**VII Semester** **OPEN ELECTIVE II**

| **NON-TRADITIONAL MACHINING** | | | |
|---|---|---|---|
| Course Code | **21ME751** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3-0-0-0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course objectives:**

- To learn various concepts related to modern machining processes & their applications.
- To appreciate the differences between conventional and non-conventional machining processes.
- To acquire a functional understanding of non-traditional manufacturing equipment.
- To know about various process parameters and their influence on performance and their applications.
- To impart knowledge on various types of energy involved in non-traditional machining processes.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

16. Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
17. Chalk and Talk method for Problem Solving.
18. Adopt flipped classroom teaching method.
19. Adopt collaborative (Group Learning) learning in the class.
20. Adopt Problem Based Learning (PBL), which fosters students' analytical skills and develops thinking skills such as evaluating, generalizing, and analysing information.

**Module-1**

Introduction to Non-traditional machining, Need for Non-traditional machining process, Comparison between traditional and non-traditional machining, general classification Non-traditional machining processes, classification based on nature of energy employed in machining, selection of non-traditional machining processes, Specific advantages, limitations and applications of non-traditional machining processes.

| | |
|---|---|
| **Teaching-Learning Process** | 1. Power-point Presentation,<br>2. Video demonstration or Simulations,<br>3. Chalk and Talk are used for Problem Solving./White board |

**Module-2**

Ultrasonic Machining (USM): Introduction, Equipment and material process, Effect of process parameters:
Effect of amplitude and frequency, Effect of abrasive grain diameter, effect of slurry, tool & work material.
Process characteristics: Material removal rate, tool wear, accuracy, surface finish, applications, advantages & limitations of USM.

Abrasive Jet Machining (AJM): Introduction, Equipment and process of material removal, process variables: carrier gas, type of abrasive, work material, stand-off distance (SOD). Process characteristics-Material removal rate, Nozzle wear, accuracy & surface finish. Applications, advantages & limitations of AJM.

| | |
|---|---|
| **Teaching-Learning Process** | . 1. Power-point Presentation,<br>2. Video demonstration or Simulations,<br>3. Chalk and Talk are used for Problem Solving./White board |

| Module-3 | |
|---|---|
| ELECTROCHEMICAL MACHINING (ECM): Introduction, Principle of electro chemical machining, ECM, elements of ECM operation, Chemistry of ECM. ECM Process characteristics: Material removal rate, accuracy, surface finish. Process parameters: Current density, Tool feed rate, Gap between tool & work piece, velocity of electrolyte flow, type of electrolyte, its concentration temperature, and choice of electrolytes. ECM Tooling: ECM tooling technique & example, Tool & insulation materials. Applications ECM:<br>Electrochemical grinding and electrochemical honing process. Advantages, disadvantages and application of ECG, ECH.<br>CHEMICAL MACHINING (CHM): Elements of the process, Resists (maskants), Etchants. Types of chemical machining process-chemical blanking process, chemical milling process. Process characteristics of CHM: material removal rate, accuracy, surface finish, advantages, limitations and applications of chemical machining process. | |
| **Teaching-Learning Process** | 1. Power-point Presentation,<br>2. Video demonstration or Simulations,<br>3. Chalk and Talk are used for Problem Solving./White board |
| **Module-4** | |
| ELECTRICAL DISCHARGE MACHINING (EDM): Introduction, mechanism of metal removal, EDM equipment: spark erosion generator (relaxation type), dielectric medium-its functions & desirable properties, electrode feed control system. Flushing types; pressure flushing, suction flushing, side flushing, pulsed flushing. EDM process parameters: Spark frequency, current & spark gap, surface finish, Heat Affected Zone. Advantages, limitations & applications of EDM, Electrical discharge grinding, Traveling wire EDM.<br>PLASMA ARC MACHINING (PAM): Introduction, non-thermal generation of plasma, equipment mechanism of metal removal, Plasma torch, process parameters, process characteristics. Safety precautions. Safety precautions, applications, advantages and limitations. | |
| **Teaching-Learning Process** | 1. Power-point Presentation,<br>2. Video demonstration or Simulations,<br>3. Chalk and Talk are used for Problem Solving./White board |
| **Module-5** | |
| LASER BEAM MACHINING (LBM): Introduction, generation of LASER, Equipment and mechanism of metal removal, LBM parameters and characteristics, Applications, Advantages & limitations.<br>ELECTRON BEAM MACHINING (EBM): Introduction, Principle, equipment and mechanism of metal removal, applications, advantages and limitations. | |
| **Teaching-Learning Process** | 1. Power-point Presentation,<br>2. Video demonstration or Simulations,<br>3. Chalk and Talk are used for Problem Solving./White board |

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to :

- Understand the compare traditional and non-traditional machining process and recognize the need for Non-traditional machining process.
- Understand the constructional features, performance parameters, process characteristics, applications, advantages and limitations of USM, AJM and WJM.
- Identify the need of Chemical and electro-chemical machining process along with the constructional features, process parameters, process characteristics, applications, advantages and limitations.
- Understand the constructional feature of the equipment, process parameters, process characteristics, applications, advantages and limitations EDM & PAM.
- Understand the LBM equipment, LBM parameters, and characteristics. EBM equipment and mechanism of metal removal, applications, advantages and limitations LBM & EBM.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% ( 18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5$^{th}$ week of the semester
- Second test at the end of the 10$^{th}$ week of the semester
- Third test at the end of the 15$^{th}$ week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4$^{th}$ week of the semester
- Second assignment at the end of 9$^{th}$ week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

- At the end of the 13$^{th}$ week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

35. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be reduced proportionally to 50 marks
36. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Books**

1 Modern Machining Process by P.C Pandey and H S Shah McGraw Hill Education India Pvt. Ltd. 2000

2 Production technology HMT McGraw Hill Education India Pvt. Ltd 2001

**Reference Books**

1 New Technology Dr. Amitabh Bhattacharyya The Institute of Engineers (India) 2000

2 Modern Machining process Aditya 2002

**Web links and Video Lectures (e-Resources):**

- .

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Case studies
- Quiz
- Topic Seminar presentation
- Assignments

**VII Semester**

| HYDRAULICS AND PNEUMATICS | | | |
|---|---|---|---|
| Course Code | **21ME752** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3-0-0-0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course objectives:**

**This course will enable students to:**

- Gain knowledge of basics of hydraulic and pneumatic systems.
- Understanding the working principles of hydraulics and pneumatics components.
- Engineering application of hydraulic and pneumatic systems.

**Teaching-Learning Process (General Instructions)**

These are sample strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Adopt flipped classroom teaching method.
4. Adopt collaborative (Group Learning) learning in the class.
5. Adopt Problem Based Learning (PBL), which fosters students' analytical skills and develops thinking skills such as evaluating, generalizing, and analysing information.

**Module-1**

**Introduction to Hydraulic Power:** Definition of hydraulic system, advantages, limitations, applications, Pascal's law, structure of hydraulic control system, problems on Pascal's law.

**The source of Hydraulic Power:** Pumps Classification of pumps, Pumping theory of positive displacement pumps, construction and working of Gear pumps, Vane pumps, Piston pumps, fixed and variable displacement pumps, Pump performance characteristics, pump Selection factors, problems on pumps.

| | |
|---|---|
| **Teaching-Learning Process** | 1. Power-point Presentation,<br>2. Video demonstration.<br>3. Chalk and Talk . |

**Module-2**

**Hydraulic Actuators and Motors:** Classification cylinder and hydraulic motors, Linear Hydraulic Actuators [cylinders], single and double acting cylinder, Mechanics of Hydraulic Cylinder Loading, mounting arrangements, cushioning, special types of cylinders, problems on cylinders, construction and working of rotary actuators such as gear, vane, piston motors, Hydraulic Motor Theoretical Torque, Power and Flow Rate, Hydraulic Motor Performance, problems, symbolic representation of hydraulic actuators (cylinders and motors).

**Control Components in Hydraulic Systems:** Classification of control valves, Directional Control Valves- Symbolic representation, constructional features of poppet, sliding spool, rotary type valves solenoid and pilot operated DCV, shuttle valve, check valves, Pressure control valves - types, direct operated types and pilot operated types. Flow Control Valves -compensated and non-compensated FCV, needle valve, temperature compensated, pressure compensated, pressure and temperature compensated FCV, symbolic representation.

| | |
|---|---|
| **Teaching-Learning Process** | 1. Power-point Presentation,<br>2. Video demonstration.<br>3. Chalk and Talk . |

**Module-3**

**Hydraulic Circuit Design And Analysis:** Control of Single and Double -Acting Hydraulic Cylinder, Regenerative circuit, Pump Unloading Circuit, Double Pump Hydraulic System, Counter balance Valve Application, Hydraulic Cylinder Sequencing Circuits, Automatic cylinder reciprocating system, Locked Cylinder using Pilot check Valve, Cylinder synchronizing circuit using different methods, factors affecting synchronization, Speed Control of Hydraulic Cylinder, Speed Control of Hydraulic Motors, Safety circuit, Accumulators, types, construction and applications with circuits.

**Maintenance of Hydraulic System:** Hydraulic Oils - Desirable properties, general type of Fluids, Sealing Devices, Reservoir System, Filters and Strainers, wear of Moving Parts due to solid - particle Contamination,temperature control (heat exchangers), Pressure switches, trouble shooting.

| | |
|---|---|
| **Teaching-Learning Process** | 1. Power-point Presentation,<br>2. Video demonstration.<br>3. Chalk and Talk . |

**Module-4**

**Introduction to Pneumatic Control:** Definition of pneumatic system, advantages, limitations, applications, Choice of working medium Characteristic of compressed air. Structure of Pneumatic control System,fluid conditioners and FRL unit. Pneumatic Actuators: Linear cylinder - Types, Conventional type of cylinder- working, End position cushioning, seals, mounting arrangements- Applications. Rod - Less cylinders types, working, advantages, Rotary cylinders- types construction and application, symbols.

**Pneumatic Control Valves:** DCV such as poppet, spool, suspended seat type slide valve, pressure control valves, flow control valves, types and construction, use of memory valve, Quick exhaust valve, time delay valve, shuttle valve, twin pressure valve, symbols. Simple Pneumatic Control: Direct and indirect actuation pneumatic cylinders, speed control of cylinders - supply air throttling and Exhaust air throttling and Exhaust air throttling.

| | |
|---|---|
| **Teaching-Learning Process** | 1. Power-point Presentation,<br>2. Video demonstration.<br>3. Chalk and Talk . |

**Module-5**

**Signal Processing Elements:** Use of Logic gates - OR and AND gates in pneumatic applications. Practical Examples involving the use of logic gates, Pressure dependant controls- types - construction - practical applications, Time dependent controls principle, Construction, practical applications.

Multi- Cylinder Application: Coordinated and sequential motion control, Motion and control diagrams. Signal elimination methods, Cascading method- principle, Practical application examples (up to two cylinders) using cascading method (using reversing valves).

**Electro- Pneumatic Control:** Principles - signal input and output, pilot assisted solenoid control of directional control valves, Use of relay and contactors. Control circuitry for simple signal cylinder application.

| | |
|---|---|
| **Teaching-Learning Process** | 1. Power-point Presentation,<br>2. Video demonstration.<br>3. Chalk and Talk . |

**Course outcomes (Course Skill Set):**

At the end of the course the student will be able to:

28. Have knowledge of hydraulic and pneumatic system and its components.
29. Understand the working principle of various hydraulic and pneumatic components.
30. Apply working principles of Hydraulic and Pneumatic Systems for various applications.
31. Determine cause for hydraulic and pneumatic system break down and performance of hydraulic pumps, motors.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% ( 18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

- At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

37. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be reduced proportionally to 50 marks
38. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks**

4. Fluid Power with Applications, Anthony Esposit,Pearson Education Inc., 6th Edition 2000.
5. Pneumatics and Hydraulics, Andrew Parr, Jaico Publishing Co, 1993.

**Reference books**

3. Industrial Hydraulics, Pippenger Hicks, McGraw Hill, New York
4. Hydraulic & Pneumatic Power for Production, HarryL. Stewart,Industrial Press US, 1997.
5. Pneumatic Systems, S. R. Majumdar, TATA McGraw Hill Publish, 1995.
6. Hydraulic & Pneumatics' CMTI Data Book.

**Web links and Video Lectures (e-Resources):**

- .

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Case studies
- Quiz
- Topic Seminar presentation
- Assignments

**VII Semester**

| OPERATIONS RESEARCH | | | |
|---|---|---|---|
| Course Code | **21ME753** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3-0-0-0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course objectives:**

- To enable the students to understand the scientific methods of providing various departments of an organization with a quantitative basis of decision making.
- To enable the students to understand the importance of various tools and techniques in finding optimal solutions to problems involving limited resources in the form of Men, Materials and machinery.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

21. Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
22. Chalk and Talk method for Problem Solving.
23. Adopt flipped classroom teaching method.
24. Adopt collaborative (Group Learning) learning in the class.
25. Adopt Problem Based Learning (PBL), which fosters students' analytical skills and develops thinking skills such as evaluating, generalizing, and analysing information.

**Module-1**

Introduction: Evolution of OR, Definitions of OR, Scope of OR, Applications of OR, Phases in OR study. Characteristics and limitations of OR, models used in OR, Linear Programming Problem (LPP), Generalized LPP- Formulation of problems as L.P.P. Solutions to LPP by graphical method (Two Variables).

| | |
|---|---|
| **Teaching-Learning Process** | 1. Power-point Presentation,<br>2. Video demonstration or Simulations,<br>3. Chalk and Talk are used for Problem Solving./White board |

**Module-2**

LPP: Simplex method, Canonical and Standard form of LP problem, slack, surplus and artificial variables, Solutions to LPP by Simplex method, Big-M Method and two-phase Simplex Method, Degeneracy in LPP. Concept of Duality, writing Dual of given LPP. Solutions to L.P.P by Dual Simplex Method.

| | |
|---|---|
| **Teaching-Learning Process** | . 1. Power-point Presentation,<br>2. Video demonstration or Simulations,<br>3. Chalk and Talk are used for Problem Solving./White board |

**Module-3**

Transportation Problem: Formulation of transportation problem, types, initial basic feasible solution using North-West Corner rule, Vogel's Approximation method. Optimality in Transportation problem by Modified Distribution (MODI) method. Unbalanced T.P. Maximization T.P. Degeneracy in transportation problems, application of transportation problem. Assignment Problem-Formulation, Solutions to assignment problems by Hungarian method, Special cases in assignment problems, unbalanced, Maximization assignment problems. Travelling Salesman Problem (TSP). Difference between assignment and T.S.P, Finding best route by Little's method. Numerical Problems.

| | |
|---|---|
| **Teaching-Learning Process** | 1. Power-point Presentation,<br>2. Video demonstration or Simulations,<br>3. Chalk and Talk are used for Problem Solving./White board |

**Module-4**

| | |
|---|---|
| Network analysis: Introduction, Construction of networks, Fulkerson's rule for numbering the nodes, AON and AOA diagrams; Critical path method to find the expected completion time of a project, determination of floats in networks, PERT networks, determining the probability of completing a project, predicting the completion time of project; Cost analysis in networks. Crashing of networks- Problems.<br>Queuing Theory: Queuing systems and their characteristics, Pure-birth and Pure-death models (only equations), Kendall & Lee's notation of Queuing, empirical queuing models – Numerical on M/M/1 and M/M/C Queuing models. | |
| **Teaching-Learning Process** | 1. Power-point Presentation,<br>2. Video demonstration or Simulations,<br>3. Chalk and Talk are used for Problem Solving./White board |
| **Module-5** | |
| Game Theory: Definition, Pure Strategy problems, Saddle point, Max-Min and Min-Max criteria, Principle of Dominance, Solution of games with Saddle point. Mixed Strategy problems. Solution of 2X2 games by Arithmetic method, Solution of 2Xn m and mX2 games by graphical method. Formulation of games.<br>Sequencing: Basic assumptions, Johnson's algorithm, sequencing 'n' jobs on single machine using priority rules, sequencing using Johnson's rule-'n' jobs on 2 machines, 'n' jobs on 3 machines, 'n' jobs on 'm' machines. Sequencing of 2 jobs on 'm' machines using graphical method. | |
| **Teaching-Learning Process** | 1. Power-point Presentation,<br>2. Video demonstration or Simulations,<br>3. Chalk and Talk are used for Problem Solving./White board |

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to :

- Understand the meaning, definitions, scope, need, phases and techniques of operations research.
- Formulate as L.P.P and derive optimal solutions to linear programming problems by graphical method, Simplex method, Big-M method and Dual Simplex method.
- Formulate as Transportation and Assignment problems and derive optimum solutions for transportation, Assignment and travelling salesman problems.
- Solve problems on game theory for pure and mixed strategy under competitive environment.
- Solve waiting line problems for M/M/1 and M/M/K queuing models.
- Construct network diagrams and determine critical path, floats for deterministic and PERT networks including crashing of Networks

Determine minimum processing times for sequencing of n jobs-2 machines, n jobs-3 machines, n jobs-m machines and 2 jobs-n machines using Johnson's algorithm.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% ( 18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

- At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

39. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be reduced proportionally to 50 marks
40. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Books**

Textbook/s

1 Operations Research P K Gupta and D S Hira S. Chand and Company LTD. Publications, New Delhi 2007

2 Operations Research, An Introduction Hamdy A. Taha PHI Private Limited Seventh Edition, 2006

Reference Books

1 Operations Research, Theory and Applications J K Sharma Trinity Press, Laxmi Publications Pvt.Ltd. Sixth Edition, 2016

2 Operations Research Paneerselvan PHI

3 Operations Research A M Natarajan, P Balasubramani Pearson Education, 2005

4 Introduction to Operations Research Hillier and Lieberman McGraw Hill 8thEd

**Web links and Video Lectures (e-Resources):**

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Case studies
- Quiz
- Topic Seminar presentation
- Assignments

| Product Design and Development (Open Elective Course) | | | |
|---|---|---|---|
| Course Code | **21ME754** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 2:0:2:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | -- | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course objectives:**

1. To prepare students to excel in new product design and development through application of knowledge and practical skills.
2. To provide students with a solid foundation in mathematical modeling of engineering problems required for bringing new products fast into the market.

**Teaching-Learning Process (General Instructions)**
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

| **Module-1** | **8 Hours** |
|---|---|
| **Introduction:** Characteristics of successful product development, Design and development of products, duration and cost of product development, the challenges of product development.<br><br>**Development Processes and Organizations:** A generic development process, concept development: the front-end process, adopting the generic product development process, the AMF development process, product development organizations, the AMF organization. | |
| **Teaching-Learning Process** | Chalk and talk method / PowerPoint Presentation |

| **Module-2** | **8 Hours** |
|---|---|
| **Product Planning:**<br><br>The product planning process, identify opportunities. Evaluate and prioritize projects, allocate resources and plan timing, complete pre project planning, reflect all the results and the process. | |
| **Teaching-Learning Process** | Chalk and talk method / PowerPoint Presentation |

| **Module-3** | **8 Hours** |
|---|---|
| **Identifying Customer Needs:**<br><br>Gather raw data from customers, interpret raw data in terms of customer needs, organize the needs into a hierarchy, establish the relative importance of the needs and reflect on the results and the process. Product Specifications: What are specifications, when are specifications established, establishing target specifications, setting the final specifications. Concept Generation: The activity of concept generation, clarifies the problem, search externally, search internally, explore systematically, reflect on the results and the process. | |
| **Teaching-Learning Process** | Chalk and talk method / PowerPoint Presentation |

| **Module-4** | **8 Hours** |
|---|---|
| **Concept Selection:**Overview of methodology, concept screening, and concept scoring,<br><br>**Concept Testing:**Define the purpose of concept test, choose a survey population, choose a survey format, communicate the concept, measure customer response, interpret the result, reflect on the results and the process. | |
| **Teaching-Learning Process** | Chalk and talk method / PowerPoint Presentation |

| **Module-5** | **8 Hours** |
|---|---|
| **Product Architecture:**What is product architecture, implications of the architecture, establishing the architecture, variety and supply chain considerations, platform planning, related system level design issues. | |
| **Teaching-Learning Process** | Chalk and talk method / PowerPoint Presentation |

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to :

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% ( 18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5$^{th}$ week of the semester
- Second test at the end of the 10$^{th}$ week of the semester
- Third test at the end of the 15$^{th}$ week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4$^{th}$ week of the semester
- Second assignment at the end of 9$^{th}$ week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

- At the end of the 13$^{th}$ week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module.

**Suggested Learning Resources:**

**Text Book:**

1. Product Design and Development - Karl.T.Ulrich, Steven D Eppinger - Irwin McGrawHill - 2000.

**Reference books:**

1. Product Design and Manufacturing - A C Chitale and R C Gupta, PH1, - 3rd Edition, 2003.
2. New Product Development - Timjones. Butterworth Heinmann -Oxford. UCI -1997
3. Product Design for Manufacture and Assembly - GeofferyBoothroyd, Peter Dewhurst and Winston Knight - 2002

**Web links and Video Lectures (e-Resources):**