

**Reference and Text Books:**

1. Introduction to operation research- By Hillier and Lieberman, McGraw-Hill

2. Operations Research - By P.K. Gupta and D.S. Hira

3. Linear Programming -By N.P. Loomba

**B. Tech. (Eighth Semester) Mechanical Engineering (Auto)**

**Automotive Electronics and Microcontrollers**

**MEA 406E**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| L | T | P | Total | Sessional | : 50 Marks |
| 4 | 1 |  | 5 | Theory | : 100 Marks |
|  |  |  |  | Total : 150 Marks  Duration of Exam: 3 Hrs. | |

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

**UNIT I**

**Basic Electronics**

Introduction, Electronic devices and circuits, Amplifiers, Converters, Digital Electronics.

**Microprocessors**

Block diagram of microcomputer, Architecture of Intel 8085, Importance of Data, Address and Control buses, Instruction formats, Addressing modes and types of instructions in Intel 8085, Instruction set of 8085. Memory Devices, RAM, ROM Types, Microprocessor interfacing with memory chips. LAN and CAN Network basics

**UNIT II**

**Microcontrollers**

Comparison of microprocessor & microcontrollers, survey of 4,8,16 & 32 bit microcontrollers. Architecture of 8051:Block Diagram, oscillator & clock, Program Counter, registers, Flags, Internal memory, stack & stack pointer, special function register, Input/Output Pins, Ports and Circuits, External memory, Counters & Timers, Serial Data input/output interrupts. DC Motor and Stepper motor controls.

**UNIT III**

**Electronic fuel control system**

Introduction, components, Open loop and closed loop control systems, intake manifold pressures, mass air flow rate sensor, Throttle body injection and multi port or point fuel injection, Fuel injection system, Injector operations, Injection system controls.

**Digital engine control system**

Motivation for electronic engine control, concept, parameters, variables, Engine mapping, control strategy, Electronic engine management components, layout. Engine cranking and warm up control, Acceleration enrichment, Deceleration leaning and idle speed control. EGR control, Variable valve timing control, Electronic Ignition control, Electronic spark timing control. Exhaust emission control engineering, Integrated engine control system.

**UNIT IV**

**Transmission control systems:**

Electronic transmission management: components, layout. Electronic control of automatic transmissions, valve actuating control system, two-wheel drive control, four-wheel drive control, all wheel drive auto control system. Electric vehicle drive controls: Electronic control of hybrid and electric vehicles. Digital controllers for drive-motor, motor-generator, battery and fuel cell.

**Chassis Control system**

Electronic management of chassis system, Cruise control systems. Electronic suspension system, antilock braking controls system, traction control system, and vehicle stability control system. Electronic Steering control. Body controls and Security

**Body control systems:** Remote central locking, Key less entry, Automatic Air conditioning systems. Security systems: immobilizer, and warning systems. Telematics, GPS Systems, Electronic control system diagnostics.

**Text Books:**

1. William B.Riddens, “Understanding Automotive Electronics ", 5th Edition, Butterworth, Heinemann Woburn, 1998.

2. William L Husselbee, " Automotive Computers and Control System: Fundamentals and Service ". Hartcourt Brace Professional Publications.

3. Thomas H Denton, "Automobile Electrical and Electronic Systems", SAE Publication.

4. Bosch Automotive Handbook, Latest Edition, SAE Publication

5. Bechtold., " Understanding Automotive Electronic ", SAE Publication

6. Ronald K Jurgen, “Automotive Microcontrollers” SAE Publications

7. Ronald K Jurgen, “ Passenger Safety and Convenience Systems” SAE Publications

8. T.Mellard, " Automotive Electronics ".

**B. Tech. (Eighth Semester) Mechanical Engineering (Auto)**

**Auto Fuel and Lubricant**

**MEA 408E**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| L | T | P | Total | Sessional | : 50 Marks |
| 3 | 1 |  | 4 | Theory | : 100 Marks |
|  |  |  |  | Total : 150 Marks  Duration of Exam: 3 Hrs. | |

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

**Unit-I**

**Manufacture of Fuels**: Structure of petroleum, refining process, fuels, thermal cracking, catalyticcracking, polymerization, alkylation, isomerisation, blending, products of refining process.

**Properties And Testing Of Fuels**: Thermo-chemistry of fuels, properties and testing of fuels, Lubricant relative density, calorific value, fire point distillation, vapour pressure, flash point, spontaneous ignition temperature, viscosity, pour point, flammability, ignitability, diesel index, API gravity, aniline point, viscosity index etc. B.I.S specification for diesel, petrol, biodiesel and CNG

**Unit-II**

**Alternative Fuels:**Use of alternate fuels in engines-LPG, CNG. Need of Alternate Fuels, availability & their properties, general use of alcohols, LPG, CNG, LNG, hydrogen, ammonia, vegetable oils, biodiesel and biogas. Merits and Demerits of alternate fuels. Introduction to alternate energy sources like electric vehicle, hybrid, fuel cell & solar car

**Unit-III**

**Fuel rating:** Cetane rating, fuel requirements. Additive - mechanism, requirements of an additive, petrol fuel additives and diesel fuel additives – specifications of fuels SI Engines – flame.

**Additives and Combustion:** propagation and mechanism of combustion, normal combustion, knocking, octane rating, fuel requirements. CI Engine, mechanism of combustion, diesel knock,.

**Unit -IV**

**Lubricants:** Manufacture of lubricating oil base stocks, manufacture of finished automotive lubricantsClassification of lubricating oils, properties of lubricating oils, tests on lubricants. Grease,classification, properties, test Specific requirements for automotive lubricants, oxidation deterioration and degradation of lubricants, additives and additive mechanism, synthetic lubricants.

**Theory of Lubrication:** Engine friction: introduction, total engine friction, effect of engine variables on friction, hydrodynamic lubrication, elasto hydrodynamic lubrication, boundary lubrication, bearing lubrication, functions of the lubrication system, introduction to design of a lubricating system.

**TEXT BOOKS**

1. V.Ganesan,“Internal Combustion Engines” Tata McGraw-Hill Publishing Co. Newdelhi  
2. M.L.Mathur and P.Sharma “A course in internal combustion engines”, Dhanpatrai Publications

3. Raymond.C.Gunther – Lubrication – Chilton Book Co., - 1971.

4. Obert.E.F “Internal Combustion Engineering and Air Pollution”, International book Co., 1988.

**REFERENCES**

1. Brame, J.S.S. and King, J.G. – Fuels – Solids, Liquids, Gaseous.  
2. Francis, W – Fuels and Fuel Technology, Vol. I & II  
3. Hobson, G.D. & Pohl.W- Modern Petroleum Technology  
4. A.R.Lansdown – Lubrication – A practical guide to lubricant selection – Pergamon  
press – 1982.  
5. Raymond.C.Gunther – Lubrication – Chilton Book Co., - 1971.

**B. Tech. (Eighth Semester) Mechanical Engineering (Auto)**

**Measurement and Instrumentation Lab**

**MEA 410E**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| L | T | P | Total | Sessional | : 50 Marks |
| 2 | - |  | 2 | Practical | : 25 Marks |
|  |  |  |  | Total : 75 Marks  Duration of Exam: 3 Hrs. | |

**List of Experiments:-**

1. Measurement with the help of vernier caliper and micrometer

2. Measurement of an angle with the help of sine bar

3. Measurement of surface roughness

4. Measurement of speed and torque of a shaft

5. Measurement of acceleration and vibrations

6. Calibration of a pressure guage with the help of a dead weight guage tester

7. Measurement of temperature using RTD / thermocouple

8. Determination of frequency & phase angle using C.R.O.

9. Measurement of Inductance by Maxwell’s Bridge.

10. Measurement of flow rate and quantity

**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. (Eighth Semester) Mechanical Engineering (Auto)**

**Project-II**

**ME 410 E**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **L** | **T** | **P/D** | **Total** | Sessional : 100Marks |
| **-** | **-** | **9** | **9** | Practical : 100 Marks |

Total : 200 Marks

Duration of Exam : 3 Hrs.

The student is expected to finish the remaining portion of the project

**B. Tech. (Eighth Semester) Mechanical Engineering (Auto)**

**Seminar**

**ME 411 E**

P/D Total

2 2 Sessional: 25 marks

Student will give a talk on some technical topics.

**Electives III Eight Semester**

**(Mechanical Engineering Auto)**

**ELECTIVE – III**

ME 420 E Non Conventional Manufacturing

ME 422 E Industrial Robotics

ME 424 E Manufacturing Management

ME 426 E Total Quality Management

ME 428 E Piping Engineering

Elective – III will be offered as departmental elective for Mechanical Engineering (Auto) students.

**B. Tech. (Eighth Semester) Mechanical Engineering (Auto)**

**Non-Conventional Manufacturing**

**ME 420 E**

L T P/D Total

|  |  |
| --- | --- |
| 3 1 - 4 Sessional | : 50 Marks |
| Theory | : 100 Marks |
| Total : 150 Marks  Duration of Exam: 3 Hrs. | |

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least**

**two questions from each unit, and students will be required to attempt only 5 questions,**

**selecting at least one from each unit.**

**UNIT I**

Unconventional machining processes, Rapid prototyping processes, their classification, considerations in process selection.

**Ultrasonic Machining**

Elements of process, design of cutting tool, metal removal mechanism, effect of parameters,

economic considerations, limitations and applications, surface finish.

**UNIT II**

**Electrochemical Machining**

Elements of process, process chemistry, metal removal mechanism, tool design, accuracy, surface finish and work material characteristics, economics advantages, limitations and applications, Electrochemical grinding, debarring and honing, Chemical machining.

**Electric Discharge Machining**

Principle and mechanism of metal removal, generators, electrode feed control, electrode material, tool electrode design, EDM wire cutting, surface finish, accuracy and applications.

**UNIT III**

**Jet Machining**

Principal and metal removal mechanism of abrasive and water jet machining, process variables, design of nozzle, advantages, limitations and applications. Plasma arc machining, Electron beam machining, laser beam machining, their principles and metal removal mechanism, process parameters, advantages and limitations, applications.

**UNIT IV**

**Rapid Prototyping**

Fundamentals, process chain, physics of processes, principles and process mechanism of SLA, SGC, LOM, FDM and SLS processes, their advantages and limitations, applications of RP processes, RP data formats, STL file format, STL file problems, STL file repair, other translators and formats.

**Rapid Tooling Process**

Introduction, fundamentals, classification, indirect RT processes, Principles of Silicone Rubber Molding, Epoxy Tooling, Spray Metal Tooling, Pattern for Investment Casting, Vacuum Casting, and Vacuum forming processes, direct RT processes, Shape Deposition manufacturing, their advantages, limitations and applications.

**Reference and Text Books**:

1. Modern machining processes -By P.C. Pandey and M.S. Shan, 1 Ml I.

2. Machining Science -By Ghosh and Mallik, Affiliated East West

3. Nontraditional Manufacturing processes -By G.F. Benedict, Maicel Dekker.

4. Advanced Methods of Machining -By J.A. McGeongh, Chapman and Hall.

5. Electrochemical Machining of Metals -By Rurnyantsev & Davydov, Mir Pub.

6. Rapid prototyping: Principles and applications in Manufacturing

**B. Tech (Eighth Semester) Mechanical Engineering (Auto)**

**Industrial Robotics**

**ME 422 E**

L T P/D Total Sessional : 50 Marks

3 1 - 4 Theory : 100 Marks

Total : 150 Marks

Duration of Exams. : 03 hours

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least**

**two questions from each unit, and students will be required to attempt only 5 questions,**

**selecting at least one from each unit.**

**UNIT I**

Automation and robots, Robot classification, Applications, Robot specifications. Dot and Cross products, Coordinate frames, , Homogeneous coordinates, Link Coordinates, The arm equation, Five-axis articulated robot (Rhino XR-3), Four-axis SCARA robot (Adept One), Six-axis articulated robot (Intelledex 660).

**UNIT II**

The Inverse kinematics problem, General properties of solutions, Tool Configuration,Inverse kinematics of Five-axis articulated robot (Rhino XR-3), Inverse Kinematics of Four-axis SCARA robot (Adept One), inverse kinematics of Six-axis articulated robot (Intelledex 660), and Inverse kinematics of a three-axis planar articulated robot, a robotic work cell. Workspace analysis, Work envelope of a five-axis articulated robot (Rhino XR-3), Work envelope of a four-axis SCARA robot (Adept One), Workspace fixtures, The pick and place operations, Continuous path motion, Interpolated motion, Straight line motion.

**UNIT III**

The tool configuration and Jacobean matrix, Joint space singularities, Generalized inverses, Resolved motion rate controls, rate control of redundant robots, rate control using {1)-inverses, The anipulator Jacobean, Induced joint torque and forces. Lagrange's equation, Kinetic and potential energy, Generalized force, Lagrange-Euler dynamic model, Dynamic model of a two-axis planner articulated robot, Dynamic model of a three-axis SCARA robot, Direct and inverse dynamics, Recursive Newton-Euler formulation, Dynamic model of a one-axis robot (inverted pendulum).

**UNIT IV**

The control problem, State equations, Constant solutions, Linear feedback systems,

Single axis PID control, PD gravity control, Computed torque control, Variable

structure control

image representation, template matching, polyhedral objects, shape analysis,

Segmentation, Iterative processing, Perspective transformations, Structured

Illumination, Camera Calibration.

Task level programming, Uncertainty, Configuration space, Gross motion planning, Grasp

Planning, Fine motion planning, Simulation of planar motion.

**Reference and Text Books:**

1. Industrial Robotics - By M.P. Groover, McGraw Hill

2. Industrial Robotics and Automation - By S.R.Deb Tata McGraw Hill

**B. Tech (Eighth Semester) Mechanical Engineering (Auto)**

**Manufacturing Management**

**ME 424 E**

L T P Sessional: 50 Marks

3 1 - Theory: 100 Marks

Total: 150 Marks

Duration of Exam: 3 Hrs

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

**Unit I**

Manufacturing Systems Designs: Definition, Systems, Subsystems, Systems Approach Fundamentals, Systems Approach for designing, Manufacturing Systems, Systematic Layout Planning (SLP), Computerized Plant Layout-CRAFT, ALDEP, CORELAP, Assembly Line balancing, Problems and solutions of assembly lines, Group Technology & Cellular Systems, Classification & Grouping, overview of FMS. Strategic consideration for comparison of various systems. Manufacturing Systems Economics: Concept of time value of money, Preparation of time profile of project, Single payment, Equal Series payment, various machine and project selection & evaluation techniques: Payback period, Present worth, Equivalent annual cost, Cost- benefit ratio, Evaluation for both equal & unequal life. Depreciation concept various methods-straight line, declining balance, Sum of the digits, Sinking fund.

**Unit II**

New Product Development (NPD): Product Development, Customer Need, Strategies for New Product Development, Product life cycle, Product status. Corporate Design Strategies, Japanese Approach to NPD. PUGH total Design approach, PAHL & BEITZ Approach, Project Approach, Cross functional Integration –Design, manufacturing, Marketing, Concurrent Engineering, Modular Design, Standardization Value Engineering & Analysis. Manufacturing Planning & Control Systems: Overview of Aggregate Planning Models, Linear Decision Rules, Management Coefficient, Direct Search Methods, Master Production Schedule, Modular Bill and Materials, Capacity planning & control, language, medium range, short range capacity planning, Toyota Production System, Just- in Time (JIT), Manufacturing –Philosophy, Elements, KANBAN, effects on layout, workers & vendors, optimized production technology (OPT).

**Unit III**

Forecasting Methods: Forecasting Framework, Forecasting cost and accuracy, Forecasting Uses and Methods – Delphi, Exponential Smoothing, Forecasting Errors – MAD, Regression Methods-Linear Model for single & multiple variables, Brief idea of computerized forecasting systems. Material Requirements Planning (MRP): Definition of MRP systems. MRP versus Order point, MRP Elements, Types of MRP – MRP I & II. Structured Bill of Materials. Regenerative & Net change MRP, Operating an MRP, Integration of Production & Inventory Control.

**Unit IV**

Maintenance & Reliability: Concept of preventive & breakdown maintenance, maintenance cost, optimal preventive maintenance simple replacement models-individual and group replacement, MAPI - methods, reliability definitions, failure analysis and curve, systems reliability- series parallel, redundancy, methods of improving reliability, MTBF, MTTR, Maintainability, availability, brief concept of terotechnology.

**Text books:**

1. Operations management – Schoroeder, Mc Graw Hill International

2. Production operations management – chary, TMH, New Delhi.

**Reference books:**

1. Production Operations Management – Adam & Ebert, PHI, New Delhi

2. Operational Management –Monks, Mcgraw Hill, Int.

3. Production & Operations Management – I. Hill, Prentice Hall Int.

4. Production Planning & Inventory Control – Narasimham etal, PHI, New Delhi

5. Production & Operation Management- Panneerselvam, PHI, New Delhi

6. Managing for Total Quality-Logothetis, PHI, New Delhi

7. Concept of Reliability Engineering –L.S. Srinath, Affiliated East West.

8. Revolutionizing Product Development – Wheelwright & Clark, Free press.

9. Management In Engineering – Freeman-Ball & Balkwill, PHI, New Delhi.

10. Production & operations management – Martinich, John Wiely , New Delhi.

11. The goal by Eliyahu M. Goldratt & Jeff Cox, Productivity Press India Ltd,, Bangalore

12. Toyota Production System by Taichi Ohno, Productivity Press India Ltd, Bangalore

**B. Tech (Eighth Semester) Mechanical Engineering (Auto)**

**Total Quality Management**

**ME 426 E**

L T P/D Total Sessional: 50 marks

3 1 - 4 Theory: 100 marks

Total: 150 Marks

Duration of Exams: 03 hours

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

**UNIT I**

Concept of Quality, Quality as the basis of market competition, Historical review, Quality philosophy of Deming, Juran, crossby etc., Obstacles, Integrating productivity and Quality. Organization of Quality, Quality council, Total Quality Culture, Quality leadership, Quality awards, Total employee involvement, Quality circles, Attitude of top management, executives and workers, Operators responsibility of Quality, causes of operator’s errors, Motivation.

**UNIT II**

Introduction lo TQM, Models for TQM. TQM implementation, Advantages of TQM, Obstacles to TQM, TQM in service sector. Concepts of Quality function deployment, cause and effect diagram, SWOT analysis, Continuous improvement, PDCA cycle, Supplier partnership, Supplier certification, Pareto diagram, Scalier diagram, Benchmarking, Taquchi's Quality Engineering, Failure mode and effect analysis, Total productive maintenance, Introduction to JIT, JIT Quality management, SQC, SPC.DPR, Kaizen, Six sigma concept.

**UNIT III**

Introduction to ISO 9000 series of standards, other quality systems, Implementation, Documentation, Internal audits', Registration, Closing Comments.

**UNIT IV**

Beyond ISO 9000 horizon, Introduction to ISO 14000, Series standards, Concepts of ISO 14001, EMS Benefits, ISO 10011- 10014, Quality systems.

**Suggested Books:**

1. Total Quality Management: By Bosterfied el al., Pearson Education India, 2001.

2. The Essence of Total Quality Management: By Johan Bank, Prentice Hall of India 2000.

3. Managing for Total Quality: By Logothelis Prentice Hall of India, 2000.

4. Total Quality Management: By Sundra Raju, Tata Mcgraw Hills publishing company, 1997.

5. TQM and ISO 9000: By K.C. Arora, S.K. Kataria & Sons 2000.

6. ISO 9000 Quality System: By Dalde & Saurabh, Standard Publishing, 1994.

**B. Tech. (Eight Semester) Mechanical Engineering (Auto)**

**Piping Engineering**

**ME 428 E**

L T P/D Total Sessional: 50 marks

3 1 - 4 Theory: 100 marks

Total: 150 Marks

Duration of Exams. : 03 hours

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

**UNIT I**

Basics of fluid mechanics: viscosity, pressure, head, and hydraulic gradient, types of fluid flow, Remolds number. Euler's equation of motion, continuity equation, Bernoulli's equation, Gas laws and compressibility factor. Determination of pipe size and pressure losses, thrusts in pipe line, water hammer in pipeline, design of gas pipeline, measurement of flow in pipes, Transportation of solid materials through pipelines.

**UNIT II**

Selection of materials, physical properties of pipe materials, recommended pipe materials Standards and specifications, steel pipes, steel pipe fittings, cast iron pipes, cast iron fittings, joining of cast iron pipes, tubes of other materials, design of flanges and flanged joints

**UNIT III**

Load on structural supports, supporting structures of pipeline, pipe supports design considerations, platforms and ladders, foundation, supporting span of overhead pipe line, stiffening ribs, pipe clamping and supporting devices, flexible hanger supports Valves, function of valves, valve materials and method of construction, pressure drop involves, valve size, Types of valves, valve fittings. Codes and standards, piping construction, welding joints in pipe line, welding processes used in pipe fabrication, preparation of pipe edged,

**UNIT IV**

Piping systems, pipe expansion, methods of compensation, thermal force calculation, Permissible equivalent stresses by additional external loads, expansion devices, calculation of anchor force using a bellow, bellow material and life, use of hinged compensators Kellogg method, Method of analysis, multi-line pipeline with two-fixed end Corrosion control In critical task, corrosion process, types of corrosion, fluid and cavitation corrosion.

**Reference and Text Books:**

1. Handbook of piping design - By Sahu, New age Int. Pubs.

2. Design of piping systems - By Kellogg, Wiley & sons