**Autonomous Program Structure**

**Second Year B. Tech.**
**Third Semester (Mechanical Engineering)**
**Academic Year: 2024-25 Onwards**

| Course Code | Course Title | Teaching Scheme Hours / Week | | | Cr | Examination Scheme | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P | | ISE | ESE | Pr/Or | |
| 23PCME301 | Strength of Materials | 3 | 1 | 0 | 4 | 50 | 50 | 0 | 100 |
| 23PCME302 | Manufacturing Processes and Technology | 3 | 0 | 0 | 3 | 50 | 50 | 0 | 100 |
| 23PCME303 | Engineering Thermodynamics | 2 | 1 | 0 | 3 | 50 | 50 | 0 | 100 |
| 23PCME304 | Engineering Materials | 3 | 0 | 0 | 3 | 50 | 50 | 0 | 100 |
| 23PCME305L | Material testing and characterization Laboratory | 0 | 0 | 2 | 1 | 25 | 0 | 25 | 50 |
| 23PCME306L | Manufacturing Processes-I Laboratory | 0 | 0 | 2 | 1 | 25 | 0 | 25 | 50 |
| 23OE301 | Open Elective-I | 3 | 0 | 0 | 3 | 50 | 50 | 0 | 100 |
| 23VEC301 | Universal Human Values | 2 | 1 | 0 | 3 | 50 | 50 | 0 | 100 |
| 23AEC301 | Design Thinking | 1 | 1 | 0 | 2 | 50 | 0 | 0 | 50 |
| | Total | **17** | **04** | **4** | **23** | **400** | **300** | **50** | **750** |

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## S. Y. B. Tech. – Semester-I

| Course Code 23PCME301 | Strength of Materials | L | T | P |
|---|---|---|---|---|
| | | 3 | 1 | 0 |
| **Pre-requisites** | Engineering Mechanics | | | |

**Course Objectives:** To make students learn

1. Concepts of stress, strain, principal stresses, and principal planes.
2. Concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
3. Determination of slopes and deflections in determinate beams by various methods.
4. Evaluation of stresses and deformation in circular shafts due to torsion.

**Course Outcomes:** After completing the course students will be able to

1. Determine the simple stresses and strains when members are subjected to axial loads.
2. Draw the shear force and bending moment diagrams for the beam subjected to different loading conditions.
3. Evaluate stresses induced in different cross-sectional members subjected to shear loads.
4. Evaluate the deflections in beams subjected to different loading conditions.
5. Analyze the shaft for torsion and bending.

| **Unit: 1** | **Simple Stresses & Strains** |
|---|---|

**Simple Stresses & Strains:** Elasticity and plasticity, Types of stresses & strains, Hooke's law, stress-strain diagram for mild steel, Working stress, Factor of safety, Lateral strain, Poisson's ratio & volumetric strain, Elastic moduli & the relationship between them, Bars of the varying section, composite bars, Temperature stresses, Strain energy, Resilience, Gradual, sudden, impact and shock loadings. State of stress at a point, General two-dimensional stress system, Principal stresses, and principal planes. Mohr's circle of stresses. theories of failure.

| **Unit: 2** | **Shear Force and Bending Moment Diagrams** |
|---|---|

**Shear Force and Bending Moment Diagrams:** Definition of the beam, Types of beams, Concept of shear force and bending moment, Shear force and Bending Moment diagrams for cantilever, simply supported and overhanging beams subjected to point loads, uniformly distributed load, uniformly varying loads, moment and combination of these loads, Point of contra flexure.

| **Unit: 3** | **Bending and Shear Stresses** |
|---|---|

**Bending and Shear Stresses:** Theory of simple bending, assumptions, bending equation, bending stresses, Shear Stresses, Shear stress, and bending stress for various beam sections like rectangular, circular, triangular, I, and T sections.

| **Unit: 4** | **Deflection of Beams** |
|---|---|

**Deflection of Beams:** slope, deflection, and radius of curvature, Differential equation for the elastic line of a beam, Double integration and Macaulay's methods, Determination of slope and deflection for cantilever and simply supported beams subjected to point loads uniformly distributed load, uniformly varying loads, moment and combination of these loads.

| **Unit: 5** | **Torsion in Circular Shaft** |
|---|---|

**Torsion in Circular Shaft:** Introduction, pure torsion, Assumptions, derivation of torsion equation for circular shafts, torsional rigidity and polar modulus Power transmitted by a shaft, combined bending and torsion.

**Books:**


| | |
|---|---|
| 1. | Ferdinand P. Beer, E. Russell Johnston, and Jr.John T. DeWolf "Mechanics of Materials", Tata McGraw-Hill. |
| 2. | D.H. Young, S.P. Timoshenko "Elements of Strength of Materials" East-West Press Pvt. Ltd. |
| 3. | R K Bansal, "A Textbook of Strength of Materials", 4th Edition, Laxmi Publications. |
| 4 | S.S. Rattan " Strength of Materials" McGraw Hill Education (India) Pvt. Ltd. |

| Course Code 23PCME302 | Manufacturing Processes and Technology | L | T | P |
|---|---|---|---|---|
| | | 3 | 0 | 0 |
| **Pre-requisites** | None | | | |

**Course Objectives:** To make students

1. Discuss casting, metal forming, joining, and advanced manufacturing technologies.
2. To determine the benefits, disadvantages, and potential applications of distinct methods of manufacturing.
3. To make the students develop a technique for manufacturing the components.

**Course Outcomes:** After completing the course students will be able to

1. Analyze various aspects of casting, such as design and defects.
2. Analyze forming processes (sheet metal working, forging, rolling, extrusion, and drawing) with respect to their process design.
3. Analyze the joining process parameters for the given joint design.
4. Identify unconventional machining processes required for industrial applications.
5. Select additive manufacturing processes for the given component manufacturing.

| **Unit: 1** | **Casting** |
|---|---|

Different types of casting (Die, Centrifugal, Continuous, and Investment) design of patterns, molds, and cores; solidification and cooling; riser and gating design, capabilities, and applications of casting processes, casting defects.

| **Unit: 2** | **Forming** |
|---|---|

Plastic deformation and yield criteria, the relationship between tensile and shear yield stresses, fundamentals of hot and cold working processes; load estimation for (bulk forging, rolling, extrusion, and drawing) and sheet metal forming processes (shearing, deep drawing, and bending).

| **Unit: 3** | **Joining processes** |
|---|---|

Introduction, principles of solid phase welding, principles of fusion (liquid state) welding, soldering, and brazing, adhesive bonding, various joining processes (solid phase welding at elevated temperature, Arc, Resistance, Gas, Thermit, Friction steer, Thermit, Ultrasonic, Electron Beam, Laser Beam, and Explosive welding), weld defects.

| **Unit: 4** | **Unconventional machining processes** |
|---|---|
| Introduction, the study of mechanics and process parameters of EDM, ECM, EBM, LBM, PAM, AJM, and USM. | |
| **Unit: 5** | **Additive Manufacturing** |
| Introduction, Additive manufacturing methodology, extrusion-based processes, Photo polymerization, material jetting, powder bed processes, Laminated-object manufacturing, Emerging AM applications, Direct manufacturing and rapid tooling, Design for additive manufacturing, additive manufacturing economics. | |

**Books:**


| | |
|---|---|
| 1. | Mikell P. Groover, "Groover's Principles of Modern Manufacturing SI Version", Wiley India Edition, ISBN: 978-8126573059 |
| 2. | Serope Kalpakjian and Stephen Schmid, "Manufacturing, Engineering and Technology", SI Edition, Pearson Education, ISBN: 978-9332587908 |
| 3. | Rao P N, "Manufacturing Technology", Tata McGraw Hill Publishing Co. Ltd., Volume I&II, New Delhi, ISBN: Volume I-978-1259062575, Volume II-978- 9353160524. |
| 4 | Hmt, H.M.T., Production technology. Tata McGraw–Hill Education. ISBN: 978-0070964433 |

| Course Code 23PCME303 | Engineering Thermodynamics | L | T | P |
|---|---|---|---|---|
| | | 2 | 1 | 0 |
| **Pre-requisites** | Engineering Physics, Engineering Chemistry | | | |

**Course Objectives:** To make students

1. Understand the First law of Thermodynamics
2. Understand the Second law of Thermodynamics and evaluate entropy change
3. Understand and analyze properties of pure substance and steam processes
4. Analyze thermodynamic Vapor Power Cycles such as the Carnot cycle and Rankine cycle and assess cycle performance.
5. Understand and evaluate performance parameters for Gas Power Cycles

**Course Outcomes:** After successful completion of the course students will be able to

1. Apply First law of Thermodynamics to analyze closed and open systems.
2. Interpret the Second law of Thermodynamics and evaluate entropy change.
3. Demonstrate proficiency in analyzing properties of pure substances and steam processes.
4. Analyze thermodynamic Vapor Power Cycles such as the Carnot cycle and Rankine cycle and assess cycle performance.
5. Evaluate performance parameters for Gas Power Cycles such as Otto and Diesel cycles.

| **Unit : 1** | **First Law of Thermodynamics** |
|---|---|

Joule's paddle wheel experiment, First law applied to closed system, Ideal gas laws and processes, First law applied to open system, Steady Flow Energy Equation (SFEE), SFEE applied to thermodynamic devices

| **Unit : 2** | **Second law of Thermodynamics and Entropy** |
|---|---|

Concept of Heat Engine, Refrigerator, and Heat Pump, Kelvin Plank statement and Clausius statement of second law of thermodynamics, Carnot theorem and its corollaries, Clausius inequality, Entropy – a system property, Evaluation of entropy change for solid, liquid, and ideal gas, Principle of increase of entropy, entropy generation

| **Unit : 3** | **Properties of Pure Substance and Steam Processes** |
|---|---|

Formation of steam, Properties of steam, Steam Tables and Mollier Chart, Various processes with steam as working substance, combined separating, and throttling calorimeter

| **Unit : 4** | **Vapor Power Cycles** |
|---|---|
| Carnot cycle, Rankine cycle, Effect of superheat and boiler pressure on the performance of Rankine cycle, efficiency, work ratio and specific steam consumption for Rankine cycle, Reheat and Regeneration | |
| **Unit : 5** | **Gas Power Cycles** |
| Air standard cycles - Otto cycle, Diesel cycle, Air Standard Efficiency, Mean Effective Pressure | |

**Books:**


| | |
|---|---|
| 1. | P. K. Nag, Engineering Thermodynamics, 5th Edition, Tata McGraw Hill Publications |
| 2. | C.P. Arora, Engineering Thermodynamics, Tata McGraw Hill Seshu P., "Textbook of Finite Element Analysis", PHI Learning Private Ltd., New Delhi, 2010. |
| 3. | Principles of Engineering Thermodynamics- Moran, Shapiro, Boettner, Baily Eighth Edition, Wiley Publication. |
| 4 | S. Domkundwar, C. P. Kothandaraman, Anand Domkundwar, Thermal Engineering, Dhanpat Rai Publishers |
| 5 | Cengel and Boles, „Thermodynamics – An Engineering Approach", 7th Edition, Tata Mc Graw Hill Publication. |
| 6 | Rayner Joel, "Basic Engineering Thermodynamics", Addison Wesley Longman |

| Course Code 23PCME304 | Engineering Materials | L | T | P |
|---|---|---|---|---|
| | | 3 | 0 | 0 |
| **Pre-requisites** | Engineering Physics, Engineering Chemistry | | | |

**Course Objectives:** To make students

1. Comprehensive understanding of various materials and their practical uses.
2. Obtain a thorough understanding of the principles and methods of crystallography, as well as the modes of deformation, strengthening mechanisms, and crystal flaws and imperfections.
3. Proficiency in analyzing phase diagrams and comprehending phase transitions in materials
4. Understand the impact of various heat treatment techniques on material properties.
5. Comprehend the significance of advanced materials in the current circumstances.

**Course Outcomes:** After completing the course students will be able to

1. Demonstrate a comprehensive understanding of the properties and practical applications of various materials including metals, ceramics, polymers andcomposites.
2. Apply principles and methods of crystallography to analyze crystal structures, identify crystal defects, and understand deformation mechanisms and strengthening processes in materials.
3. Interpret phase diagrams and predict phase transitions in materials systems, including solid-state transformations and equilibrium phase relationships.
4. Evaluate the effects of different heat treatment techniques, on the microstructure and mechanical properties of materials.
5. Recognize the significance of advanced materials, such as nanomaterials, biomaterials, and smart materials, in addressing contemporary challenges and advancing technological innovations.

| **Unit: 1** | **Materials and Applications** |
|---|---|

**Metals and Alloys:** Ferrous and Non-Ferrous properties and their applications.
**Plastics:** Thermosetting and Thermoplastics along with examples; properties and applications.
**Ceramics:** Classification, properties and its applications.
**Composites:** Metal matrix based, Polymer matrix-based, ceramic matrix based with examples and applications.

| **Unit: 2** | **Crystal Structure and Imperfections** |
|---|---|

| | |
|---|---|
| **Crystal Structure**: Study of Crystal structure BCC, FCC, HCP and lattice parameters and properties, Miller Indices.<br>**Defects (Imperfection) in Crystal**: Point, Line, Surface, Volume.<br>**Deformation and work hardening, Strengthening mechanisms.** | |
| **Unit: 3** | **Solid Solutions and Iron-Iron Carbide Phase Diagram** |
| **Solid solutions**: Types and Hume-Rothery rule for Substitutional solid solutions<br>**Solidification**: Nucleation & crystal growth.**Iron-Carbon System**: Basic terminology, Gibbs Phase rule, Iron-Iron Carbide Phase Diagram in detail with emphasis on the invariant reactions. | |
| **Unit: 4** | **Heat treatment Processes** |
| **Diffusion**: Diffusion Mechanism<br>**Heat Treatment Processes**: Introduction, Annealing and its types, Normalising, Hardening, Tempering, Quenching, Austempering and Martempering.<br>**Surface Hardening**: Classification, Carburising, Nitriding, Carbonitriding, Flame hardening and Induction hardening. | |
| **Unit: 5** | **Advanced materials** |
| **Advanced steels:** with examples and applications,<br>**Superalloys:** classification with applications, Basic properties of **superconducting** materials along its classification and uses, Science of **Nanomaterials**,<br>**Biomaterials, and implants** along with applications.<br>Phase change materials and their advantages and uses.<br>**Functionally graded materials** and **Metamaterials** along with their features and uses. | |
| **Books:** | |
| 1. | Dr. V. D. Kodgire & S. V. Kodgire, "Material Science & Metallurgy For Engineers", Everest Publication. |
| 2. | William D. Callister, "Materials Science and Engineering an Introduction", Jr, John Wiley &Sons, Inc. |
| 3 | Mechanical Metallurgy, George E. Dieter, McGraw Hill, 2017 |
| 4 | Raghvan V., "Material Science & Engineering", Prentice Hall of India, New Delhi. 2003. |

| Course Code 22PCME305L | Material Testing and Characterization Laboratory | L | T | P |
|---|---|---|---|---|
| | | 0 | 0 | 2 |
| **Pre-requisite** | | | | |

**Course Objectives:** To make students

1. Understand various mechanical property measurement techniques.
2. Observe the fractographic features in materials.
3. Analyzing various nondestructive testing methods.
4. Preparation of specimens for microstructural characterization.
5. Importance of heat treatment processes on properties of materials.

**Course Outcomes:** Students will be able to

1. Measurement of various mechanical properties required for material selection.
2. Analyzing fracture behavior under various loading conditions.
3. Inspection of surface and sub-surface defects present in materials.
4. Determining microstructure in metals and alloys using metallographic techniques.
5. Modifying various properties in materials using heat treatment processes.

**Lab Work**

| | |
|---|---|
| 1 | Perform a Tensile test of the given specimen and evaluate the following parameters: (a) yield strength (b) ultimate tensile strength (c) fracture strength (d) Percentage elongation (e) percentage reduction in area. |
| 2 | Examine the variation of Brinell hardness number with applied load for given samples. |
| 3 | Study the variation of Vickers hardness number with applied load for given specimens. |
| 4 | Evaluate the Rockwell hardness number of the given sample using the appropriate scale. |
| 5 | Determine the impact energy and observe the nature of the fracture surface of given specimens using an Izod impact testing machine. |
| 6 | Inspect surface flaws and cracks present in a given sample using a dye penetrant test. |
| 7 | Detect surface/subsurface flaws and cracks in the given magnetic specimen using Magnetic particle testing. |
| 8 | Using an Ultrasonic Flaw Detector detects the flaw in a given specimen. |

| | |
|---|---|
| 9 | Prepare the steel and cast iron samples for optical microscopic examination and comment on their microstructures. |
| 10 | Perform and evaluate the Hardenability of a given specimen with the help of the Jominy End Quench test. |
| **Books:** | |
| 1 | Dr. V. D. Kodgire & S. V. Kodgire, "Material Science & Metallurgy For Engineers", Everest Publication. |
| 2 | William D. Callister, "Materials Science and Engineering an Introduction", Jr, John Wiley &Sons, Inc. |
| 3 | Mechanical Metallurgy, George E. Dieter, McGraw Hill, 2017 |
| 4 | Raghvan V., "Material Science & Engineering", Prentice Hall of India, New Delhi. 2003. |

| Course Code 22PCME306L | Manufacturing Processes - I Lab | L | T | P |
|---|---|---|---|---|
| | | 0 | 0 | 2 |
| **Pre-requisite** | None | | | |

**Course Objectives:** To make students

1. To discuss metal forming, and joining manufacturing technologies.
2. To determine the benefits, disadvantages, and potential applications of distinct methods of manufacturing.
3. To make the students develop a technique for manufacturing the components.

**Course Outcomes:** Students will be able to

1. Identifying the suitable manufacturing process for the effective fabrication of engineering components.
2. Perform different machining operations on Machine tools for the manufacturing of components.
3. Program CNC lathe for manufacturing of required components.
4. Utilize joining processes for fabrication of given assembly.

**Lab Work**

| | |
|---|---|
| 1. | Demonstration of physical hazards, safety, and precautions. |
| 2. | To manufacture assembly of a minimum 6 number of components such as press tool, Oldham coupling, and wheel support assembly. Which involves the use of various machine tools such as lathe, milling, drilling, CNC, and manufacturing processes such as welding techniques out of TIG/ MIG/Resistance/Gas welding. |

**Books:**


| | |
|---|---|
| 1. | Mikell P. Groover, "Groover's Principles of Modern Manufacturing SI Version", Wiley India Edition, ISBN: 978-8126573059 |
| 2. | Serope Kalpakjian and Stephen Schmid, "Manufacturing, Engineering and Technology", SI Edition, Pearson Education, ISBN: 978-9332587908 |
| 3. | Rao P N, "Manufacturing Technology", Tata McGraw Hill Publishing Co. Ltd., Volume I&II, New Delhi, ISBN: Volume I-978-1259062575, Volume II-978- 9353160524. |
| 4. | Hmt, H.M.T., Production technology. Tata McGraw–Hill Education. ISBN: 978-0070964433 |

| 23VEC301 : Universal Human Values 2 | | | |
|---|---|---|---|
| **Teaching Scheme** | | | **Examination Scheme** |
| Lectures: 2 Hours / Week | | | ISE: 50 Marks |
| Tutorial: 1 Hour/Week | | | ESE: 50 Marks |

| **Course Objectives:** | |
|---|---|
| 1 | To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings. |
| 2 | To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. |
| 3 | To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature. |
| | |

| **Course Outcomes:** | |
|---|---|
| After completion of the course, students will be able to | |
| CO1 | Understand the significance of value inputs in formal education and start applying them intheir life and profession |
| CO2 | Distinguish between values and skills, happiness and accumulation of physical facilities, theSelf and the Body, Intention and Competence of an individual, etc. |
| CO3 | Analyze the value of harmonious relationship based on trust and respect in their life andprofession |
| CO4 | Examine the role of a human being in ensuring harmony in society and nature. |
| CO5 | Apply the understanding of ethical conduct to formulate the strategy for ethical life andprofession. |

| **Unit I:** | **Introduction to Value Education** |
|---|---|
| Understanding Value Education, Self exploration as the Process for Value Education, Continuous Happiness and Prosperity which is the Basic Human Aspirations, Right Understanding, Relationship and Physical Facility, Current Scenario for Happiness and Prosperity, Method to Fulfill the Basic Human Aspirations. | |

| | |
|---|---|
| **Unit II:** | **Harmony in the Human Being** |
| Understanding Human being as the Co-existence of the Self and the Body, distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Program to ensure self-regulation and Health. | |
| | |
| **Unit III:** | **Harmony in the Family and Society** |
| Harmony in the Family, Family being the Basic Unit of Human Interaction, Values in Human-to-Human Relationship, Trust which is the Foundational Value in Relationship, Respect as the Right Evaluation, Understanding Harmony in the Society, Vision for the Universal Human Order. | |
| | |
| **Unit IV:** | **Harmony in the Nature or Existence** |
| Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels and the Holistic Perception ofHarmony in Existence. | |
| | |
| **Unit V:** | **Implications of the Holistic Understanding, a Look at Professional Ethics** |
| Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human order, Competence in Professional Ethics, Holistic Technologies, Production Systems and Management Models, Typical Case Studies with Strategies for Transition towards Value-based Life and Profession. | |
| | |
| **Text Books:** | |
| 1. | R. R. Gaur, R. Asthana, G. P. Bagaria, **"The Textbook A Foundation Course in Human Valuesand Professional Ethics"**, Excel Books, New Delhi, (2nd Revised Edition), (2019). |
| 2. | R. R. Gaur, R. Asthana, G. P. Bagaria, **"Teachers' Manual for A Foundation Course in HumanValues and Professional Ethics",** Excel Books, New Delhi, (2nd Revised Edition), (2019). |
| **Reference Books:** | |
| 1. | A. Nagaraj,**"Jeevan Vidya: EkParichaya"**, Jeevan Vidya Prakashan, Amarkantak, (1999). |
| 2. | A.N. Tripathi, **"Human Values"**, New Age Intl. Publishers, New Delhi, (2004). |
| 3. | Mohandas Karamchand Gandhi, **"The Story of My Experiments with Truth",** Prakash booksPublishers, Daryaganj, New Delhi, (1983). |
| 4. | E. F. Schumacher, **"Small is Beautiful"**, Harper CollinsPublishers, Noida, Uttar Pradesh, (2010). |
| 5. | Cecile Andrews, **"Slow is Beautiful"**, New Society Publishers, Canada, (2006). |
| 6. | J. C. Kumarappa, **"Economy of Permanence", ,** Sarva Seva Sangh Prakashan, Wardha, Sevagram,(2017). |

| | |
|---|---|
| 7. | Pandit Sunderlal ,**"Bharat Mein Angreji Raj",** Prabhat Prakashan, New Delhi (2018). |
| 8. | Dharampal,**"Rediscovering India",** Society for Integrated Development of Himalayas, (2003). |
| 9. | Mohandas Karamchand Gandhi, **" Hind Swaraj or Indian Home Rule",** Navajivan PublicationHouse, Ahemadabad (2003). |
| 10. | Maulana Abdul Kalam Azad**, "India Wins Freedom",** Orient BlackSwan, (1989) |
| 11. | Romain Rolland**, " Swami Vivekananda",** Advaita Ashram Publication Ramkrishna Math, (2nd Edition), (2010). |
| 12. | Romain Rolland, "**Gandhi",** Srishti Publishers & Distributor, (2002). |
| 13. | Annie Leonard, "**The story of stuff**", Little, Brown Book Group, (2005). |
| **Online Resources:** | |
| NPTEL course on Humanities and social sciences<br>https://nptel.ac.in/courses/109/104/109104068/ | |

| Course Code 23AEC301 | **Design Thinking** | L | T | P |
|---|---|---|---|---|
| | | 1 | 1 | 0 |
| **Pre-requisites** | | | | |

**Course Objectives:** To make students learn

1. Design Thinking process
2. User centric approach for designing a solution.
3. Problem analysis with various methods
4. Applications of Design Thinking

**Course Outcomes:** After completing the course students will be able to

1. Apply the design process for real world problems.
2. Apply types of thinking ideas into visuals or prototypes.
3. Analyze problems with various methods and approaches for innovative user centric solutions.
4. Recommend a solution based on stages of Design Thinking.

| **Unit: 1** | **Introduction to Design thinking** |
|---|---|

Human Centred Design approach, Concept of Design Thinking. Features of Design Thinking, Process of thinking, Creative thinking, Lateral thinking, User centric approach and personas, Thinking hats.

| **Unit: 2** | **Stages of Design Thinking** |
|---|---|

Empathy: Difference Between Empathy and Sympathy, Empathy Techniques, Empathy Maps, define: Identification of Problem, Defining and Refining of Problem Statement, Ideate: Process of Ideation, Prototyping, Testing.

| **Unit: 3** | **Design thinking approaches** |
|---|---|

Visualization, Journey Mapping, Value Chain Analysis, Mind Mapping, Development, Assumption Testing, Prototype, Co-Creation, Learning Launches, Story Telling.

| **Unit: 4** | **Design Thinking for Strategic Innovations and its applications** |
|---|---|

Strategic Management, Innovation Management, Frameworks for Innovation, Types of Innovations: Disruptive vs. Sustaining innovation, Radical vs. incremental innovation, Architectural vs. Modular Innovation, The Innovation Matrix, Business Model Innovation

Applications: Product Development, Process Development, Service Management.

| **Books:** | |
|---|---|
| 1. | Bryan Lawson, "How designers think: The design process demystified", 4th Edition, Butterworth Architecture |
| 2. | Nigel Cross, "Design Thinking", Berg Publishers – 2011 |
| 3. | Makarand Ramesh Velankar, Leena Manojkumar Panchal, "Design Thinking Primar", Techknowledge Publications- September 2023, ISBN: 978-93-5563-711-6 |
| 4 | Ben Crothers, "Design Thinking Fundamentals", O'Reily |
| 5 | Tim Brown, "Change by Design: How Design Thinking Transforms Organizations", HarperCollins – 2009 |
| 6 | Susan Weins Chenk, "Hundred things every designer needs to know about people", New Riders Publication |
| 7 | Vijay Kumar, "101 Design Methods: A Structured Approach for Driving Innovation in Your Organization", Wiley Publication |
| 8 | Roger L. Martin, "Design of Business: Why Design Thinking is the Next Competitive Advantage" Harvard Business Press |
| 9 | Karl Ulrich, "Design: Creation of Artifacts in Society" - 2011 |
| 10 | Bala Ramadurai, "Karmic Design Thinking" |
| 11 | T. Amabile, "How to kill creativity", SAGE Publication - 2006 |
| 12 | William Lidwell, Kritina Holden, Jill Butler, "Universal principles of Design ", Rockport Publishers |
| 13 | Bella Martin, Bruce Hanignton, Bruce M Hanington "Universal methods of design", Rockport Publishers - 2012 |
| 14 | Roman Kizanie, "Empathy: Why it matters, how to get it", Tarcher Perigee Publishers |
| 15 | Karla McLaren, "The Art of Empathy: A complete Guide to life's most essential skill", Sounds True Publishers |