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| Fourth Semester | | | | | |
|---|---|---|---|---|---|
| **Group** | **Paper Code** | **Paper** | **L** | **P** | **Credits** |
| **Theory Papers** | | | | | |
| BS | BS-202 | Probability, Statistics and Linear Programming | 4 | | 4 |
| HS/MS | HS-204 | Technical Writing* | 2 | | 2 |
| PC | MEC-206 | Manufacturing Science and Technology-II | 4 | | 4 |
| PC | MEC-208 | Material Science and Metallurgy | 4 | | 4 |
| PC | MEC-210 | Thermal Engineering - II | 4 | | 4 |
| PC | MEC-212 | Machine Design-I | 4 | | 4 |
| **Practical / Viva Voce** | | | | | |
| BS | BS-252 | Probability, Statistics and Linear Programming Lab | | 2 | 1 |
| PC | MEC-254 | Manufacturing Science and Technology-II Lab | | 2 | 1 |
| PC | MEC-256 | Thermal Engineering - II Lab | | 2 | 1 |
| PC | MEC-258 | Machine Design - I Lab | | 2 | 1 |
| **Total** | | | **22** | **8** | **26** |

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| Paper Code(s): BS-202 | L | P | C |
|---|---|---|---|
| Paper: Probability, Statistics and Linear Programming | 4 | - | 4 |

**Marking Scheme:**

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

**Instructions for paper setter:**

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

**Course Objectives:**

| | |
|---|---|
| 1: | To understand probability and probability distributions. |
| 2: | To understand methods of summarization of data. |
| 3: | To understand and use test for hypothesis. |
| 4: | To understand methods for solving linear programming problems. |

**Course Outcomes (CO):**

| | |
|---|---|
| CO1: | Ability to solve probability problems and describe probability distributions. |
| CO2: | Ability to describe and summarize data. |
| CO3: | Ability to use test for hypothesis. |
| CO4: | Ability to formulate and solve linear programming problems. |

**Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High**

| CO/PO | *PO01* | *PO02* | *PO03* | *PO04* | *PO05* | *PO06* | *PO07* | *PO08* | *PO09* | *PO10* | *PO11* | *PO12* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***CO1*** | - | 3 | 1 | 1 | 1 | - | - | - | - | - | 1 | 2 |
| ***CO2*** | - | 3 | 1 | 1 | 1 | - | - | - | - | - | 1 | 2 |
| ***CO3*** | - | 3 | 2 | 2 | 1 | - | - | - | - | - | 2 | 2 |
| ***CO4*** | - | 3 | 3 | 3 | 1 | - | - | - | - | - | 2 | 2 |

**Unit I**

Basics: Probability and Statistical models, Sample Spaces and Events, Counting Techniques, Interpretations and Axioms of Probability, Unions of Events and Addition Rules, Conditional Probability, Intersections of Events and Multiplication and Total Probability Rules, Independence, Bayes' Theorem, Random Variables.

Discrete and Continuous Random Variables and Distributions: Probability Distributions and Probability Mass / density Functions, Cumulative Distribution Functions, Mean and Variance of a Random Variable, Discrete and continuous Uniform Distribution, Binomial Distribution, Geometric and Negative Binomial Distributions, Hypergeometric Distribution, Poisson Distribution. Normal Distribution, Normal Approximation to the Binomial, and Poisson Distributions; Exponential Distribution, Erlang and Gamma Distributions, Weibull Distribution, Lognormal Distribution, Beta Distribution.

**Unit II**

Joint Probability Distributions for Two Random Variables, Conditional Probability Distributions and Independence, Joint Probability Distributions for Two Random Variables, Covariance and Correlation, Common Joint Distributions, Linear Functions of RandomVariables, General Functions of Random Variables, Moment-Generating Functions.

Numerical Summaries of Data, Stem-and-Leaf Diagrams, Frequency Distributions and Histograms, Box Plots, Time Sequence Plots, Scatter Diagrams, Probability Plots. Point Estimation, Sampling Distributions and the

| Paper Code(s): MEC-206 | L | P | C |
|---|---|---|---|
| Paper: Manufacturing Science & Technology - II | 4 | - | 4 |

**Marking Scheme:**

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

**Instructions for paper setter:**

1. There should be 9 questions in the term end examinations question paper.
2. The first ($1^{st}$) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

**Course Objectives :**

| | |
|---|---|
| 1. | To understand the concepts of metal cutting and tool materials. |
| 2. | To develop an understanding of the various machine tools. |
| 3. | To introduce students to different gear forming methods and jigs & fixtures |
| 4. | To acquire a fundamental knowledge on non-traditional machining processes. |

**Course Outcomes (CO)**

| | |
|---|---|
| **CO 1** | Understand and apply concepts of cutting tool geometry, materials, mechanism of chip formation and mechanics of metal cutting |
| **CO 2** | Illustrate and identify the various constructional features and operations performed on machine tools. |
| **CO 3** | Analyse the kinematic motions and associated mathematical relationships in a machine tool. |
| **CO 4** | Select a machine tool, cutting tool and holding devices as per the requirement of metal cutting and submit report in a team. |

**Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)**

| | PO01 | PO02 | PO03 | PO04 | PO05 | PO06 | PO07 | PO08 | PO09 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | - | 3 | - | 2 | - | - | - | - | - | - |
| **CO 2** | 3 | - | 2 | - | - | 2 | - | - | - | - | - | - |
| **CO 3** | 3 | 3 | 2 | 2 | - | 2 | - | - | - | - | - | - |
| **CO 4** | 3 | 2 | 2 | 3 | - | 2 | - | - | 3 | 3 | - | - |

**UNIT-I**

Theory of Metal Cutting: Single point cutting tool nomenclature, geometry. Mechanics of Chip Formation, Types of Chips. Merchants circle diagram and analysis, Ernst Merchant's solution, shear angle relationship, problems of Merchant's analysis. Tool Wear and Tool failure, tool life. Effects of cutting parameters on tool life. Tool Failure Criteria, Taylor's Tool Life equation. Problems on tool life evaluation.

Cutting Tool Materials: Desired properties and types of cutting tool materials, Cutting fluids and its desired properties, types and selection. Heat generation in metal cutting, factors affecting heat generation. Heat distribution in tool, work piece and chip. Measurement of tool tip temperature.

**UNIT-II**

Lathe, Shaper, Planer and Slotter: Classification, constructional features, work and tool holding devices for General lathe, Turret and Capstan Lathe. Tool Layout, shaping Machine, Planing Machine, Driving mechanisms of lathe, shaping and planing machine tools, Different operations on lathe, shaping machine, planing, slotting

machine tools. Problems on machining time calculations, thread cutting.

Drilling: Classification, constructional features, drilling & related operations. Types of drill & drill bit nomenclature, Basic principle of design of drill bits, drill materials, related problems.

**UNIT-III**

Milling and Grinding: Classification, constructional features, milling cutters nomenclature, milling operations, up milling and down milling concepts. Various milling operations. Indexing Methods: Simple and compound. Problems on indexing and machining time calculation. Grinding: Selection of grinding wheel, Classification, constructional features of grinding machines (Centerless, cylindrical and surface grinding), Dressing and truing of grinding wheels.

Broaching process: Principle of broaching, Applications, advantages and limitations. Finishing and other Processes Lapping and Honing operations – Principles, arrangement of set up and application. Super finishing process, polishing, buffing operation and application.

Gear Manufacturing: Gear forming, gear generation, gear shaping and gear hobbing.

**UNIT - IV**

Jigs & Fixtures: Important considerations in jigs and fixture design. Main principles of designing of jigs & fixtures, elements of Jigs and fixtures. Different devices and methods of locations. Different types of clamps used in jigs & fixtures.

Introduction to CNC machines- Principles of operation. Basics of Manual part programming methods.

Non- Traditional Machining: Need and classification of non-traditional machining, Principle, equipment & operation of Electric discharge machining, Laser Beam Machining, Electro Chemical Machining, Ultrasonic Machining, Abrasive Jet Machining, Water Jet Machining, Electron Beam Machining.

**Textbook(s):**

1. B.L. Juneja, G. S. Sekhon, Nitin Seth, "Fundamental of Metal Cutting and Machine Tools", New Age International; 2nded.
2. A. Ghosh and A.K. Mallik, "Manufacturing Science", East West Press.
3. P. H. Joshi, "Jigs and Fixtures", Tata McGraw Hill;2nd ed.

**References:**

1. G. Boothroyd, "Fundamentals of Metal Machining and Machine Tools", Taylor and Francis; 3rd ed.
2. M. C. Shaw, "Metal Cutting Principles", Oxford University Press.
3. J.A. McGeough, "Advanced Methods of Machining", Springer International Edition.
4. P.C. Sharma, "A Text Book of Production Engineering", S. Chand, New Delhi;(2004)
5. H. S. Bawa, "Workshop Technology", Vol.2, Tata McGraw Hill;(2004)
6. G.K. Lal, "Introduction to Machining Science", New age International.
7. A. Bhattacharya,Metal cutting Theory and Practice- New Central Book Agency.

| Paper Code(s): MEC-208 | L | P | C |
|---|---|---|---|
| Paper: Material Science and Metallurgy | 4 | - | 4 |

**Marking Scheme:**

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

**Instructions for paper setter:**

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

**Course Objectives :**

| | |
|---|---|
| 1. | To develop the knowledge of lattice structure and their defects. |
| 2. | To develop the relation between structural and mechanical properties of metals for the selection of product design. |
| 3. | Identify the microstructure and properties of Iron-Iron carbide Phase diagram. |
| 4. | To develop the knowledge of various composite materials and their applications. |

**Course Outcomes (CO)**

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

| | |
|---|---|
| **CO 1** | Summarize the properties of crystal structures of metallic elements and understand the mechanism of diffusion and deformation. |
| **CO 2** | To relate the material behaviour under environmental conditions and interpret the characteristics of steel through iron- iron carbide and TTT diagram. |
| **CO 3** | Relate the properties of steel with heat treatment processes and study the effect of alloying elements in steel. |
| **CO 4** | Classify types of corrosion and composites. |

**Course Outcomes (CO) to Programme Outcomes (PO) mapping (Scale 1: low, 2: Medium, 3: High)**

| | PO01 | PO02 | PO03 | PO04 | PO05 | PO06 | PO07 | PO08 | PO09 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 1 | 3 | 2 | - | - | - | - | - | - | 3 | 3 |
| **CO 2** | 3 | 2 | 3 | 2 | - | - | - | - | - | - | 3 | 3 |
| **CO 3** | 3 | 2 | 3 | 2 | - | - | - | - | - | - | 3 | 3 |
| **CO 4** | 3 | - | - | 2 | - | 3 | 3 | - | - | - | 3 | 3 |

**UNIT – I**

Structure of metal: Crystal structure (BCC, FCC and HCP), Packing factor and density calculation, miller indices, imperfections in solids.

Diffusion: Diffusion mechanisms, steady state and non-steady state diffusion, factors affecting diffusion.

Deformation: Slip, twinning, critical resolved shear stress, effect of cold working and hot working on mechanical properties, principles of recovery, re-crystallization and gain growth.

**UNIT – II**

Fracture: Types of fracture- ductile and brittle, ductile to brittle transition temperature (DBTT), Fatigue- Endurance limit, S-N Curve, factors affecting fatigue.

Creep: Mechanism of creep, creep curve, basic consideration in the selection of material for high temperature service.

Equilibrium diagram: solids solutions and alloys, Gibbs phase rule, unary and binary eutectic phase diagram, lever rule, Iron- Iron carbide Phase diagram, TTT-diagram, Effect of alloying elements on TTT diagram.

**UNIT–III**

Heat Treatment: Principles and purpose of heat treatment of plain carbon steels, annealing, normalizing, hardening, tempering, quenching, austempering, martempering, case hardening processes – carburizing, nitriding, cyaniding, induction and flame hardening, Hardenability: determination of hardenability, Jominy end quench test.

Materials: Types of Plain carbon steels, effect of alloying elements on steel, Cast iron-white, grey, malleable and nodular cast iron, properties and application of cast iron, properties and uses of high speed steel, stainless steel, spring steel, Non-ferrous materials.

**UNIT– IV**

Corrosion: Types of corrosion, mechanism of corrosion, preventions against corrosion.

Introduction to composite materials- Classification, Properties and applications of composite materials.
Surface Coatings: Introduction to metallic coating and coating methods.

**Text Books (s):**

1. W. D. Callister, David G. Rethwisch, "Materials Science and Engineering: An Introduction", Wiley & Sons; 9thed. (2013).
2. K. I. Parashivamurthy, "Material Science and Metallurgy", Pearson.
3. Sidney H. Avner, "Introduction to Physical Metallurgy", Tata McGraw-Hill, New Delhi; (1997).

**Reference Books:**

1. L. Krishna Reddi, "Principles of Engineering Metallurgy", New Age Publication, New Delhi; (2001)
2. Buduisky et. al., "Engineering Materials & Properties", Prentice Hall India, New Delhi; (2004)
3. Peter Haasten, "Physical Metallurgy", Cambridge Univ. Press; (1996)
4. Raymond A. Higgin., "Engineering Metallurgy Part 1", Prentice Hall India, New Delhi; (1998)

| Paper Code(s): MEC-210 | L | P | C |
|---|---|---|---|
| Paper: Thermal Engineering – II | 4 | - | 4 |

**Marking Scheme:**

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

**Instructions for paper setter:**

1. There should be 9 questions in the term end examinations question paper.
2. The first ($1^{st}$) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

**Course Objectives :**

| | |
|---|---|
| 1. | To understand the working of steam nozzle at design condition and off design condition. To differentiate clearly between impulse and impulse-reaction turbine. |
| 2. | To understand the working of reciprocating compressor & refrigeration cycle. |
| 3. | To understand the combustion in I.C engine and appreciate the concept of knocking. |
| 4. | To be able to compute performance parameters of an I.C engine and to determine components of heat balance of given i.C engine. |

**Course Outcomes (CO)**

| | |
|---|---|
| **CO 1** | To determine the mass flow rate through steam nozzle and to be able to determine blade efficiency and stage efficiency of steam turbine blading. |
| **CO 2** | To determine work requirement of a reciprocating compressor and to analyze refrigeration system based on vapour compression refrigeration system. |
| **CO 3** | Explain the combustion in I.C engine and enumerate the factors responsible for knocking. |
| **CO 4** | Evaluate performance parameter of I.C engine and draw heat balance sheet of specified engine. |

**Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)**

| | PO01 | PO02 | PO03 | PO04 | PO05 | PO06 | PO07 | PO08 | PO09 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | 2 |
| **CO 2** | 3 | 3 | 3 | 3 | - | - | 2 | - | - | - | - | 2 |
| **CO 3** | 3 | 3 | 3 | 3 | - | - | 2 | - | - | - | - | 2 |
| **CO 4** | 3 | 3 | 3 | 3 | - | - | 2 | - | - | - | - | 2 |

**UNIT-I**

Steam Nozzle: Types of nozzles, flow of steam through nozzles, condition for maximum discharge through nozzle, nozzle efficiency, effect of friction and off design condition of convergent nozzle and convergent-divergent nozzle.

Steam Turbine: Working principle and types of steam turbines, velocity diagrams for impulse and reaction turbines, compounding of impulse turbines, optimum velocity ratio and maximum efficiency, comparison of impulse and reaction turbines, reheat factor.

**UNIT-II**

Air Compressors: Steady flow analysis, isothermal, adiabatic and polytropic compression, single- and multi-stage compression, ideal intermediate pressure, compressor clearance, volumetric and isothermal efficiency, minimum work requirement of a compressor.

Refrigeration Cycle: Vapour compression refrigeration cycle, description, analysis, refrigerating effect, power required, unit of refrigeration, COP, Refrigerants and its desirable properties. Vapor absorption refrigeration system.

**UNIT-III**

Internal Combustion Engine: Combustion in S.I. engine, Combustion in C.I. engine and its stages, Knocking in S.I. and C.I. engine and its detrimental effect, Factors affecting knocking in S.I. and C.I. engine.

**UNIT – IV**

I.C. Engine performance: Measurement of performance parameters of an engine, different methods to determine Indicated power and friction power of an engine, components of heat balance sheet of a given Engine, Ignition system, Fuel injection system, Lubrication system.

**Textbook(s):**

1. S. Domkundwar, Thermal Engineering, Dhanpat Rai & Co (p) Ltd.
2. P.K Nag, Applied Thermodynamics, Tata McGraw Hill (p) Limited.
3. Mathur & Sharma, Internal Combustion Engine, Dhanpat Rai Publication.

**References:**

1. Onkar Singh, Applied Thermodynamics, New Age International (p) Limited.
2. Cohen & Rogers, Gas Turbines, Pearson Prentice Hall, ISBN- 9780582236325.
3. R. K. Rajput, "Engineering Thermodynamics", Lakshmi Publications.
4. V.Ganesan, "Internal Combustion Engine ", Tata McGraw Hill Publishing Co., New Delhi.
5. Gordon Rosers, & Yon Mahew; Engineering Thermodynamics", Pearson.

| Paper Code(s): MEC-212 | L | P | C |
|---|---|---|---|
| Paper: Machine Design – I | 4 | - | 4 |

**Marking Scheme:**

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

**Instructions for paper setter:**

1. There should be 9 questions in the term end examinations question paper.
2. The first ($1^{st}$) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

**Course Objectives :**

| | |
|---|---|
| 1. | To understand ab-initio design concepts under various constraints, stress concentration and dynamic loading. Also analyse the design of static joints and pipes. |
| 2. | To conceptualise joints for power transmission in rotating parts, suspension parts and in leverage. |
| 3. | To analyse bolted & screwed fastenings and structural plates joining for complex engineering applications under myriad of loads. |
| 4. | To thoroughly understand the design procedure for speed variation effects in toothed elements and power screws. |

**Course Outcomes (CO)**

| | |
|---|---|
| **CO 1** | Grasp the systematic design procedure & design principles considering constraints of various methods of manufacture and effect of static & dynamic forces on joints for rods. |
| **CO 2** | Synthesis of keyed-coupled shafts and stress analysis of flexible elements & levers. |
| **CO 3** | Design analysis of fastening threads and various temporary & permanent joints for plates. |
| **CO 4** | Analyse the effect of changing speeds on designed toothed elements and efficient power transmitting devices. |

**Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)**

| | PO01 | PO02 | PO03 | PO04 | PO05 | PO06 | PO07 | PO08 | PO09 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 2 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 2 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 2 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 2 | 3 |

**UNIT-I**

Introduction: Systematic Design Process (SDP), Basic principles for mechanical design, Use of standards. Manufacturing consideration in design of casting & machining parts.

Dynamic and fluctuating stresses, fatigue failure and endurance limit, design under combined direct & varying stresses. Stress concentration, causes and remedies in design.

Factor of safety and it's affecting factors, Tolerances and fits as per BIS, Materials selection, Designation of steels.

Detailed design procedure of Spigot & Socket Cotter joint, Knuckle joint, Pipe joint. Numerical Design Problems.

**UNIT-II**

Shafts, keys and couplings: Transmission Shafts, materials, design of shafts on strength & rigidity basis and under combined torsional and bending loads as per ASME code. Keys, types and applications. Design of rigid and pin bushed flexible couplings.

Levers, types, Design of Bell crank lever.
Springs and their applications, design of close coiled helical springs. Numerical Design Problems.

**UNIT-III**

Riveted & Welded Joints: Types of riveted joints, Failure modes, strength equations, joint efficiency, Riveted joint for boiler shells, Riveted joints under direct and eccentric loads. Welded joints, strength of parallel, transverse & combined filled welded joints, axially loaded unsymmetrical welded joint, eccentrically loaded welded joints, welded joints subjected to bending moment and torsional moment.
Threaded Joints: Types of screwed fastenings, Initial tightening loads in bolts, Torque requirement, Uniform strength bolt, Direct & eccentrically loaded bolted joints. Numerical Design Problems.

**UNIT - IV**

Power Screws: Types of threads of power screws - Square, trapezoidal & Acme threads, Torque requirement, efficiency, irreversibility & self-locking, Complete analysis of design of screw jack.
Spur Gear: Classification of Gears, spur gear terminology, Gear tooth failure, Lewis equation for beam strength of tooth, dynamic and wear loads. Numerical Design Problems.

**Textbook(s):**
1. V.B. Bhandari, "Design of Machine elements", Tata McGraw Hill Education Private Ltd. Third Edition (2012)
2. Maleeve Hartman and O.P. Grover, "Machine Design", CBS Publishers& Distributors Pvt. Ltd. Sixth Edition (2015)

**References:**
1. K. Mahadevan, "Design Data Book", CBS Publishers & Distributors.
2. J.E. Shigley & C.R. Mischke, "Mechanical Engineering Design", Tata McGraw Hill Co. Inc.
3. P.C. Sharma and D.K Aggarwal., "Machine Design", S.K. Kataria & Sons.
4. R.C. Juvinal andK.M. Marshek, "Fundamentals of Machine component Design", Wiley India .
5. R.I. Norton, "Machine Design" Pearson.

btechnotes.in Wishes You Good Luck!