# Curriculum Structure and Evaluation Scheme for M. Tech. in Mechanical Production Engineering with Multidisciplinary Minor

(To be implemented for 2025-2027 Batch)

HOD
DEPT. OF MACHANICAL ENGINEERING
SHRI BALASAHEB MANE SHIKSHAN PRASARAK MANDAL'S
ASHOKRAO MANE GROUP OF INSTITUTIONS

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(To be implemented for 2025-2027 Batch)

# ABBREVIATIONS

- **L:** Lecture
- **T:** Tutorial
- **P:** Practical
- **ISE-I-** In Semester Evaluation I
- **ISE-II-** In Semester Evaluation II
- **MSE:** Mid Semester Exam
- **ESE:** End Semester Exam
- **PCC**: Program Core Course
- **PEC**: Program Elective Course
- **OE**: Open Elective Course
- **AEC:** Ability Enhancement Course
- **AC:** Audit Course
- **RM:** Research Methodology

**Department:** Department of Mechanical Engineering
**Semester: I**

| Type of Course | Course Code | Course Name | Teaching Scheme | | | | Evaluation Scheme | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Cr | Components | Max | Min for Passing | |
| PCC | P25MP101 | Advanced Material and Processing | 3 | 1 | - | 4 | ISE-I | 10 | | 40 |
| | | | | | | | MSE | 30 | | |
| | | | | | | | ISE-II | 10 | | |
| | | | | | | | ESE | 50 | 20 | |
| PCC | P25MP102 | Production and Operation Management | 3 | 1 | - | 4 | ISE-I | 10 | | 40 |
| | | | | | | | MSE | 30 | | |
| | | | | | | | ISE-II | 10 | | |
| | | | | | | | ESE | 50 | 20 | |
| PCC | P25MP103 | Metal Casting Technology | 3 | 1 | - | 4 | ISE-I | 10 | | 40 |
| | | | | | | | MSE | 30 | | |
| | | | | | | | ISE-II | 10 | | |
| | | | | | | | ESE | 50 | 20 | |
| PEC | P25MP104 | Program Elective-I | 3 | - | - | 3 | ISE-I | 10 | | 40 |
| | | | | | | | MSE | 30 | | |
| | | | | | | | ISE-II | 10 | | |
| | | | | | | | ESE | 50 | 20 | |
| RM | P25MP105 | Research Methodology and IPR | 2 | - | - | 2 | ISE-I | 10 | | 40 |
| | | | | | | | MSE | 30 | | |
| | | | | | | | ISE-II | 10 | | |
| | | | | | | | ESE | 50 | 20 | |
| ELC | P25MP106 | Seminar | | - | 2 | 1 | ISE | 50 | | 40 |
| | | | | | | | ESE (OE) | 50 | 20 | |
| PCC | P25MP107 | PG Lab- I | | - | 4 | 2 | ISE | 50 | | 40 |
| | | | | | | | ESE (POE) | 50 | 20 | |
| AC | P25MP108 | Yoga and Meditation | 1 | - | -- | | - | - | - | |
| | | | | | | | - | - | | |
| | | | | | | | - | - | | |
| **Total** | | | 15 | 3 | 06 | 20 | 700 | | | |
| | | | 24 | | | | | | | |
| **Total Contact Hours- 24** | | | **Total Credits- 20** | | | | | | | |

**Department:** Department of Mechanical Engineering
**Semester: II**

| Type of Course | Course Code | Course Name | Teaching Scheme | | | | Evaluation Scheme | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Cr | Components | Max | Min for Passing | |
| PCC | P25MP201 | Quality Control and Reliability | 3 | 1 | - | 4 | ISE-I | 10 | | 40 |
| | | | | | | | MSE | 30 | | |
| | | | | | | | ISE-II | 10 | | |
| | | | | | | | ESE | 50 | 20 | |
| PCC | P25MP202 | Advanced CNC Technology | 3 | 1 | - | 4 | ISE-I | 10 | | 40 |
| | | | | | | | MSE | 30 | | |
| | | | | | | | ISE-II | 10 | | |
| | | | | | | | ESE | 50 | 20 | |
| PCC | P25MP203 | Advances in Welding and Joining Technology | 3 | - | - | 3 | ISE-I | 10 | | 40 |
| | | | | | | | MSE | 30 | | |
| | | | | | | | ISE-II | 10 | | |
| | | | | | | | ESE | 50 | 20 | |
| PEC | P25MP204 | Program Elective-II | 3 | - | - | 3 | ISE-I | 10 | | 40 |
| | | | | | | | MSE | 30 | | |
| | | | | | | | ISE-II | 10 | | |
| | | | | | | | ESE | 50 | 20 | |
| OE | P25MP205 | Open Elective-I | 3 | - | - | 3 | ISE-I | 10 | | 40 |
| | | | | | | | MSE | 30 | | |
| | | | | | | | ISE-II | 10 | | |
| | | | | | | | ESE | 50 | 20 | |
| VEC | P25MP206 | Technologies for Industrial Evolution | 2 | - | - | 2 | ISE-I | 25 | 20 | 20 |
| | | | | | | | ISE-II | 25 | | |
| ELC | P25MP207 | Mini Project | - | - | 2 | 1 | ISE-I | 25 | | 40 |
| | | | | | | | ISE-II | 25 | | |
| | | | | | | | ESE (POE) | 50 | 20 | |
| PCC | P25MP208 | PG Lab- II | - | - | 4 | 2 | ISE | 50 | | 40 |
| | | | | | | | ESE (POE) | 50 | 20 | |
| ELC | P25MP209 | Internship/Field Training | - | - | - | - | Will be Evaluated in Sem-III | - | - | |
| **Total** | | | **17** | **2** | **06** | **22** | **750** | | | |
| | | | **25** | | | | | | | |
| **Total Contact Hours- 25** | | | | | | **Total Credits- 22** | | | | |

**Department:** Department of Mechanical Engineering
**Semester: III**

| Type of Course | Course Code | Course Name | Teaching Scheme | | | | Evaluation Scheme | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Cr | Components | Max | Min for Passing | |
| OE | P25MP301 | Open Elective-II[$] | 3 | | - | 3 | ISE-I | 10 | | 40 |
| | | | | | | | MSE | 30 | | |
| | | | | | | | ISE-II | 10 | | |
| | | | | | | | ESE | 50 | 20 | |
| MDM | P25MP302 | Multi-Disciplinary Minor[$] | 3 | - | - | 3 | ISE-I | 10 | | 40 |
| | | | | | | | MSE | 30 | | |
| | | | | | | | ISE-II | 10 | | |
| | | | | | | | ESE | 50 | 20 | |
| ELC | P25MP303 | Dissertation Phase- I* | - | - | 20 | 10 | ISE-I | 25 | | 40 |
| | | | | | | | ISE-II | 25 | | |
| | | | | | | | ESE(POE) | 50 | 20 | |
| ELC | P25MP209 | Internship/Field Training | - | - | | 2 | ISE-I | 50 | 20 | - |
| **Total** | | | 6 | - | 20 | 18 | 350 | | | |
| | | | 26 | | | | | | | |
| **Total Contact Hours- 26 Total Credits- 18** | | | | | | | | | | |

*$ It is mandatory to opt these courses certification from SWAYAM/NPTEL, MOOC platform.
* It is required to complete 30% work of Dissertation.
# It is required to do Four weeks domain specific industrial internship after completing first year of the program evaluated in Semester-III

**Department:** Department of Mechanical Engineering
**Semester: IV**

| Type of Course | Course Code | Course Name | Teaching Scheme | | | | Evaluation Scheme | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Cr | Components | Max | Min for Passing | |
| ELC | P25MP401 | Dissertation Phase- II* | - | - | **40** | **20** | ISE-I | 50 | 40 | 80 |
| | | | | | | | ISE-II | 50 | | |
| | | | | | | | ESE | 100 | 40 | |
| **Total** | | | **-** | **-** | **40** | **20** | **200** | | | |
| | | | **40** | | | | | | | |

It is required to publish/present two papers out of which at least one paper should be in a SCI/ SCIE/ SCOPUS/ Web of Science/ Peer-Reviewed Journal before Thesis Submission.

# Exit Courses after Semester– II - P.G. Diploma

| Type of Course | Course Code | Course Name | Teaching Scheme | | | | Evaluation Scheme | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Cr | Components | Max | Min for Passing |
| AEC | P25MP210 | Management Information System | 4 | - | - | 4 | ISE | 50 | 40 |
| | | | | | | | ESE | 50 | |
| ELC | P25MP211 | Internship/ Training | - | - | - | 2 | ISE-I | 50 | 40 |
| | | | | | | | ESE | 50 | |
| **Total** | | | 4 | 0 | 0 | 6 | 200 | | |
| | | | 2 | | | | | | |
| **Total Contact Hours- 4 Total Credits- 06** | | | | | | | | | |

*It is mandatory to opt this course certification from SWAYAM/NPTEL MOOC platform
# Four weeks domain specific industrial internship after successfully completing first year of the program.

# PROGRAM ELECTIVE CORE

*(Students have to select any one Program Elective Core course out of 03, for each applicable semester, of their interest, offered by the Department from the table below)*

**Program Elective Core - I**

| Sr. | Course Code | Course Name | Semester |
|---|---|---|---|
| 1 | P25MP 104A | Abrasive Machining and Finishing Processes | I |
| 2 | P25MP 104B | Sustainable Manufacturing | |
| 3 | P25MP 104C | Manufacturing Planning and Control | |

**Program Elective Core - II**

| Sr. | Course Code | Course Name | Semester |
|---|---|---|---|
| 1 | P25MP 204 A | Computer Integrated Manufacturing | II |
| 2 | P25MP 204 B | Total Productive Maintenance | |
| 3 | P25MP 204 C | Lasers in Manufacturing | |

# MULTIDISCIPLINARY MINOR (MDM) BASKET

*(Students have to select any one course of their interest (other than a courses offered by their program) for the award of Minor Degree from the table below)*

| **Name of the MDM Basket- Product Development** | | | | |
|---|---|---|---|---|
| **Sr.** | **Course Code** | **Course Name** | **Semester** | **Offered by the Department** |
| **1** | P25MP302 | Product Life Cycle Management | III | Mechanical Engineering |

# OPEN ELECTIVE COURSES

*(Students have to select any one Open Elective course, for each applicable semester, of their interest from the basket below.)*

| Open Elective – I Semester II | | | Open Elective – II Semester III | | |
|---|---|---|---|---|---|
| **Sr.** | **Course Code** | **Course Name (OE)** | **Sr.** | **Course Code** | **Course Name (OE)** |
| 1 | P25MP205A | Environment and Development | 1 | P25MP301A | Labour Welfare and Industrial Relations |
| 2 | P25MP205B | Engineering Economics | 2 | P25MP301B | Sustainable Technology |
| 3 | P25MP205C | Project Management | 3 | P25MP301C | Entrepreneurship Development |
| 4 | P25MP205D | Healthcare Engineering | 4 | P25MP301D | Industrial Automation |

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## Department of Mechanical Engineering

**PG Program**: Mechanical Production Engineering

**Semester: I**

| Type of Course | Course Code | Course Name | Teaching Scheme | | | | Evaluation Scheme | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Cr | Components | Max | Min for Passing | |
| PCC | P25MP101 | Advanced Material and Processing | 3 | 1 | - | 4 | ISE-I | 10 | | 40 |
| | | | | | | | MSE | 30 | | |
| | | | | | | | ISE-II | 10 | | |
| | | | | | | | ESE | 50 | 20 | |
| PCC | P25MP102 | Production and Operation Management | 3 | 1 | - | 4 | ISE-I | 10 | | 40 |
| | | | | | | | MSE | 30 | | |
| | | | | | | | ISE-II | 10 | | |
| | | | | | | | ESE | 50 | 20 | |
| PCC | P25MP103 | Metal Casting Technology | 3 | 1 | - | 4 | ISE-I | 10 | | 40 |
| | | | | | | | MSE | 30 | | |
| | | | | | | | ISE-II | 10 | | |
| | | | | | | | ESE | 50 | 20 | |
| PEC | P25MP104 | Program Elective-I | 3 | - | - | 3 | ISE-I | 10 | | 40 |
| | | | | | | | MSE | 30 | | |
| | | | | | | | ISE-II | 10 | | |
| | | | | | | | ESE | 50 | 20 | |
| OE | P25MP105 | Research Methodology and IPR | 2 | - | - | 2 | ISE-I | 10 | | 40 |
| | | | | | | | MSE | 30 | | |
| | | | | | | | ISE-II | 10 | | |
| | | | | | | | ESE | 50 | 20 | |
| ELC | P25MP106 | Seminar | | - | 2 | 1 | ISE | 50 | | 40 |
| | | | | | | | ESE (OE) | 50 | 20 | |
| PCC | P25MP107 | PG Lab- I | | - | 4 | 2 | ISE-I | 50 | | 40 |
| | | | | | | | ESE (POE) | 50 | 20 | |
| AC | P25MP108 | Yoga and Meditation | 1 | - | -- | | - | - | - | |
| | | | | | | | - | - | | |
| | | | | | | | - | - | | |
| **Total** | | | **15** | **3** | **06** | **20** | **700** | | | |
| | | | **24** | | | | | | | |
| **Total Contact Hours- 24** | | | | | | **Total Credits- 20** | | | | |

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## Department of Mechanical Engineering

| **Title of the Course Name**: Advanced Material and Processing<br>**Course Code**: P25MP101 | **L** | **T** | **P** | **Credits** |
|---|---|---|---|---|
| | 3 | 1 | -- | 4 |
| | ISE | MSE | ESE | Total |
| | **20** | **30** | **50** | **100** |

**Pre-Requisite:**Materials, Manufacturing Processes

**Course Objectives: The course aims,**

1. To introduce the classification, composition, structure, and properties of engineering materials
2. To familiarize students with advanced manufacturing techniques
3.To impart knowledge on micro-machining processes
4. To analyze the processing techniques, structural design, and application areas of smart materials

| **Course Outcomes: At the end of the course, students will be able to:** | |
|---|---|
| CO1 | Understand the fundamental properties, classifications, and applications of conventional and modern engineering materials. |
| CO2 | Analyze the influence of heat treatment processes on the structure and mechanical properties |
| CO3 | Evaluate various advanced and non-conventional machining techniques |
| CO4 | Apply the knowledge of material behavior and processing methods to select suitable materials and processes for engineering design and manufacturing challenges. |

| **Course Content** | | |
|---|---|---|
| **Unit No.** | **Unit title and Content** | **Hrs** |

| | | |
|---|---|---|
| 1 | **Review of Engineering Materials-**<br>metals, alloys- ferrous and non-ferrous, plastics and polymers, ceramics and composites. Dual phase steels, micro alloyed steels, High strength low alloy steels, transformation inducted plasticity (TRIP) steels, Maraging steels. Heat treatment of ferrous and nonferrous alloys for modification of structure and properties. | **06** |
| 2 | **Modern materials-** Compositions, properties and applications of: Inter-metallics, Ni and Ti aluminides, smart materials, shape memory alloys, Metallic glass- quassi-crystals, semiconductors, conductors & super conducting materials. Magnetic and photoelectric materials, optical materials, Bio materials, nano-materials. Polymer materials, formation of polymer structures, production techniques of fibers, foams, adhesives and coatings. Structure, properties and applications of engineering polymers | **06** |
| 3 | **Composites:** Fibers-glass, boron, carbon, organic, ceramic and metallic fibers- Matrix materialspolymers, metals and ceramics. Processing of polymer matrix composites: open mould process, bag molding, compression molding with BMC and SM- filament winding, pultrussion-centrifugal casting, injection molding, applications of PMC‟s. Processing of metal matrix polymers: solid state fabrication techniques- diffusion bonding, powder metallurgy techniques, plasma spray, chemical and physical vapour deposition, Liquid state fabrication methods, Infiltration, squeeze casting, Rheo casting, compo casting. Applications. | **07** |
| 4 | **Advanced Fine Finishing Process:**<br>Abrasive Flow Machining; Magnetic Abrasive Finishing; Magneto Rheological Abrasive Finishing: Process principle, process equipment; Analysis and modeling of finishing mechanism; parametric analysis; Applications. | **06** |
| 5 | **Micro-Machining:**<br>Introduction to micromachining, Micro-electro discharge Machining: Principles of micro-EDM, micro-EDM, micro-WEDM, micro-WEDG, micro-ECM, Principles of micro-turning, micro-drilling and micro-milling, micro grinding, Hybrid micromachining method, films and film depurification,Oxidation,diffusion,ion-implantation,etching,bonding, metallization, surface and bulk machining – LIGA Process, Solid free form fabrication. | **06** |

| | | |
|---|---|---|
| 6 | **Advances in Non-Conventional Machining Processes:**<br>A review of non-conventional machining processes, Analysis of mechanical, thermal and Electro-chemical type non-traditional machining processes. Tool design for selected nontraditional machining processes. Modeling and simulation of selected processes. A comparative study of various processes. | **06** |

**Text Books:**

1. Chawla K. K., "*Composite Materials*", Springer-Verlag New York Inc., 2nd edition, 2001.

2. Amitabha Ghosh & A. K. Mallik, "*Manufacturing Science*", Affiliated East-West Press, 2nd edition, 2010.

3.NishaKumar,"*Non-Conventional Machining in Modern Manufacturing Systems*", IGI Global,1st Edition, 2018.

4. Kalpakjian&Schmid, "*Manufacturing Engineering and Technology*", Pearson, 8th edition, 2023.

**Reference Book:**

1. Groover, M. P. "*Fundamentals of Modern Manufacturing* ", Wiley India , 4th edition, 2013.
2. Kalpakjian, S.,"*Manufacturing Engineering and Technology"*. Pearson, 4th edition,2001.
3. Fassi, I**. "***M*icro-Manufacturing Technologies & Applications" Springer, 1St edition 2017.
4. Ashby & Jones, "*Engineering Materials: An Introduction to Properties, Applications and Design",*Elsevier, 5th edition, 2018.

| **Title of the Course Name**: Production and Operation Management<br>**Course Code**: P25MP102 | **L** | **T** | **P** | **Credits** |
|---|---|---|---|---|
| | 3 | 1 | -- | 4 |
| | ISE | MSE | ESE | Total |
| | **20** | **30** | **50** | **100** |

**Pre-Requisite:** Production, Industrial Management

**Course Objectives: The course aims,**

1. To evaluate the key factors influencing the design of effective operating systems.
2. To compare various operating systems used in firms.
3. To predict production outcomes under varying conditions and constraints.
4. To develop efficient production planning and operations scheduling systems

| **Course Outcomes: At the end of the course, students will be able to:** | |
|---|---|
| CO1 | Identify and evaluate the key factors and the interdependence of these factors in the design of effective operating systems |
| CO2 | Analysis of operating systems of the firm |
| CO3 | Predict the production using different models |
| CO4 | Design production planning and operations scheduling |

| **Course Content** | | |
|---|---|---|
| **Unit No.** | **Unit title and Content** | **Hrs** |
| 1 | **Introduction, Product and Service Design**: Relation between production and operations and other functions, products and services, impact of information technology on productions and operations management, Business strategy- competitive priorities, developing operations strategy, productivity and competitiveness. Traditional and concurrent product design, design for manufacture, service, assembly, Design of services, types of services, Quality of design, costs of quality | **07** |

| | | |
|---|---|---|
| 2 | **Forecasting Models:** Classification, simple and weighted moving average method, exponential smoothening methods: additive model, trends and seasonality model, mixed model, Regression (linear and multiple) models, causal model, measures of forecasting accuracy, reliability of forecasts | **06** |
| 3 | **Aggregate Production Planning:** Production planning strategies, aggregate production planning model, chase demand and level workforce strategies, and techniques- trial and error, linear programming, transportation model, dynamic programming, Master production schedule, Materials requirement planning - structure and application; Capacity planning- measures and methods to generate capacity, Aggregate planning for services- yield management | **06** |
| 4 | **Operations Scheduling**: Approaches to scheduling – infinite and finite loading, forward or backward scheduling, Assignment model for assigning jobs to work centers, dispatching rules for scheduling n jobs on one machine, composite rules, scheduling with Johnson‟s rule – n jobs-2 stations with same and different sequence, 2 jobs-n stations (graphical method), preparation of Gantt‟s chart, job shop scheduling, open shop scheduling, dynamic scheduling in flexible manufacturing systems, employee scheduling for service | **06** |
| 5 | **Inventory Management: C**lassification, EOQ models, order timing decisions, Safety Stock and reorder level decisions. Order quantity and reorder point, Continuous review systems, periodic review systems, selective inventory control - ABC analysis, Multi-item and Coordinated Replenishment Models- Spare parts and maintenance inventory models, Inventory models with probabilistic demands: Single period discrete probabilistic demand model, multiple period probabilistic models | **06** |
| 6 | **Theory of constraints:** Optimized Production Technology, Drum-rope-buffer models, CONWIP models, Planning and Control of JIT. | **05** |

**Text Books:**

1. R. B. Khanna, " *Production & Operations Management*", PHI 1st edition, 2007.

2. Martin K. Starr, "*Production & Operations Management*", India Edition, Cengage Learning, 1st edition 2007

3. Dr. K.C. Arora, "*Production & Operations Management*", University Science Press , 1st edition, 2009

**Reference Book:**

1. Jay Heizer, "*Operations Management*", Pearson 9th Edition, 2009
2. Lee J. Krajewski & Larry P Ritzman, "Operations Management- Strategy & Analysis", Pearson Education, 6th edition, 2001
3. E Silver, "*Inventory management and Production Planning and Scheduling*", Wiley India ,3rd edition 1998

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## Department of Mechanical Engineering

| | L | T | P | Credits |
|---|---|---|---|---|
| **Title of the Course Name**: Metal Casting Technology<br>**Course Code**: P25MP103 | 3 | 1 | -- | 4 |
| | ISE | MSE | ESE | Total |
| | **20** | **30** | **50** | **100** |

**Pre-Requisite:** Manufacturing Processes, Basic of casting

**Course Objectives:** The course aims

1. To develop foundational knowledge of various casting processes, tools, materials.
2. To impart practical knowledge of moulding techniques, tools, pattern types and sand properties
3. To enable students to design and analyze gating systems and casting setups
4. To familiarize students with industrial melting practices & advanced casting processes

**Course Outcomes: At the end of the course, students will be able to:**

| | |
|---|---|
| CO1 | Select the appropriate casting process for the manufacturing of a given component |
| CO2 | Design of gating and Risering system |
| CO3 | Analyze the flow of molten metal in gating system |
| CO4 | Describe the need and significance of special casting processes with appropriate inspection methods |

| Course Content | | |
|---|---|---|
| **Unit No.** | **Unit title and Content** | **Hrs** |
| 1 | **Principles of Metal Casting and Moulding Sand Technology:** Different casting processes, Terminology and tools of sand moulding, Moulding sand and design, Moulding sand properties, Moulding sand property testing. | **06** |
| 2 | **Pattern Design and Gating System in Sand Casting** Different types of Patterns and Allowances, Steps involved in making sand castings, Design of Gating system, design of, Sand Casting defects | **06** |

| | | |
|---|---|---|
| 3 | **Melting Practices and Solidification in Casting:** Melting, fluidity and solidification, Melting furnaces and practice, Treatment of molten metal, Fluidity of molten metal, solidification. | **06** |
| 4 | **Casting Alloys: Types and Applications:** Common cast alloys: Cast iron and steels, Aluminum and magnesium cast alloys, Copper, Zinc and Titanium cast alloys. | **06** |
| 5 | **Advanced Casting Techniques and Specialized Moulding Methods:** Permanent mould and special casting processes: Die casting process, investment casting process, continuous casting process, Evaporative pattern casting and plaster moulding, vacuum sealed moulding and squeeze casting. | **06** |
| 6 | **Casting Finishing, Inspection, and Environmental Aspect:** Finishing design and environment: shakeout, fettling and finishing, Inspection, testing and quality, design consideration and Economics, Environment, Health and safety aspects. | **06** |

**Texts Books:**

1. Khanna, O. P**.** *"A Text-Book of Foundry Technology* "DhanpatRai& Sons,15th edition, 2011.
2. Hajra Choudhury, S. K**.** *"Elements of Workshop Technology(Vol. I & II)".* Media Promotors, 1st edition,2001.
3. Rao, P. N. "Manufacturing Technology, Volume 1*"* ,5th edition, 2024

**Reference Books:**

1.Flinn, "*Fundamentals of Metal Casting*", Addison Wesley, 1st Edition, 1963.
2.Heine, R. W., Loper, "*Principles of Metal Casting*", McGraw Hill, 2nd Edition, 1967.
3.Niebel, Draper, "*Product Design and Process Engineering Practice*", McGraw Hill Foundry / Isaac Pitman, 1st Edition, 1974.

| **Title of the Course Name**: Abrasive Machining and Finishing Processes<br>**Course Code**: P25MP104A | **L** | **T** | **P** | **Credits** |
|---|---|---|---|---|
| | 3 | -- | -- | 3 |
| | ISE | MSE | ESE | Total |
| | **20** | **30** | **50** | **100** |

**Pre-Requisite:** Machine Tool and Manufacturing Processes

**Course Objectives:** The course aims to:
1. To introduce the principles and applications of abrasive machining and grinding fluids.
2. To Introduce students with advanced surface finishing techniques
3. To provide comprehensive knowledge of non-traditional machining processes
4. To explore magnetically assisted abrasive finishing and hybrid machining techniques

**Course Outcomes: At the end of the course, students will be able to:**

| | |
|---|---|
| CO1 | Describe the fundamental concepts of abrasive machining, grinding fluids, and surface finishing processes |
| CO2 | Classify and compare advanced non-traditional machining processes and magnetic/abrasive flow-based techniques. |
| CO3 | Analyze the working mechanisms and performance characteristics of magneto-rheological and hybrid finishing processes |
| CO4 | Evaluate the sustainability and environmental impact of modern machining methods |

| **Course Content** | | |
|---|---|---|
| **Unit No.** | **Unit title and Content** | **Hrs** |
| 1 | **Abrasive Machining and Grinding Fluids**<br>Introduction to abrasive machining and finishing processes, grinding process, grinding fluids, grinding fluid additives, grinding fluids and its emissions. | **06** |

| | | |
|---|---|---|
| 2 | **Advanced Surface Finishing Processes**<br>Honing process, Lapping process, Super finishing and sand blasting, vibratory bowl finishing, rotary barrel finishing or tumbling, drag finishing, Ice bonded abrasive finishing, pitch polishing, pad polishing | **06** |
| 3 | **Advanced Non-Traditional Machining Processes**<br>Abrasive jet machining, Abrasive water jet machining, Ultrasonic machining, Electric discharge grinding, Electric discharge diamond grinding, Electro-chemical machining. | **07** |
| 4 | **Magnetic and Abrasive Flow-Based Finishing Techniques**<br>Abrasive flow machining, Magnetic field assisted abrasive finishing, Magnetic abrasive finishing, Magnetic abrasive deburring, Magnetic float finishing. | **06** |
| 5 | **Magneto-Rheological Based Finishing Processes**<br>Magneto rheological finishing, Magneto rheological Abrasive flow finishing, Rotational Magneto rheological Abrasive flow finishing. | **06** |
| 6 | **Hybrid and Eco-Friendly Precision Machining Methods**<br>Elastic emission machining, Powder mixed EDM, sustainable grinding process: biodegradation of grinding fluids, MQL in grinding process. | **05** |

**Texts Books:**

1 V. K. Jain," *Micro-manufacturing Processes*", CRC Press, 1st Edition, 2012
2 V. K. Jain, "*Nanofinishing science and Technology, Basic and Advanced finishing and Polishing Processes*", CRC Press, 1st Edition, 2016
3 A. Ghosh and A. K. Malik, "*Manufacturing Science*", East West Press, 2nd Edition,2010

**Reference Books:**

1 J. A. McGeough, "*Advanced Methods of Machining*", Springer Science and Business,,1st Edition,1988
2 Zhang, Y., & Li, C "*Hybrid-Energy Sustainable Machining: Mechanism and Processability*". Springer Nature Singapore,1st Edition, 2025.
3V. P. Astakhov and S. Joksch, "*Metalworking fluids for cutting and grinding*", Woodhead Publishing, 1st edition,2012
4 Khan, D. A., Alam, Z., &Iqbal, F."*Magnetic Field Assisted Finishing: Methods, Applications and Process Automation"*. CRC Press, 1st edition, 2021.

| **Title of the Course Name**: Sustainable Manufacturing<br>**Course Code**: P25MP104B | **L** | **T** | **P** | **Credits** |
|---|---|---|---|---|
| | 3 | -- | -- | 3 |
| | ISE | MSE | ESE | Total |
| | **20** | **30** | **50** | **100** |

**Pre-Requisite:** Product Life cycle, Production Management.

**Course Objectives:** The course aims to:

1.To enable learners to comprehend the fundamentals of sustainable manufacturing

2.To develop the ability to perform Life Cycle Assessment of manufacturing processes

3. To cultivate skills in modeling green manufacturing systems and Industry 4.0.

4. To introduce students to simulation-based decision-making and data analysis using tools.

**Course Outcomes: At the end of the course, students will be able to:**

| | |
|---|---|
| CO1 | Explain the fundamental concepts of sustainable manufacturing |
| CO2 | Apply life cycle assessment procedures and utilize appropriate techniques |
| CO3 | Analyze discrete event simulation models and interpret statistical data |
| CO4 | Evaluate and design smart and sustainable manufacturing systems using Industry 4.0 technologies |

| **Course Content** | | |
|---|---|---|
| **Unit No.** | **Unit title and Content** | **Hrs** |
| 1 | **Fundamentals of Sustainable Manufacturing:** Basics of production, Sustainability and manufacturing, Introduction to simulation, basic statistical concept for sustainable manufacturing analysis. | **05** |
| 2 | **Life Cycle Assessment: Elements and Procedure**<br>Life cycle assessment, Life cycle assessment elements, Life cycle assessment procedure, Quantitative Techniques in LCA, Integration of LCA in Sustainable Manufacturing | **06** |

| | | |
|---|---|---|
| 3 | **Green Manufacturing Strategies:**<br>Green manufacturing modeling: metrics for green manufacturing, Indices for green manufacturing, Developing green manufacturing system, green manufacturing techniques. | **06** |
| 4 | **Simulation and Data Analysis for Sustainable Systems**<br>Basics of discrete event simulation and system modeling, Statistical analysis techniques: regression, ANOVA, hypothesis testing, Design of experiments (DoE) for sustainability studies, Interpreting simulation data for process improvement | **07** |
| 5 | **Smart and Sustainable Manufacturing Systems**<br>Concept of Industry 4.0 and digital transformation in sustainability, Smart factories: architecture and sustainable benefits, IoT in green manufacturing, Role of AI/ML in predictive energy/resource management | **07** |
| 6 | **Sustainability Frameworks**<br>Sustainability framework, basic modeling functions for factory simulation, Productivity and sustainability, Decision Support Systems for Sustainable Manufacturing. | **05** |

**Texts Books:**

**1.** Stark, "*Sustainable Manufacturing*: Challenges, Solutions and Implementation Perspectives", Springer, 1st edition, 2017.
**2.**Jawahir, I. S, "*Sustainable Manufacturing: Fundamentals and Applications*", Wiley, 1st edition, 2013
**3.**V. K. Jain, "*Sustainable Manufacturing Processes*", Springer, 1st edition, 2019

**ReferenceBooks**:

1. Ibrahim Garbie ,"*Sustainability in Manufacturing Enterprises*", Springer publication, 1st edition, 2016.
2.J. Paulo Davim , "*Green manufacturing processing and systems*" , Springer publication , 1st edition,2013
3. GüntherSeliger, JérémyBonvoisin ,"*Sustainable Manufacturing*", Springer publication, 1st edition,2017

| **Title of the Course Name**: Manufacturing Planning and Control<br>**Course Code**: P25MP104C | **L** | **T** | **P** | **Credits** |
|---|---|---|---|---|
| | 3 | -- | -- | 3 |
| | ISE | MSE | ESE | Total |
| | **20** | **30** | **50** | **100** |

**Pre-Requisite:** Production Systems

**Course Objectives:** The course aims to:
1. To understand the structure and functioning of various manufacturing systems and production models.
2. To Apply advanced manufacturing strategies and preplanning methods for effective production control.
3. To Implement operations planning and control systems such as MRP, MRP II, and JIT effectively.
4. Evaluate quality and cost performance in manufacturing systems using simulation and case studies.
5. Analyze and optimize FMS operations through lot sizing, production scheduling, and line of balance.

**Course Outcomes: At the end of the course, students will be able to:**

| | |
|---|---|
| CO1 | Describe the structure, components, and production models of various manufacturing systems. |
| CO2 | Apply design and decision-making tools such as group technology and line balancing to improve manufacturing system performance. |
| CO3 | Analyze operations planning and control strategies including MRP, ERP. |
| CO4 | Evaluate quality and cost control techniques and design simulation-based solutions for real-time monitoring and optimization. |

| **Course Content** | | |
|---|---|---|
| **Unit No.** | **Unit title and Content** | **Hrs** |
| 1 | **Introduction to Manufacturing Systems and Production Models**<br>Overview of manufacturing systems and various issues of interest: assembly line, repetitive batch manufacturing, Cellular manufacturing | **05** |

| | | |
|---|---|---|
| 2 | **Advanced Manufacturing Systems and Production Planning**<br>FMS, JIT, CIM, preplanning: forecasting, economic analysis, aggregate planning, capacity planning, inventory planning | **06** |
| 3 | **Design Decisions in Manufacturing Systems**<br>Decision making in design of manufacturing systems: group technology, line balancing, plant layout, Cellular Manufacturing. | **06** |
| 4 | **Operations Planning and Control Systems**<br>Operations planning: MRP, MRP II, hierarchical planning systems, JIT systems ,Enterprise Resource Planning (ERP) Systems | **07** |
| 5 | **FMS Operations and Scheduling Strategies**<br>FMS Operation and control: lot sizing decisions, production scheduling, line of balance,Real-Time Monitoring,Multi-objective scheduling | **06** |
| 6 | **Quality and Cost Control in Manufacturing Systems**<br>Quality planning and control, cost planning and control, Simulation analysis of manufacturing systems, case studies | **06** |

**Texts Books:**

1. Jacobs, "*Manufacturing Planning and Control for Supply Chain Management*", McGraw-Hill Education, 3rd Edition, 2024.
2. Groover, M. P," *Fundamentals of Modern Manufacturing: Materials, Processes, and Systems*", Wiley & Sons, 7th Edition, 2022
3. Chang, "*Computer-Aided Manufacturing*", Pearson Education, 3rd edition 2005.

**References:**

1.D.D.Bedworth and J.E Bailey, "*Integrated Production Control, System-management, Analysis and Design*", John Wiley, 1stedition,1983.
2. A.C.Hax and D.Candea,"*Production and Inventory Managemeny*", Prentice-Hall, 1st Edition, 1984.
3. M.G.Korgaokar," *JIT Manufacturing, Macmillan*", 1st edition,1992

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## Department of Mechanical Engineering

| **Title of the Course Name:** Research Methodology and IPR<br>**Course Code:**P25MP105 | **L** | **T** | **P** | **Credits** |
|---|---|---|---|---|
| | 2 | - | - | 2 |
| | ISE | MSE | ESE | Total |
| | **20** | **30** | **50** | **100** |

**Pre-Requisite:** Research

**Course Objectives:** The course aims:

1. To introduce the fundamental principles of research methodology.
2. To develop an understanding of research design and analysis.
3. To enable formulation of research problems and objectives.
4. To provide knowledge about Intellectual Property Rights and their importance.
5. To create awareness about patents, copyrights, and trademarks.

**Course Outcomes: At the end of the course, students will be able to:**

| CO | Course Outcomes |
|---|---|
| CO1 | Understand the basic concepts and types of research. |
| CO2 | Identify appropriate research problems and prepare research proposals. |
| CO3 | Understand the importance of ethics in research and publication. |
| CO4 | Explain the significance and types of Intellectual Property Rights. |
| CO5 | Apply for patents and understand processes involved in IPR protection. |
| CO6 | Demonstrate the impact of IPR on innovation and economic growth. |

| Course Content | | |
|---|---|---|
| **Unit No.** | **Contents** | **Hrs** |
| 1 | **Introduction to Research Methodology**<br>Meaning, Objectives, Motivation, Types of Research, Research Approaches, Research Process, Criteria of Good Research | **06** |
| 2 | **Research Problem and Design**<br>Identifying Research Problem, Literature Survey, Research Objectives, Research Design Concepts, Features of Good Design | **06** |
| 3 | **Data Collection and Analysis**<br>Sources of Data, Sampling Methods, Data Processing, Statistical | **06** |

| | | |
|---|---|---|
| | Techniques, Hypothesis Testing, Report Writing | |
| 4 | **Ethics in Research**<br>Ethical Principles, Plagiarism, Impact of Misconduct, Ethical Committees, Publishing Ethics | **06** |
| 5 | **Introduction to IPR**<br>Overview of Intellectual Property, Importance of IPR, Types: Patents, Trademarks, Copyrights, Industrial Designs | **06** |
| 6 | **IPR Procedures and Case Studies**<br>Patent Filing Procedure, Patentable and Non-patentable Items, Patent Search, Licensing, Case Studies on IPR Disputes | **06** |

**Text Books:**

1. C. R. Kothari, "Research Methodology: Methods and Techniques", New Age International, 2nd Edition, 2004.

2.P. Pandey and S. Pandey, *"Research Methodology: Tools and Techniques"*, Bridge Center, 1st Edition, 2015.

3. NeerajPandey and KhushdeepDharni, *"Intellectual Property Rights"*, PHI Learning, 1st Edition, 2014

**Reference Books:**

**1.**Ranjit Kumar, "*Research Methodology: A Step-by-Step Guide*", Sage Publications, 4th Edition, 2014**.**

**2.**T. Ramakrishna, "*Basic Principles and Acquisition of Intellectual Property Rights*", CIPRA, NLSIU, 1st Edition, 2005.

3. V. Scaria, "*Intellectual Property Rights in the Global Era*", LexisNexis, 1st Edition, 2012.

**MOOC/NPTEL Platform:**

**1.**NPTEL Course: Research Methodology – Prof. RajatAgarwal (IIT Roorkee)

2.SWAYAM Course: Understanding IPR – Prof. Feroz Ali (IIT Madras)

| **Title of the Course Name**: Seminar<br>**Course Code**: P25MP106 | **L** | **T** | **P** | **Credits** |
|---|---|---|---|---|
| | -- | -- | 2 | 1 |
| | ISE | MSE | ESE | Total |
| | **50** | **50** | **50** | **100** |

**Pre-Requisites:** Previously studied courses

**Course Objectives:** The course aims to:

1. To identify and critically compare technical issues within the chosen area of specialization.
2. To develop the ability to compile an annotated bibliography showcasing research and scholarly inquiry.
3. To enhance skills in writing well-structured technical reports using proper formatting, language, and logic.
4. To interpret, evaluate, and analyze technical topics with clarity and depth of understanding

**Course Outcomes: At the end of the course, students will be able to:**

| | |
|---|---|
| CO1 | Identify and compare technical issues related to the area of course specialization |
| CO2 | Outline annotated bibliography of research demonstrating scholarly skills. |
| CO3 | Prepare a well organized report employing elements of technical writing & critical Thinking. |
| CO4 | Demonstrate the ability to describe, interpret and analyze technical issues and develop competence in presenting |

| **Title of the Course Name**: PG LAB-I<br>**Course Code**: P25MP107 | **L** | **T** | **P** | **Credits** |
|---|---|---|---|---|
| | -- | -- | 4 | 2 |
| | ISE | MSE | ESE | Total |
| | **50** | **--** | **50** | **100** |

**Course Objectives:** The course aims to:
1. To enable students to measure and analyze cutting forces in milling operations using experimental methods.
2. To develop competency in modeling mechanical components using advanced CAD software.
3. To apply knowledge of fluid power systems in designing hydraulic circuits.
4. To perform finite element analysis of machine components using simulation tools such as ANSYS and LS-DYNA.

**Course Outcomes: At the end of the course, students will be able to:**

| | |
|---|---|
| CO1 | Measure the cutting forces in machining process |
| CO2 | Apply solid modeling tools to create structural and machine component models and analyze their mechanical behavior using simulation software such as ANSYS or LS-DYNA. |
| CO3 | Design a hydraulic circuit for the given application |
| CO4 | Analyze real-time industrial manufacturing practices and compare them with theoretical concepts |

**Perform the following experiments (Any Five)**

| **Exp. No.** | **Content** |
|---|---|
| 1 | Cutting force determination using force dynamometer. |
| 2 | Experimental study in micromachining using photo chemical machining. |
| 3 | Analysis of machine components using ANSYS/LS Dyna etc. software |
| 4 | Solid modeling of structural components using modeling software. |
| 5 | Solid modeling of machine components using modeling software. |

| | |
|---|---|
| 6 | Sequencing of cylinders using hydraulic trainer kit. |
| 7 | Synchronizing of cylinders using hydraulic trainer kit. |
| 8 | Industrial Visit |

| **Title of the Course Name:**Yoga and Meditation<br>**Course Code:**P25MP108 | **L** | **T** | **P** | **Credits** |
|---|---|---|---|---|
| | 1 | -- | -- | -- |
| | ISE | MSE | ESE | Total |
| | **--** | **--** | **--** | **--** |

**Pre-Requisite:** Basic understanding of human anatomy and interest in physical and mental well-being.

**Course Objectives:**

1. To explore the philosophical and psychological foundations of Yoga and Meditation.
2. To introduce and practice the Eight Limbs of Yoga (*Ashtanga Yoga*) for holistic self-regulation.
3. To train students in meditation, breathing, and ethical practices for enhancing clarity, focus, and emotional balance.
4.To help students integrate yogic wisdom and mindfulness

**Course Outcomes: At the end of the course, students will be able to**

| | |
|---|---|
| CO1 | Comprehend the core teachings of YogaSutras. |
| CO2 | Practice foundational yogic techniques. |
| CO3 | Apply principles of *Yama* and *Niyama* for improved discipline, ethics, and self-awareness. |
| CO4 | Develop concentration and mindfulness for stress reduction and productivity. |

| Course Content | | |
|---|---|---|
| **Unit No.** | **Unit title and Content** | **Hrs** |
| 1 | **Foundations of Yoga Philosophy**<br>Origin and evolution of Yoga; Introduction to Yoga Sutras.Definition of Yoga – "YogasChittaVrittiNirodha".The five Vrittis (mental fluctuations) and their control. | **03** |
| 2 | **Ethical and Personal Discipline (Yama &Niyama)**<br>The five Yamas – Ahimsa, Satya, Asteya, Brahmacharya, Aparigraha.<br>The five Niyamas – Shaucha, Santosha, Tapas, Svadhyaya, IshwarPranidhana.Relevance of Yama-Niyama in academic and professional life. | **03** |
| 3 | **Physical & Mental Purification (Asana, Pranayama, Pratyahara)**<br>*Asana* – Role of posture; stability and comfort in the body<br>Pranayama – Breath control techniques; calming the nervous system<br>Pratyahara – Withdrawal of senses; mastering inner awareness | **03** |
| 4 | **Concentration, Meditation, and Liberation (Dharana, Dhyana, Samadhi)**<br>Dharana – Developing concentration and focus<br>Dhyana – The process and practice of meditation<br>Samadhi – State of absorption; experiencing inner peace and unity | **03** |

**References:**

1. Swami Satchidananda, *"The Yoga Sutras of Patanjali"*, Integral Yoga Publications, 1st Edition, 2012.
2. B. K. S. Iyengar, *"Light on the Yoga Sutras of Patanjali"*, HarperCollins Publishers India, 1st Edition, 2002.
3. Swami SatyanandaSaraswati, *"Four Chapters on Freedom"*, Yoga Publications Trust, 1st Edition, 2008.
4. Swami Vivekananda, *"Raja Yoga"*, AdvaitaAshrama, 1st Edition, 1896 (Reprint 2020).

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## Department of Mechanical Engineering

**Department:** Department of Mechanical Engineering
**Semester: II**

| Type of Course | Course Code | Course Name | Teaching Scheme | | | | Evaluation Scheme | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Cr | Components | Max | Min for Passing | |
| PCC | P25MP201 | Quality Control and Reliability | 3 | 1 | - | 4 | ISE-I | 10 | | 40 |
| | | | | | | | MSE | 30 | | |
| | | | | | | | ISE-II | 10 | | |
| | | | | | | | ESE | 50 | 20 | |
| PCC | P25MP202 | Advanced CNC Technology | 3 | 1 | - | 4 | ISE-I | 10 | | 40 |
| | | | | | | | MSE | 30 | | |
| | | | | | | | ISE-II | 10 | | |
| | | | | | | | ESE | 50 | 20 | |
| PCC | P25MP203 | Advances in Welding and Joining Technology | 3 | - | - | 3 | ISE-I | 10 | | 40 |
| | | | | | | | MSE | 30 | | |
| | | | | | | | ISE-II | 10 | | |
| | | | | | | | ESE | 50 | 20 | |
| PEC | P25MP204 | Program Elective-II | 3 | - | - | 3 | ISE-I | 10 | | 40 |
| | | | | | | | MSE | 30 | | |
| | | | | | | | ISE-II | 10 | | |
| | | | | | | | ESE | 50 | 20 | |
| OE | P25MP205 | Open Elective-I | 3 | - | - | 3 | ISE-I | 10 | | 40 |
| | | | | | | | MSE | 30 | | |
| | | | | | | | ISE-II | 10 | | |
| | | | | | | | ESE | 50 | 20 | |
| VEC | P25MP206 | Technologies for Industrial Evolution | 2 | - | - | 2 | ISE-I | 25 | 20 | 20 |
| | | | | | | | ISE-II | 25 | | |
| ELC | P25MP207 | Mini Project | - | - | 2 | 1 | ISE-I | 25 | | 40 |
| | | | | | | | ISE-II | 25 | | |
| | | | | | | | ESE (POE) | 50 | 20 | |
| PCC | P25MP208 | PG Lab- II | - | - | 4 | 2 | ISE | 50 | | 40 |
| | | | | | | | ESE (POE) | 50 | 20 | |
| ELC | P25MP209 | Internship/Field Training | - | - | - | - | Will be Evaluated in Sem-III | - | - | |
| **Total** | | | 17 | 2 | 06 | 22 | **750** | | | |
| | | | 25 | | | | | | | |
| **Total Contact Hours- 25** | | | | | | **Total Credits- 22** | | | | |

| **Title of the Course Name**: Quality Control and Reliability<br>**Course Code**: P25MP201 | **L** | **T** | **P** | **Credits** |
|---|---|---|---|---|
| | 3 | 1 | -- | 4 |
| | ISE | MSE | ESE | Total |
| | **20** | **30** | **50** | **100** |

Pre Requisite:- Machining Processes, industrial management

**Course Objectives:** The course aims to:
1. To explore the foundational philosophies and frameworks of quality management.
2 To equip students with the skills to design and analyze experiments for process and quality improvement.
3. To develop the ability to apply various quality improvement tools.
4. To enable students to understand and apply Statistical Process Control

**Course Outcomes: At the end of the course, students will be able to:**

| | |
|---|---|
| CO1 | Explain the principles of Total Quality Management (TQM) and the role of continuous improvement in modern manufacturing. |
| CO2 | Apply statistical tools and techniques such as confidence intervals, hypothesis testing, ANOVA, and factorial design to improve product and process quality. |
| CO3 | Analyze quality improvement tools and models to identify root causes and enhance customer satisfaction. |
| CO4 | Evaluate and design robust manufacturing systems using Statistical Process Control (SPC), Taguchi methods, and reliability engineering principles for long-term product quality and system reliability. |

| Course Content | | |
|---|---|---|
| **Unit No.** | **Unit title and Content** | **Hrs** |
| 1 | **Total Quality Management in Manufacturing**:<br>Introduction: New culture of TQM, TQM axioms, consequences of total quality managing, cost of total quality, valuable tools for quality, and the Japanese factor.<br>The Deming Approach to management: Deming's fourteen points for management, deadly sins & diseases, implementing the Deming's philosophy, Deming on management.Juran on Quality: Juran`s quality trilogy, JuranVs Deming. | **07** |
| 2 | **Quality Leadership and Continuous Improvement Strategies**<br>Crosby & the Quality Treatment: Crosby diagnosis of a troubled company, Crosby's quality vaccine, Crosby's absolutes for quality management, Crosby's fourteen steps for quality improvement.<br>Imai`s Kaizen: The concept, Kaizen & innovation, the Kaizen management practices. | **06** |
| 3 | **Statistical Analysis and Experimental Design for Quality and Process Improvement**<br>Basic Techniques for Statistical Analysis: Introduction, measures of central tendency & dispersion, confidence intervals, hypothesis testing, frequency distributions & histograms, probability distributions, measuring linear associations.<br>Design & Analysis of Experiments: Introductions, factorial experiments, aliasing, constructing fractional designs, analysis of variance. | **06** |
| 4 | **Tools and Techniques for Quality Improvement :**<br>Affinity diagram, bar chart, block diagram brain storming, cause and effect analysis, control charts, cost benefit analysis, customer-supplier relationship check list, decision analysis, flow charts, force field analysis, line graph/run charts, pareto analysis, quality costing, quality function development (QFD), quality project approach & problem solving process, risk analysis scatter diagrams. | **06** |

| | | |
|---|---|---|
| 5 | **Statistical Process Control and Taguchi Methods**<br>Statistical Process Control: Introduction, data collection plan, variables charts, attributes, interpreting the control charts.<br>Taguchi's Approach to Experimental Design & Offline Quality Control: Introduction, Taguchi's recommended design techniques, from Deming to Taguchi & vice-versa. | **06** |
| 6 | **Reliability Engineering**<br>Reliability: Introduction, life cycle curves & probability distribution in modeling reliability, system reliability, operating characteristic curves, reliability and life testing plans. | **05** |

**Texts Books:**

1. N. Logothetis, *Managing for Total Quality: From Deming to Taguchi and SPC*, Prentice Hall of India, New Delhi, 1st Edition, 2005.
2. A. Mitra, *Fundamentals of Quality Control and Improvement*, Prentice Hall of India, New Delhi,2nd Edition,2003.

**Reference Books:**

**1** R.F. Lochner& J.E. Matar**, "***Designing for Quality"***,** Chapman & Hall**,** 1st Edition**,** 2001**.**
**2** A. Zaidi**, "***SPC: Concepts, Methodologies and Tools"***,** Prentice Hall of India**,**1st Edition**,** 1995.

| **Title of the Course Name**: Advanced CNC Technology<br>**Course Code**: P25MP202 | **L** | **T** | **P** | **Credits** |
|---|---|---|---|---|
| | 3 | -- | -- | 3 |
| | ISE | MSE | ESE | Total |
| | **20** | **30** | **50** | **100** |

**Prerequisite**: Machine Tools

**Course Objectives:** The course aims to:

1 To understand the significance of CNC machines in modern manufacturing.
2 To describe the role and importance of feedback devices in CNC control systems.
3 To develop accurate CNC part programs for different machining operations.
4 To simulate and verify CNC part programs using relevant simulation software.

**Course Outcomes: At the end of the course, students will be able to:**

| | |
|---|---|
| CO1 | Explain the significance of CNC machines |
| CO2 | Describe the significance of the feedback devices in CNC machines |
| CO3 | Identify the key features of CNC system |
| CO4 | Develop and Simulate CNC part program for a given components |

| **Course Content** | | |
|---|---|---|
| **Unit No.** | **Unit title and Content** | **Hrs** |
| 1 | **Fundamentals of CNC and Control Systems**<br>Introduction to Numerical Control in computer aided manufacturing, components of a CNC system, types of CNC systems, open loop and closed loop control systems. | **06** |

| | | |
|---|---|---|
| 2 | **Drives, Feedback, and CNC Machine Construction** Drives and controls, interpolators, feedback devices, CNC machine constructional features. | **06** |
| 3 | **CNC Tooling, and Advanced System Feature**<br>CNC design considerations, CNC turret punch press, tooling for CNC, APC, ATC, CNC machine accessories, advanced features of CNC system | **06** |
| 4 | **CNC Programming and Simulation Tools**<br>Conversational and graphics based software, solids based part programming, free form surface machining, simulation and verification of CNC programs, Manual Part Programming, | **06** |
| 5 | **Advanced CNC Programming and System Utilization**<br>Computer assisted part programming. Maintenance and installation of CNC systems, utilization of CNC machines. | **06** |
| 6 | **CNC Part Programming for Turning and Milling Applications**<br>CNC part programming for turning and milling, post processors, CNC part programming with CAD-CAM. | **06** |

**Texts Books:**

**1.**Rao, P. N., "*CAD/CAM: Principles and Applications*" , McGraw-Hill, 3rd edition, 2010.
2. B. S. Pabla, "*CNC Machines*", New Age International Pvt. Ltd., 3rd edition, 2018
3. V. K. Jain, "*Advanced Machining Processes*", Allied Publishers Pvt. Ltd., 1st edition, 2007

**Reference Book:**

1. S. Krar, A. Gill.,"*CNC Technology and Programming*", McGraw-Hill Publishing Co., 1st edition, 1990.
2. P. J. Amic, "*Computer Numerical Control Programming*", Prentice Hall, 1st edition, 1996.
3. K. J.Astrom, B. Wittenmark, "Adaptive Control" ,2nd Edition,1994
4. Alan Overby , "*CNC Machining Handbook*", McGraw-Hill,1st edition, 2010

| **Title of the Course Name**: Advances in Welding and Joining Technology<br>**Course Code**: P25MP203 | **L** | **T** | **P** | **Credits** |
|---|---|---|---|---|
| | 3 | -- | -- | 3 |
| | ISE | MSE | ESE | Total |
| | **20** | **30** | **50** | **100** |

**Prerequisite**: Materials, Metallurgy

**Course Objectives:** The course aims to:
1 To introduce the principles, classifications, and applications of conventional and advanced welding and joining processes.
2 To develop understanding of modern welding technologies such as laser beam welding, electron beam welding, hybrid welding, and solid-state joining methods.
3 To explain the thermal and metallurgical aspects of welding, including heat transfer, solidification, stress analysis, and weld joint design.
4 To impart knowledge of weld defect analysis, non-destructive testing methods, and safety practices in welding operations.

**Course Outcomes: At the end of the course, students will be able to:**

| | |
|---|---|
| CO1 | Select the appropriate welding process for the application |
| CO2 | Select the appropriate input parameters for enhancing weld quality |
| CO3 | Describe the melted and heat affected zone of a metal |
| CO4 | Describe the welding defects and Analyze the stresses in welding structures |

| **Course Content** | | |
|---|---|---|
| **Unit No.** | **Unit title and Content** | **Hrs** |
| 1 | **Fundamentals of Welding Processes**<br>Welding processes classification, arc welding processes-solid state welding processes, plasma arc welding and ultrasonic welding - Resistance welding process-different types weld joints, welding positions. | **06** |
| 2 | **Secondary Joining Methods**<br>Brazing, soldering and adhesive bonding, process principles & applications, Comparison with welding methods, Selection of joining methods for specific applications | **06** |

| | | |
|---|---|---|
| 3 | **Advanced Welding Techniques**<br>Electron beam welding -Laser beam welding -Hybrid welding -CMT welding –SpinArc GMAW –Tandem GMAW -Activated TIG welding-Hot wire TIG welding-Diffusion bonding -Weld Surfacing & cladding. | **06** |
| 4 | **Solid-State and High-Energy Welding Methods**<br>Friction Surfacing, Friction stir spot welding, Explosive Welding, Welding of Al and Mg based alloys -Dissimilar welding of Non-ferrous alloys -Friction welding with Cu interlayer, Magnetically impelled arc butt (MIAB) welding -Under water welding -Welding of Cu, Al, Ti and Ni alloys | **07** |
| 5 | **Weld Metallurgy and Thermal Considerations**<br>Heat transfer during welding, Solidification mechanisms in welds, Heat Affected Zone, Residual stresses and their effects, Pre-weld and post-weld heat treatments, design consideration in weld joint. | **06** |
| 6 | **Inspection, Defects, and Safety in Welding**<br>Types and causes of welding defects,Methods of defect prevention and correction,Inspection and testing of welds,Visual, Radiographic, Ultrasonic, Magnetic Particle, Dye Penetrant testing,Safety measures in welding environments,Codes and standards related to welding quality and safety | **06** |

**Text Books**

1 Dr. R.S. Parmar, *"Welding Processes and Technology"*, Khanna Publishers, 3rd ed.,2011.
2 H.S. Bawa, *"Manufacturing Technology– I"*, Tata McGraw Hill Publishers, 2007
3 P. L. Jain, *"Principles of Foundry Technology"*, Tata McGraw Hill Publishers, 5th ed., 2012.

**Reference Book:**

1 S.V. Nadkarni, *"Modern Arc Welding Technology"*, Oxford & IBH Publishing Co. Pvt. Ltd., 2nd ed., 2018.
2 Cornu J.**,** *"Advanced Welding Systems – Volumes I, II and III"*, JAICO Publishers, 1st ed,1994
3. J.F. Lancaster, *"Metallurgy of Welding"*, George Allen & Unwin Publishers, 1980
4. Howard B. Cary & Scott C. Helzer, *"Modern Welding Technology"*, Prentice Hall, 5th ed. 2001**.**

| **Title of the Course Name**: Computer Integrated Manufacturing<br>**Course Code**: P25MP204A | **L** | **T** | **P** | **Credits** |
|---|---|---|---|---|
| | 3 | -- | -- | 3 |
| | ISE | MSE | ESE | Total |
| | **20** | **30** | **50** | **100** |

**Prerequisite**: Manufacturing Processes, Basic Mathematics and Geometry

**Course Objectives:** The course aims to:
1. To explain the importance of sustainable practices in modern manufacturing systems.
2. To describe the procedure and key elements involved in life cycle assessment.
3. To analyze green manufacturing models for improving process sustainability.
4. To apply sustainability frameworks and green manufacturing principles in the development of smart factories.

**Course Outcomes: At the end of the course, students will be able to:**

| | |
|---|---|
| CO1 | Explain the need and significance of sustainable manufacturing processes |
| CO2 | Describe the procedure of life cycle assessment in a manufacturing context |
| CO3 | Analyze the need and significance of green manufacturing modeling |
| CO4 | Interpret the role of renewable energy in green machining |
| CO5 | Apply the sustainability and green manufacturing system in developing a smart factory |

| **Course Content** | | |
|---|---|---|
| **Unit No.** | **Unit title and Content** | **Hrs** |
| 1 | **Introduction to Computer Integrated Manufacturing and Automation** Computers and manufacturing systems, Computer numerical control, Automation in Production Systems, automated manufacturing systems- types of automation, reasons for automating, computerized elements of a CIM system, CAD/CAM and CIM. Mathematical models and matrices: production rate, production capacity, utilization and availability, manufacturing lead time, work-in process, | **06** |

| | | |
|---|---|---|
| 2 | **Automated Production and Assembly Line Systems**Fundamentals, system configurations, applications, automated flow lines, buffer storage, control of production line, analysis of transfer lines, analysis of flow lines without storage, partial automation, analysis of automated flow lines with storage buffer, fundamentals of automated assembly systems, numerical problems. | **06** |
| 3 | **Computer-Aided Design and Geometric Transformations**<br>The design process, applications of computers in design, software configuration, functions of graphics package, constructing the geometry. Transformations: 2D transformations, translation, rotation and scaling, homogeneous transformation matrix, concatenation, numerical problems on transformations | **06** |
| 4 | **Group Technology, FMS, and Line Balancing Techniques**<br>Fundamentals of Group Technology and Flexible Manufacturing Systems, types of FMS, FMS components, Material handling and storage system, applications, benefits, computer control systems, FMS planning and design issues, Automated Storage and Retrieval Systems, Line Balancing: Line balancing algorithms, methods of line balancing, | **06** |
| 5 | **Industrial Robotics and Applications**<br>Robot anatomy, joints and links, common robot configurations, robot control systems, accuracy and repeatability, end effectors, sensors in robotics. Robot programming methods: on-line and off-line methods. Robot industrial applications: Material handling, processing and assembly and inspection. | **08** |
| 6 | **Computerized Manufacturing Planning and Control Systems**<br>Computer Aided Process Planning, Retrieval and Generative Systems, benefits of CAPP, Production Planning and Control Systems, typical activities of PPC System, computer integrated production management system, Material Requirement Planning, inputs to MRP system, working of MRP, outputs and benefits, Capacity Planning, Computer Aided Quality Control, Shop floor control | **06** |

**Texts Books**

**1.**Rehg, J. A, "*Computer-Integrated Manufacturing"*, Prentice Hall ,3rd edition, 2004.
2.Scheer, A.-W., "*CIM: Computer Integrated Manufacturing – Towards the Factory of the Future*", Springer, 3rd edition, 1994.
3.Rao, P. N., "*CAD/CAM: Principles and Applications*" , McGraw-Hill, 3rd edition, 2010.

**References:**

1.Groover, M.P.,"*Automation, production systems, and computer-integrated*", Tata McGraw Hill. 5th edition, 2011.
2. Weatherall, A."*Computer integrated manufacturing: from fundamentals to implementation*". Butterworth-Heinemann, 2nd edition, 2013
3. Alasdair Gilchrist ,"*Industry 4.0: The Industrial Internet of Things*", Apress,1st edition, 2017,

| **Title of the Course Name**: Total Productive Maintenance<br>**Course Code**: P25MP204B | **L** | **T** | **P** | **Credits** |
|---|---|---|---|---|
| | 3 | -- | -- | 3 |
| | ISE | MSE | ESE | Total |
| | **20** | **30** | **50** | **100** |

**Prerequisite**: Production systems, TQM

**Course Objectives:** The course aims to:
1. To impart fundamental knowledge of Total Productive Maintenance.
2. To develop the ability to analyze and implement various maintenance models.
3. To enable students to plan, implement, and evaluate TPM practices.
4. To introduce students with advanced maintenance management techniques.s

**Course Outcomes: At the end of the course, students will be able to:**

| | |
|---|---|
| CO1 | Apply maintenance strategies to increase the productivity of plant and equipment with modest investment. |
| CO2 | Explain the key operational activities involved in a quality management system. |
| CO3 | Analyse the causes of accelerated deterioration during the production process. |
| CO4 | Evaluate the root causes of productivity losses in industrial operations. |
| CO5 | Employing consultants to create this culture is common practice. |

| **Course Content** | | |
|---|---|---|
| **Unit No.** | **Unit title and Content** | **Hrs** |
| 1 | **Fundamentals of Maintenance and TPM Concepts**<br>Outline of TPM. Maintenance Concepts, Objectives and functions, Tero technology, Reliability Centered, Maintenance, (RCM), maintainability prediction, availability and system, effectiveness, organization for maintenance | **06** |
| 2 | **Equipment Effectiveness and Preventive Maintenance Models**<br>TPM-challenging limits, maximizing equipment effectiveness, Maintenance Models, Minimal repair, maintenance types, balancing preventive maintenance, and breakdown maintenance, preventive maintenance schedules: deviations on target values, preventive maintenance schedules: functional characteristics, replacement models | **06** |

| | | |
|---|---|---|
| 3 | **TPM Structure**<br>Organizing for TPM implementation, PM Concepts, Importance of TPM, Zero breakdown concepts, Zero Defects and TPM, maximizing equipment effectiveness, autonomous maintenance program, five pillars of TPM, TPM Small group activities | **06** |
| 4 | **TPM Planning, Implementation, and Global Trends**<br>TPM implementation and stabilization, TPM Planning and Implementation, Organization for TPM, management decision, awareness and training for TPM, establishment of basic policies and goals, formation of master plan, TPM implementation, Ongoing global trends in TPM. | **06** |
| 5 | **Human Factors and Maintenance Logistics**<br>TPM small group activities, Maintenance Logistics, Human factors in maintenance, maintenance manuals, maintenance staffing methods, queuing applications, simulation, spare parts management, maintenance planning and scheduling | **06** |
| 6 | **Advanced Maintenance Techniques and Condition Monitoring**<br>The PM prize for outstanding TPM plants, Online Monitoring Condition Monitoring Techniques, Vibration Monitoring and Signature Analysis. Wear Debris Monitoring, Maintenance Management Information System, Expert systems, Corrosion Monitoring and Control. | **06** |

**Text Books:**

1.R. Srinivasan, "*Total Productive Maintenance"*, Prentice Hall India, 1st Edition, 2006.
2.Amit Kumar Gupta and S. Ghosh, "*Total Productive Maintenance: A Systematic Approach"*, Laxmi Publications, 1st Edition, 2012.
3. P. A. Kumar, "*TPM Implementation: A Practical Approach"*, Notion Press, 1st Edition, 2018.

**Reference Books:**

1.Nahchi-Fujikoshi Corporation, "*Training for TPM*", Japan Institute of Plant Maintenance, 1st Edition, 1990.
2.S. Nakajima, "*Introduction to TPM: The Purtor Factory*", Japan Institute of Plant Maintenance, 1st Edition, 1986.
3. S. Nakajima, "*TPM: Maintenance Prevention Design*", Productivity Press Inc., 1st Indian Edition, 1993.
4.K. Shirose, Y. Kimura, and M. Kaneda, "*An Advanced Step in TPM Implementation*", Japan Institute of Plant Maintenance,2nd Edition, 1995.

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## Department of Mechanical Engineering

| Title of the Course Name: **Lasers in Manufacturing**<br>Course Code: P25MP204C | **L** | **T** | **P** | **Credits** |
|---|---|---|---|---|
| | 3 | 1 | -- | 4 |
| | ISE | MSE | ESE | Total |
| | **20** | **30** | **50** | **100** |

**Course Objectives:** The course aims to:

1 To introduce the fundamentals of laser technology and its significance in various manufacturing processes.
2 To provide comprehensive knowledge of laser-based processes such as cutting, welding, surface treatment, and forming.
3 To expose students to advanced laser applications in additive manufacturing and laser-assisted machining.
4 To enable students to understand the integration of lasers with automation systems such as CNC and CAD for modern manufacturing.

**Course Outcomes: At the end of the course, students will be able to:**

| | |
|---|---|
| CO1 | Explain the need and significance of lasers in modern manufacturing processes. |
| CO2 | Describe the mechanism and key parameters of the laser welding process and analyze common defects in welds. |
| CO3 | Illustrate the laser-based surface modification techniques such as hardening, alloying, and cladding, and evaluate their effects on material properties. |
| CO4 | Compare laser-based additive manufacturing and laser-assisted machining processes in terms of working principles, parameters, and outcomes. |

| Course Content | | |
|---|---|---|
| **Unit No.** | **Unit title and Content** | **Hrs** |
| 1 | **Fundamentals of Laser Technology in Manufacturing**<br>Lasers in manufacturing: Importance and application, Fundamentals of Laser Technology, Laser system: Construction and types, Principle of operation, Types of laser cutting and kerf geometry, Types of Lasers in material removal, process and performance parameters | **06** |
| 2 | **Laser Welding and Forming Techniques**<br>Mechanisms of laser welding, effects of process parameters during laser welding and study of defects in weld beads, Material forming and fundamental of laser forming, process parameters and their effects on the performance of laser forming. | **07** |
| 3 | **Laser Surface Engineering**<br>Surface treatment and applications of lasers, laser surface hardening, laser surface alloying, Lasercladding | **05** |
| 4 | **Laser-Based Additive Manufacturing**<br>Additive manufacturing techniques, Laser scanning stereolithography, selective laser sintering and selective laser melting, process and performance parameters of laser based additive manufacturing techniques | **06** |
| 5 | **Automation and Integration in Laser Manufacturing**<br>Lasers in manufacturing automation, CNC for laser-based manufacturing, CAD for laser-based manufacturing, Laser assisted material forming, effect of coatings, 3D laser forming and micro forming. | **06** |

**Text Books**:
1. W. M. Steen, "*Laser Material Processing"*, Springer-Verlag, London, 4th edition. 2005.
2. S. N. Joshi and U. S. Dixit, "*Laser Based Manufacturing"*, Springer India, 2015.

**Reference Books**:
1. N. B. Dahotre & A. Samant, "*Laser Machining of Advanced Materials"*, CRC Press, London, 1st ed, 2011.
2. K. Sugioka, M. Meunier & A. Piqué, "*Laser Precision Microfabrication"*, Springer-Verlag, Berlin/Heidelberg, 2010.
3. J. C. Ion," *Laser Processing of Engineering Materials"*, Elsevier, 2005.

| **Title of the Course Name:** Environment and Development<br>**Course Code:** P25MD205A | **L** | **T** | **P** | **Credits** |
|---|---|---|---|---|
| | 3 | -- | -- | 3 |
| | ISE | MSE | ESE | Total |
| | **20** | **30** | **50** | **100** |

**Pre-Requisite:** Basic knowledge of environmental science and sustainable practices

**Course Objectives:**

1. To understand the interrelationship between environment and development.
2. To assess the impact of development activities on ecosystems, biodiversity, and natural resources.
3. To analyze sustainable development concepts, environmental ethics, and green technologies.
4. To explore national and international environmental policies and enhance awareness on climate change and mitigation strategies.

**Course Outcomes: At the end of the course, students will be able to**

| | |
|---|---|
| CO1 | Recall and summarize the core concepts of environmental science, sustainable development, climate change, resource degradation, and ecological ethics. |
| CO2 | Interpret the interrelationships between environment, development, governance policies, and technological strategies for sustainability. |
| CO3 | Apply the principles of sustainable development, green technologies, and environmental ethics. |
| CO4 | Evaluate contemporary environmental issues and global case studies to assess the effectiveness of policies, renewable technologies, and sustainable practices. |

| **Course Content** | | |
|---|---|---|
| **Unit No.** | **Unit title and Content** | **Hrs** |
| 1 | **Introduction to Environment and Development**<br>Definition and Scope, Need for Sustainable Development, Historical | **6** |

| | | |
|---|---|---|
| | Background, Environmental Movements. | |
| 2 | **Natural Resources and Environmental Degradation**<br>Types of Natural Resources, Resource Depletion, Land Degradation, Pollution and Biodiversity Loss. | **6** |
| 3 | **Sustainable Development and Environmental Ethics**<br>Principles of Sustainability, Environmental Ethics, Ecological Footprint, Green and Clean Technologies. | **6** |
| 4 | **Climate Change and Global Concerns**<br>Climate Change Causes and Impacts, Global Warming, Carbon Cycle, Adaptation and Mitigation Strategies. | **6** |
| 5 | **Policy and Governance**<br>Environmental Policies, Acts and Protocols (India & Global), Role of Government and NGOs, Environmental Impact Assessment (EIA). | **6** |
| 6 | **Contemporary Issues and Case Studies**<br>Urbanization and Environment, Renewable Energy, Case Studies on Sustainable Practices in India and Abroad. | **6** |

**Text Books:**

1. R. Rajagopalan, *"Environmental Studies: From Crisis to Cure"*, Oxford University Press, 3rd edition, 2016.
2. Erach Bharucha, *"Textbook of Environmental Studies"*, UGC Publication, 1st edition, 2005.
3. P. D. Sharma, *"Ecology and Environment"*, Rastogi Publications, 11th edition, 2021.

**Reference Books:**

**1.** W. P. Cunningham and M. A. Cunningham, *"Principles of Environmental Science"*, Tata McGraw-Hill, 7th edition, 2014.

2. D. B. Botkin and E. A. Keller, *"Environmental Science: Earth as a Living Planet"*, Wiley India, 8th edition, 2011.

3. J. D. Sachs,*"The Age of Sustainable Development"*,Columbia University Press, 1st ed., 2015.

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## Department of Mechanical Engineering

| Course Name: **Engineering Economics** | **L** | **T** | **P** | **Credits** |
|---|---|---|---|---|
| **Course Code:** P25MD205B | 3 | -- | -- | 3 |
| | ISE | MSE | ESE | Total |
| | **20** | **30** | **50** | **100** |

**Pre-Requisite:** Mathematics**,** Management Information Systems (MIS)

**Course Objectives: The course aims,**

1. To understand fundamental economic concepts and cost analysis in engineering.
2. To apply interest formulas and cash flow techniques to evaluate alternatives.
3. To analyse depreciation and asset replacement decisions.
4. To evaluate public vs private projects with cost-benefit considerations.

**Course Outcomes: At the end of the course, students will be able to:**

| | |
|---|---|
| **CO1** | Recall and define key concepts in engineering economics such as cost elements, interest factors, cash flow models, depreciation techniques, and project financing. |
| **CO2** | Interpret and compare economic decision-making tools including present worth, future worth, annual equivalent, and rate of return across engineering applications. |
| **CO3** | Apply economic analysis techniques to evaluate material selection, make-or-buy decisions, equipment replacement, depreciation schedules, and project investments. |
| **CO4** | Evaluate engineering alternatives and public-private project outcomes using life-cycle costing, value engineering principles, and inflation-adjusted economic assessments. |

**Course Contents**

| Unit No. | Contents | Hours |
|---|---|---|
| 1 | **Introduction Engineering Economy:** Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering – Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics – Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis, P – V ratio, Elementary economic Analysis– Material selection for product, Design selection for a product, Process planning. | 6 |
| 2 | **Value Engineering:** Make or buy decision, Value engineering – Function, aims, Value engineering procedure. Interest formulae and their applications– Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fundfactor,EqualpaymentseriespaymentPresentworthfactor– equalpaymentseriescapitalrecovery factor – Uniform gradient series annual equivalent factor, Effective interest rate,Examples in all the methods. | 6 |
| 3 | **Cash Flow:** Methods of comparison of alternatives – Present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, Cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, Cost dominated cash flow diagram), rate of return method, Examples in all methods. | 6 |
| 4 | **Replacement And Maintenance Analysis:** Replacement and Maintenance analysis – Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset– capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely. | 6 |
| 5 | **Depreciation:** Depreciation – Introduction, Straight line method of depreciation, – Declining balance method of depreciation – Sum of the years digits method of depreciation, – Sinking fund method of depreciation/Annuity method of depreciation, service output method of depreciation – Evaluation of public alternatives – Introduction – Examples – Inflation adjusted decisions – Procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset. | 6 |
| 6 | **Financing & Public vs Private Projects:** Financing sources, economic evaluation in public projects, social costs, and regulatory factors. | 6 |

**Text Books:**

1. Panneer Selvam, R, "*Engineering Economics*", Prentice Hall of India Ltd, New Delhi,2001.
2. Suma Damodaran, " *Managerial economics*", Oxford university press2006
3. Stonier and hauge "A Text book of Economic Theory" by, pearson Publication.

**Reference Books:**

1. Sampat Mukherjee, *"Modern Economic Theory"*, New Age International Publisher, 1st edition.
2. DeGarmo, *"Engineering Economics"*, Prentice Hall, 1st edition.
3. Bo Sodersten, *"International Economics"*, Macmillan, 1st edition

| Course Name: **Project Management** | **L** | **T** | **P** | **Credits** |
|---|---|---|---|---|
| | 3 | -- | -- | 3 |
| Course Code: **P25MD205C** | ISE | MSE | ESE | Total |
| | **20** | **30** | **50** | **100** |

**Pre-Requisite:** Knowledge of simple geometrical theories and their constructional procedure.

**Course Objectives: The course aims,**

1. To impart basic concepts Project Management.
2. To impart and inculcate proper understanding of the Project Management.
3. To improve the visualization skill of Project Management.
4. To impart knowledge about standard principles of Project Management.

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

| | |
|---|---|
| **CO1** | Recall and summarize project management fundamentals, work breakdown structures, scheduling tools, resource allocation, and control strategies. |
| **CO2** | Interpret and explain the stages of project management, scheduling techniques, cost estimation, and contract and procurement processes. |
| **CO3** | Apply project planning, scheduling, resource optimization, and project execution techniques using tools like Gantt charts, CPM/PERT, and cost-time trade-offs. |
| **CO4** | Evaluate project success through monitoring, post-project evaluation, financial control, and risk analysis to improve future project outcomes. |

**Course Contents**

| Unit No. | Contents | Hours |
|---|---|---|
| 1 | **Introduction to Project management:** Definition and objectives of Project Management, Characteristics of projects, Stages of Project Management, Project Planning Process, Establishing Project organization. Work definition: Defining work content, Time Estimation Method, Project Cost Estimation and budgeting, Project Risk Management, Project scheduling and Planning Tools: Work Breakdown structure, LRC, Gantt charts, CPM/PERT Networks. | 6 |
| 2 | **Project Planning and Resource Optimization:** Developing Project Plan (Baseline), Project cash flow analysis, Project scheduling with resource constraints: Resource Leveling and Resource Allocation. Time Cost Trade off: Crashing Heuristic. | 6 |
| 3 | **Project Execution and Control Strategies:** Project Implementation: Project Monitoring and Control with PERT/Cost, Computers applications in Project Management, Contract Management, Project Procurement Management. Post-Project Analysis. | 6 |
| 4 | **Project Scheduling & Control:** Developing Project Plan (Baseline), Project cash flow analysis, Project scheduling with 28 resource constraints: Resource Leveling and Resource Allocation. Time Cost Trade off: Crashing Heuristic. | 6 |
| 5 | **Project Execution, Monitoring & Evaluation:** Project Implementation: Project Monitoring and Control with PERT/Cost, Computers applications in Project Management, Contract Management, Project Procurement Management. Post-Project Analysis. | 6 |

**Reference Books:**

1. Shtub, A., Bard, J. F., & Globerson, S., *"Project Management: Engineering, Technology and Implementation"*, Prentice Hall India, 1st edition,
2. Lock, D., *"Project Management Handbook"*, Gower Publishing, 1st edition

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## Department of Mechanical Engineering

| Title of the Course Name: **Healthcare Engineering** | **L** | **T** | **P** | **Credits** |
|---|---|---|---|---|
| | 3 | -- | -- | 3 |
| Course Code:**P25MD205D** | ISE | MSE | ESE | Total |
| | **20** | **30** | **50** | **100** |

**Pre-Requisite:** Basics of Management, Market Research Fundamentals, Financial Accounting Basics.

**Course Objectives:** The course aims:

1. To understand how the healthcare system works and what challenges it faces.
2. To learn how to improve hospital services using planning and optimization methods.
3. To study how patient waiting lines and hospital processes can be modeled and improved.
4. To explore new technologies like AI, remote care, and digital tools in future healthcare.

| **Course Outcomes: Students will be able to** | |
|---|---|
| **CO1** | Recall fundamental components of healthcare systems, including resource planning, queuing models, data flows, and innovations in digital health. |
| **CO2** | Interpret and formulate mathematical models for workforce optimization, facility layout, patient queuing, and healthcare delivery systems |
| **CO3** | Apply optimization, queuing theory, and simulation methods to enhance healthcare system efficiency, throughput, and patient experience. |
| **CO4** | Evaluate emerging healthcare technologies and simulation outcomes to improve clinical operations, policy design, and access to quality care. |

| Unit No. | Unit title and Content | Hours |
|---|---|---|
| 1 | **Introduction to Healthcare System**<br>**Introduction:** Facets of a Healthcare System, Size of a Healthcare System, Health Insurance and Financing, Healthcare Services, Healthcare Ecosystem, Healthcare System Challenges, Access to Healthcare, Healthcare Systems Engineering, Understanding Delivery: Data and Processes: Types of Healthcare Data, National Datasets, Healthcare Delivery Process Data, Process Throughput | 7 |
| 2 | **Healthcare Resource Workforce and Access to Care Optimization**<br>**Workforce:** Optimization, Supply-Demand Matching, Assignment Models, Optimization : Facility Optimization, Developing Facility Layout to Minimize Travel Wastage, Considering Multiple Conflicting Objectives, Optimization using a Modeling Language | 7 |
| 3 | **Modeling Patient Queues**<br>Kendall's Notation for Queuing Systems, Little's Law, Markovian Queuing Models: M/M/1, M/G/1 Queuing Model, Modeling Interconnected Services using Queuing Networks. | 5 |
| 4 | **Healthcare System Simulation**<br>Building a Simulation Study Framework, Event Calendars in Discrete Event Simulation, Input Modeling in Simulation, Output Analysis in Simulation, Estimation in a Non-Terminating, Non-Stationary System: Emergency Department, Simulation of a Hospital Queuing Network | 6 |
| 5 | **Future of Healthcare**<br>Shifting from Volume to Value, Evidence-Based Medicine, Personalized Medicine, Vision of the Future, Connected Medicine, Disease and Condition Management: Virtual Assistants, Remote Monitoring, Medication Adherence, Accessible Diagnostic Tests, Smart Implantable, Digital Health and Therapeutics, AI, Conversational AI, Making and rationalizing decisions: Drug discovery, 3-D printing, Personalized prosthetics, Bioprinting and tissue engineering, Pharmacology and devices, Education, Gene therapy, Virtual and Augmented Reality, Merged Reality, Pain Management, Physical Therapy, Nursing and Delivery of Medicine, Virtual Appointments and Classrooms, Blockchain, Patient Record Access, Applications of AI in Healthcare | 10 |

**Reference Books:**

1. Sanjay Mehrotra, Kevin Bui, *"Healthcare Engineering"*, Springer, 1st edition, 2022.
2. Arjun Panesar, *"Machine Learning and AI for Healthcare"*, Apress, 1st edition, 2019.

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## Department of Mechanical Engineering

| Title of the Course Name: **Technologies for Industrial Evolution**<br><br>**Course Code:** P25MD206 | **L** | **T** | **P** | **Credits** |
|---|---|---|---|---|
| | 3 | -- | -- | 3 |
| | ISE-I | ISE-II | ESE | Total |
| | **25** | **25** | **-** | **50** |

**Pre-Requisite:** Knowledge of Automation, IoT and Industrial Engineering.

| **Course Objectives: The course aims,** |
|---|
| 1. To understand the key technologies & impact of technological evolution on modern industries.<br>2. To provide insight into the integration of AI, Big Data, and Cloud Computing in industrial operations.<br>3. To familiarize students with digital twin, predictive maintenance, and robotic process automation.<br>4. To enable students to analyze current trends and future directions in industrial digitization. |

| **Course Outcomes: Students will be able to** | |
|---|---|
| **CO1** | Recall the evolution, core technologies, digital tools, automation systems, predictive analytics, and future trends shaping Industry 4.0. |
| **CO2** | Interpret the role and integration of smart technologies such as IIoT, AI, cloud computing, and robotics in modern manufacturing ecosystems. |
| **CO3** | Apply digital transformation methods and smart manufacturing tools to solve real-world challenges in automation, condition monitoring, and fault diagnostics. |
| **CO4** | Evaluate the impact of Industry 4.0 initiatives using sustainability frameworks, case study insights, and advanced tools like digital twins and 5G networks. |

## Course Contents

| Unit No. | Contents | Hours |
|---|---|---|
| 1 | **Introduction to Industrial Evolution** Historical Industrial Revolutions, Key Drivers of Industry 4.0, Comparison of Industry 3.0 and 4.0, Global Trends and Indian Scenario. | 06 |
| 2 | **Core Technologies in Industry 4.0** IIoT, Smart Sensors, Embedded Systems, Cyber Physical Systems (CPS), Edge and Fog Computing. | 06 |
| 3 | **Digital Transformation Tools** Cloud Computing, Big Data Analytics, AI & Machine Learning for Industry, Blockchain in Supply Chain. | 06 |
| 4 | **Automation and Smart Manufacturing** Additive Manufacturing, Smart Factories, Industrial Robotics, Human-Machine Collaboration. | 06 |
| 5 | **Predictive Maintenance and Digital Twin** Condition Monitoring, Real-time Data Acquisition, Digital Twin Modeling, Fault Diagnosis. | 06 |
| 6 | **Future Trends and Case Studies** Green Manufacturing, Sustainable Technologies, 5G for Industry, Case Studies on Digital Transformation. | 06 |

**Text Books:**

**1.** Alasdair Gilchrist, "*Industry 4.0: The Industrial Internet of Things*", Apress, 1st Edi., 2016.
**2.**SabinaJeschke, "*Industrial Internet of Things: Cyber Manufacturing Systems*", Springer, 1st Edition, 2017.
**3.** Markus Brettel,"*How Virtualization, Decentralization and Network Building Change the Manufacturing Landscape: An Industry 4.0 Perspective*", Procedia CIRP (Elsevier), 1st Edition, 2014.

**Reference Books:**

**1.**Douglas M. Considine and Glenn D. Considine, *"Standard Handbook of Industrial Automation"*, Springer, 1st Edition, 1987.
**2.** Norman A. Anderson, *"Instrumentation for Process Measurement and Control"*, Chilton Company, 3rd Edition, circa 1990.
**3.**Olushola Akande, *"Industrial Automation from Scratch"*, Packt Publishing,1st Edition, 2023.

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An Autonomous Institute

## Department of Mechanical Engineering

| **Title of the Course Name:** Mini Project<br>**Course Code:** P25MP207 | **L** | **T** | **P** | **Credit** |
|---|---|---|---|---|
| | -- | -- | 2 | 1 |
| | ISE | MSE | ESE | Total |
| | **50** | **--** | **50** | **100** |

**Pre-Requisites**: Previously studied courses.

**Course Objectives:** The course aims to:
1. To identify and define real-time engineering or managerial problems
2. To develop innovative solutions using current tools and technologies.
3. To enhance teamwork and project execution skills.
4. To improve technical documentation and presentation abilities.

**Course Outcomes: At the end of the course, students will be able to:**

| | |
|---|---|
| CO1 | Identify and define an engineering or industrial problem of practical relevance or research interest. |
| CO2 | Analyze the problem systematically and apply domain knowledge to propose viable solutions. |
| CO3 | Document the project findings clearly in a structured report and defend the work through oral presentation. |
| CO4 | Demonstrate initiative, self-learning, and professional responsibility in executing project tasks individually or collaboratively. |

| **Title of the Course Name:** PG LAB-II<br>**Course Code**: P25MP208 | **L** | **T** | **P** | **Credits** |
|---|---|---|---|---|
| | -- | -- | 4 | 2 |
| | ISE | MSE | ESE | Total |
| | **50** | **--** | **50** | **100** |

**Prerequisite**:- Basic Geometry, Machine Tools.

**Course Objectives:** The course aims to:
1 To demonstrate the working mechanism of EDM.
2 To apply statistical quality control tools and software
3 To design and simulate pneumatic circuits for industrial automation applications
4 To develop CNC part programs using commercial CAD/CAM software tools.

**Course Outcomes: At the end of the course, students will be able to:**

| | |
|---|---|
| CO1 | Explain the working mechanism of EDM |
| CO2 | Use of statistical quality control software to analyze data |
| CO3 | Design a pneumatic circuit for the given application |
| CO4 | Develop a CNC program and simulation of given component. |

**Perform the following experiments (Any five)**

| **Exp. No.** | **Content** |
|---|---|
| 1 | Study of EDM/Wire EDM for metal machining |
| 2 | Use of statistical quality control software for process optimization like Minitab, LibreOffice Calc, SOFA Statistics, PSPP, R (with QCC package) |
| 3 | Sequencing of cylinders using Pneumatic trainer kit |
| 4 | Modelling of component and determination of mass properties |
| 5 | Synchronizing of cylinders using Pneumatic trainer kit |
| 6 | Develop a CNC program for rough and finish turning of a step shaft. |
| 7 | Develop a CNC program for turning operations using canned cycle |

| | |
|---|---|
| 8 | Tool Path Simulation Using Software. |

# Exit Courses after Semester– II - P.G. Diploma

| Type of Course | Course Code | Course Name | Teaching Scheme | | | | Evaluation Scheme | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Cr | Components | Max | Min for Passing | |
| PCC | P25MP209 | Management Information System | 3 | 1 | - | 4 | ISE-I | 50 | 20 | |
| | | | | | | | ISE-II | 50 | 20 | |
| ELC | P25MP210 | Internship/ Training | | - | 8 | 4 | ISE-I | 50 | 20 | |
| | | | | | | | ISE-II | 50 | 20 | |
| **Total** | | | **3** | **1** | **8** | **8** | **200** | | | |

| **Title of the Course Name**: Management Information System<br>**Course Code**: P25MP210 | **L** | **T** | **P** | **Credits** |
|---|---|---|---|---|
| | 4 | - | -- | 4 |
| | ISE | MSE | ESE | Total |
| | **50** | **-** | **50** | **100** |

**Pre-Requisite**: Basic computer knowledge, Production and Manufacturing,

**Course Objectives:** The course aims to:
1.To introduce key terminologies and foundational concepts in marketing management, IT.
2.To equip students with the skills to design, develop, and implement IT solutions to improve overall efficiency.
3.To understand and critically evaluate ethical and legal issues in business.
4. To develop project planning, teamwork, and time management skills.

**Course Outcomes: At the end of the course, students will be able to:**

| | |
|---|---|
| CO1 | Determine key terminologies and concepts including IT, marketing, management, economics, accounting, finance in the major areas of business |
| CO2 | Demonstrate understanding of computer systems, hardware, software, and data resource management in enterprise computing environments. |
| CO3 | Analyze the use of telecommunications, networking, and ERP systems in developing and managing business/IT solutions across functional areas. |
| CO4 | Evaluate the challenges and best practices in IT security, ethical issues, and global management of information technology in organizations. |

| **Course Content** | | |
|---|---|---|
| **Unit No.** | **Unit title and Content** | **Hrs** |
| 1 | **Introduction to Information Systems and Business Strategy**<br>Organization and Information Systems, Foundation Concepts, Information Systems in Business, The Components of Information Systems, Competing with Information Technology, Fundamentals of Strategic Advantage, Using Information Technology for Strategic Advantage. Changing Environment and its impact on Business, Kinds of Information Systems. | **06** |

| | | |
|---|---|---|
| 2 | **Computer Systems and Data Resource Management** Computer Fundamentals, Computer Hardware, Computer Systems: End User and Enterprise Computing, Computer Peripherals: Input, Output, and Storage Technologies, Computer Software, Application Software, System Software, Computer System Management, Data Resource Management, Technical Foundations of Database Management, Managing Data Resources | **06** |
| 3 | **Telecommunications and Networking in Business** Telecommunication and Networks, Telecommunications and Networks, The Networked Enterprise, Telecommunications Network Alternatives | **06** |
| 4 | **Business System Development and Implementation** Fundamentals, Implementation Challenges, Developing Business/IT Solutions, Developing Business Systems, Implementing Business Systems. | **06** |
| 5 | **Information Systems in Functional Areas and IT Management** Manufacturing and Service Systems Information systems for Accounting, Finance, Production and Manufacturing, Marketing and HRM functions, Enterprise Resources Planning (ERP), Choice of IT, Nature of IT decision, Managing Information Technology, Managing Global IT, | **06** |
| 6 | **IT Security, Ethics, and Global Management** Security and Ethical Challenges, Security and Ethical Challenges, Security and Ethical, and Societal Challenges of IT, Security Management of Information Technology, Enterprise and Global Management of Information Technology | **06** |

**Texts Books:-**

1. MahadeoJaiswal and Monika Mital, "*Management Information Systems*", Oxford University Press, 1st Edition, 2008.
2.C.S.V. Murthy, "*Management Information System: Text and Applications*", Himalaya Publishing House, 3rd Edition, 2013.

**Reference Books:-**

**1.** Kenneth J Laudon, "*Management Information Systems*", Pearson/PHI, 10th Edition, 2007.
2. W. S. Jawadekar, "*Management Information Systems*", TMH, 3rd Edition, 2004.