KAMARAJ
COLLEGE OF ENGINEERING & TECHNOLOGY
(An Autonomous Institution - AFFILIATED TO ANNA UNIVERSITY, CHENNAI)
S.P.G.Chidambara Nadar - C.Nagammal Campus
S.P.G.C. Nagar, K.Vellakulam – 625 701 (Near VIRUDHUNAGAR).

B.E. MECHANICAL ENGINEERING
REGULATION – 2020
AUTONOMOUS SYLLABUS
CHOICE BASED CREDIT SYSTEM
VII TO VIII SEMESTER CURRICULUM AND SYLLABI

VISION:

To make the Department of Mechanical Engineering the unique of its kind in the field of Research and Development activities in the prominent field of Mechanical Engineering in this part of the world.

MISSION:

To impart highly innovative and technical knowledge in the field of Mechanical Engineering to the urban and unreachable rural student folks through “Total Quality Education”.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEO 1: Graduates of the Programme will excel in Technical knowledge and apply Innovative skills in the field of Mechanical Engineering.

PEO 2: Graduates will contribute to the Technological Development and Research Activities through “Total Quality Education”.

PEO 3: Graduates of the Programme will accomplish the Leadership Qualities and Social Responsibilities through “Life Long Learning”.

PROGRAM OUTCOMES:

After going through the four years of study, the Mechanical Engineering graduates will have the ability to

POs	Graduate Attribute	Programme Outcome
1	Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2	Problem analysis	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	Design/evelopment of solutions	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4	Conduct investigations of complex problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5	Modern tool usage	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6	The engineer and society	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7	Environment and sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9	Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	Communication	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11	Project management and finance	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12	Life-long learning	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO1 : Graduates will be able to create and analyze the Research and Development activities related to Design and Manufacturing.

PSO2 : Graduates will be able to Design, Develop need based products in Mechanical Engineering and Allied Industries.

SEMESTER VII

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	ME1701	Principles of Industrial Engineering	PC	3	3	0	0	3
2	ME1702	Robotics	PC	3	3	0	0	3
3		Open Elective – II*	OE	3	3	0	0	3
4		Professional Elective – III	PE	3	3	0	0	3
5		Professional Elective – IV	PE	3	3	0	0	3
6		Professional Elective – V	PE	3	3	0	0	3
7		Online Course – 2**	OL	0	0	0	0	3
PRACTICALS								
8	ME1711	Automation & IOT Laboratory	PC	4	0	0	4	2
9	ME1721	Technical Seminar	EEC	2	0	0	2	1
			TOTAL	**24**	**18**	**0**	**6**	**24**

SEMESTER VIII

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
PRACTICALS								
1	ME1821	Project Work	EEC	20	0	0	20	10
2		Online Course – 2**						
			TOTAL	20	0	0	20	10

***** Course from the Curriculum of other UG Programme**.**

**The students shall complete the online course in this semester and credits would be added in consolidated mark sheet.

PROFESSIONAL ELECTIVES (PEs)

PROFESSIONAL ELECTIVE III (SEMESTER VII)

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1	ME1731	Concepts of Engineering Design	PE	3	3	0	0	3
2	ME1732	Mechatronics and IoT	PE	3	3	0	0	3
3	ME1733	Product Design using Value Engineering	PE	3	3	0	0	3
4	ME1734	Solar Energy Technology	PE	3	3	0	0	3
5	ME1735	Waste management and energy recovery	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE VI (SEMESTER VII)

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1	ME1736	Composite Materials	PE	3	3	0	0	3
2	ME1737	Power Plant Technology	PE	3	3	0	0	3
3	ME1738	Precision Manufacturing	PE	3	3	0	0	3
4	ME1739	Process Planning and Cost Estimation	PE	3	3	0	0	3
5	ME1740	Supply Chain Management	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE V (SEMESTER VII)

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1	ME1741	Entrepreneurship Development	PE	3	3	0	0	3
2	ME1742	Introduction to Industry 4.0	PE	3	3	0	0	3
3	ME1743	Lean Manufacturing	PE	3	3	0	0	3
4	ME1744	Maintenance Engineering	PE	3	3	0	0	3
5	GE1671	Total Quality Management	PE	3	3	0	0	3

OPEN ELECTIVE II (SEMESTER VII)

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
Offered to CSE,ECE,EEE,EIE, AI&DS, CIVIL, IT,BT and MTR								
1	OME761	3-D Printing and Design	OE	3	3	0	0	3
Offered to MTR,CIVIL.ECE.EIE,EEE and BT								
2	OME762	Industrial Safety	OE	3	3	0	0	3
Offered to CSE,ECE,EEE,EIE, AI&DS, CIVIL, IT,BT and MTR								
3	OME763	Selection of Materials	OE	3	3	0	0	3
4	OME764	Testing of Materials	OE	3	3	0	0	3

ME1701 PRINCIPLES OF INDUSTRIAL ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To enable students to understand the fundamental economic concepts for engineering and to learn the techniques of incorporating inflation factor in economic decision making.
- To equip the students about fundamental concept and principles of industrial safety.

UNIT I INTRODUCTION TO ECONOMICS 9

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 - V ratio, Elementary economic Analysis.

UNIT II JOINING PROCESSES 9

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 fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor - Uniform gradient series annual equivalent factor, Effective interest rate**.**

UNIT III CASH FLOW AND DEPRECIATION 9

Cash flow- Introduction, Methods of comparison of alternatives -Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method.

Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation-Evaluation of public alternatives- introduction, Examples, Inflation adjusted decisions – Examples on comparison of alternatives and determination of economic life of asset.

UNIT IV INDUSTRIAL SAFETY 9

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire,

guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT V FAULT TRACING 9

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like machine tool, Pump, Air compressor, Internal combustion engine, Boilers and Electrical motors, Types of faults in machine tools and their general causes.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Explain the basic terminologies in Engineering Economics, Elementary Economic Analysis and Value Engineering Procedures.

CO2: Interpret the Value of Money using Interest Formulae and their Applications**.**

CO3: Interpret the Depreciation, Inflation Methods and explain the various Alternatives.

CO4: Explain the fundamental concept and principles of Industrial safety.

CO5: Evaluate faults in various tools, equipment and machines.

TEXT BOOKS

1. Panneer Selvam., 2001, R, *Engineering Economics*, Prentice Hall of India Ltd.
2. L M Deshmukh.,2005, *Industrial Safety Management*, Tata McGraw-Hill Education.

REFERENCE BOOKS

1. Chan S.Park., 2011, *Contemporary Engineering Economics*, Prentice Hall.
2. Donald.G. Newman, Jerome.P.Lavelle., 2010, *Engineering Economics and analysis,*Engg. Press,Texas.
3 Degarmo, E.P., Sullivan, W.G and Canada., J.R, 2011., *Engineering Economy*.

4 Charles D. Reese., 2003, *Occupational Health and Safety Management* A Practical Approach, CRC Press.

5 J Maiti, Pradip Kumar Ray., 2017, *Industrial Safety Management,* 21st Century Perspectives of Asia, Springer.

ME1702 **ROBOTICS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the functions of the basic components of a robot.
- To study the use of various types of Ends of Effectors and Sensors
- To impart knowledge in Robot Kinematics and Programming
- To learn Robot safety issues and economics.

UNIT I FUNDAMENTALS OF ROBOT 9

Robot - Definition - Robot Anatomy - Coordinate Systems, Work Envelope Types and Classification- Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load- Robot Parts and their Functions-Need for Robots-Different Applications.

UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS 9

Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

UNIT III SENSORS 9

Requirements of a sensor, Principles and Applications of the following types of sensors- Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors, binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors. Machine Vision for Robots.

UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING 9

Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces- Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design-

Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs – Machine Vision.

UNIT V IMPLEMENTATION AND ROBOT ECONOMICS 9

RGV, AGV; Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Explain the concepts of industrial robots, classification, specifications and coordinate systems.

CO2: Illustrate the different types of robot drive systems as well as robot end effectors.

CO3: Apply the different sensors in robotics to improve the ability of robots.

CO4: Develop robotic programs for different tasks and familiarize with the kinematics motions of robot.

CO5: Examine the implementation of robots in various industrial sectors and interpolate the economic analysis of robots.

TEXT BOOKS

1. Groover M.P., 2012, *Industrial Robotics -Technology Programming and Applications*, McGraw Hill.
2. Klafter R.D., Chmielewski T.A and Negin M., 2003, *Robotic Engineering - An Integrated Approach*, Prentice Hall.

REFERENCE BOOKS

1. Craig J.J., 2008, *Introduction to Robotics Mechanics and Control*, Pearson Education.
2. Deb S.R., 2013, *Robotics Technology and Flexible Automation*, Tata McGraw Hill Book Co.

3 Fu.K.S., Gonzalz R.C. and Lee C.S.G., 1987, *Robotics Control, Sensing, Vision and Intelligence*, McGraw Hill Book Co.

4 Janakiraman P.A., 1995, *Robotics and Image Processing*, Tata McGraw Hill.

5 Koren Y., 1992, *Robotics for Engineers*, Mc Graw Hill Book Co.

6 Craig J.J., 2008, *Introduction to Robotics Mechanics and Control*, Pearson Education.

ME1711 AUTOMATION & IoT LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

- To know the method of design, modelling & analysis of basic electrical, hydraulic & pneumatic Systems which enable the students to understand the concept of Automation
- To create an environment for research, design, development and testing of IoT solutions.

LIST OF EXPERIMENTS

1. Design and testing of electro hydraulic bi directional Motor System.
2. Design and testing of electro hydraulic Double Acting Cylinder Reciprocating System.
3. Sequencing of two pneumatic cylinders using manually operated directional control valve.
4. Sequencing of two pneumatic cylinders using electro pneumatic trainer kit (With and without timer).
5. Sequencing of two pneumatic cylinders using PLC.
6. Design a pneumatic two-cylinder sequencing circuit using automation studio software.
7. Design a pneumatic three-cylinder sequencing circuit using automation studio software.
8. Implement the following experiments using Arduino
    a. Temp and Humidity measurement.
    b. Fire alarm indication using Buzzer.
9. Write Program for monitoring sensor values in real time using Arduino.
    a. IR Temperature sensor.
    b. Gas leakage detection.
10. Study the ESP8266 WIFI module and write program to transfer the data in the cloud.
    a. Light Control Monitoring.
    b. Soil Condition Monitoring.
    c. Human detection – PIR Sensor.
11. Various applications using Raspberry Pi

a. Stepper Motor.

b. Face recognition.

c. Finger print recognition.

d. RFID.

12. Experiments on Industrial IoT

a. Smart AC Controller System.

b. Health monitoring.

c. Energy Meter monitoring for theft detection.

13. Study on SCADA .

TOTAL: 60 PERIODS

EQUIPMENT NEEDED (FOR 30 STUDENTS)

HARDWARES

S.No.	NAME OF THE EQUIPMENT	Qty.
	Personal Computers (Intel Core i3, 500 GB, 4 GB RAM).	30
1	Electro Hydraulic Trainer Kit.	1
2	Basic Pneumatic Trainer Kit.	1
3	Electro Pneumatic Trainer Kit.	1
4	PLC Pneumatic Trainer Kit.	1
5	Sensors and Actuator.	60
6	Arduino Boards.	10
7	Node MCU.	10
8	GSM/GPRS shields.	10
9	Raspberry PI 4.	10

SOFTWARES

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Automation Studio Software.	10 Licence
2	Software: Arduino IDE, Third Party Cloud API like (Azure/ Think speak), Python 3 interpreter.	30

OUTCOMES:

CO 1 : Design the different types of Hydraulic circuits and its industrial applications.

CO 2 : Design the different types of Pneumatic circuits and its industrial applications.

CO 3 : Write ladder programming and application of programmable logic controllers to problems and challenges in Automation.

CO 4 : Design & Develop IOT Devices for home automation and security systems.

CO 5 : Build IoT applications using Arduino and Raspberry Pi.

ME1721 **TECHNICAL SEMINAR**

L	T	P	C
0	0	2	1

To enrich the communication skills of the student and presentations of technical topics of interest, this course is introduced. In this course, a student has to present three Technical papers or recent advances in engineering/technology that will be evaluated by a Committee constituted by the Head of the Department.

TOTAL: 30 PERIODS

OUTCOMES

CO 1 : Demonstrate the technical contents of Design and manufacturing oriented topics for identifying recent studies on the specified area.

CO 2 : Discuss the current energy scenario in all aspects and its remedies.

CO 3 : Develop managerial skills by adopting team coordination, communication and proper execution.

CO 4 : Executing statistical data analysis on the assigned technical contents.

CO 5 : Use of modern tools on technical content preparation and delivery.

ME1821 **PROJECT WORK**

L	T	P	C
0	0	20	10

OBJECTIVES:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

Project reports and to face reviews and viva voce examination. The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 300 PERIODS

OUTCOMES

CO 1 : Identifying a potential problem based on literature survey/impending industrial/real time needs.

CO 2 : Categorizing various solution methodologies to solve problem taken for study.

CO 3 : Carry out design/experimental procedure relevant to the problem.

CO 4 : Analyze design/experimental results.

CO 5 : Draw conclusion based on analysis and recommend solution to potential engineering problems.

ME1731 **CONCEPTS OF ENGINEERING DESIGN**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the Design Fundamentals.
- To explain the customer oriented design and societal considerations.
- To impart knowledge in materials selection process for design and reliability concepts.

UNIT I DESIGN FUNDAMENTALS 9

Importance of design- The design process-Considerations of Good Design – Morphology of Design –Organization for design– Computer Aided Engineering – Designing to codes and standards – Concurrent Engineering – Product and process cycles – Technological Forecasting – Market Identification – Competition Bench marking.

UNIT II CUSTOMER ORIENTED DESIGN & SOCIETAL CONSIDERATIONS 9

Identification of customer needs- customer requirements- Quality Function Deployment- Product Design Specifications- Human Factors in Design – Ergonomics and Aesthetics. Societal consideration - Contracts – Product liability – Protecting intellectual property – Legal and ethical domains – Codes of ethics – Ethical conflicts – Environment responsible design-future trends in interaction of engineering with society.

UNIT III DESIGN METHODS 9

Creativity and Problem Solving –Creativity Methods-Theory of Inventive Problem Solving (TRIZ)– Conceptual Decomposition-Generating design concepts-Axiomatic Design – Evaluation Methods-Embodiment Design-Product Architecture-Configuration Design- Parametric Design. Role of models in design-Mathematical Modeling – Simulation – Geometric Modeling –Rapid prototyping- Finite Element Analysis– Optimization – Search Methods.

UNIT IV MATERIAL SELECTION, PROCESSING AND DESIGN 9 9

Material Selection Process – Economics – Cost Vs Performance – Weighted property Index – Value Analysis – Role of Processing in Design – Classification of Manufacturing Process – Design for Manufacture – Design for Assembly –Designing for castings, Forging, Metal Forming, Machining and Welding – Residual Stresses – Fatigue, Fracture and Failure.

UNIT V PROBABILITY CONCEPTS IN DESIGN FOR RELIABILITY 9 **9**

Probability – Distributions – Test of Hypothesis – Design of Experiments – Reliability Theory – Design for Reliability – Reliability centered Maintenance-Robust Design-Failure mode Effect Analysis.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Describe the fundamental concepts of Design.

CO2: Explain the costumer oriented concepts and societal consideration for Design process.

CO3: Describe the Design methods for critical problem solving, RPT and optimizations techniques.

CO4: Explain the materials selection and manufacturing methods for design process.

CO5: Interpret the probability concepts in Design for reliability.

TEXT BOOKS

1. Dieter, George E., 2018, *Engineering Design - A Materials and Processing Approach*, 4th edition, McGraw Hill, International Editions, Singapore.

REFERENCE BOOKS

1. Pahl, G, and Beitz, W.,1984, *Engineering Design*, Springer – Verlag, NY
2. Ray, M.S.,1985, *Elements of Engineering. Design*, Prentice Hall Inc.
3. Suh, N.P., 1990, *The principles of Design*, Oxford University Press, NY.
4. Karl T. Ulrich and Steven D. Eppinger, 2000, *Product Design and Development* McGraw Hill Edition.

ME1732 **MECHATRONICS AND IoT**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To impart knowledge about the elements and techniques involved in Mechatronics systems which are very much essential to understand the emerging field of automation.
- Discuss the interdisciplinary applications of Electronics, Electrical, Mechanical and Computer Systems for the Control of Mechanical, Electronic Systems and sensor technology.
- Discuss the architecture of Microprocessor, Microcontroller, PPI & PLC.
- Discuss various Actuators and Mechatronics system using the knowledge and skills acquired through the course and also from the given case studies.
- Understand IoT architectures and smart objects for real world application.
- Build simple IoT Systems using Arduino and Raspberry Pi.

UNIT I INTRODUCTION 9

Introduction to Mechatronics – Systems – Concepts of Mechatronics approach – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance sensors – Strain gauges – Eddy current sensor – Hall effect sensor – Temperature sensors – Light sensors.

UNIT II MICROPROCESSOR, MICROCONTROLLER AND PROGRAMMABLE PERIPHERAL INTERFACE 9

Introduction – Architecture of 8085 – Pin Configuration – Concepts of 8051 microcontroller – Block diagram - Architecture of 8255 - Temperature Control – Stepper Motor Control.

UNIT III PROGRAMMABLE LOGIC CONTROLLER 9

Introduction – Basic structure – Input and output processing – Programming – Mnemonics – Timers, counters and internal relays – Data handling – Selection of PLC.

UNIT IV ACTUATORS AND MECHATRONIC SYSTEM DESIGN 9

Types of Stepper and Servo motors – Construction – Working Principle – Advantages and Disadvantages. Design process-stages of design process – Traditional and Mechatronics design concepts – Case studies of Mechatronics systems – Pick and place Robot – Engine Management system – Automatic car park barrier.

UNIT V DEVELOPMENT OF IoT SOLUTIONS 9

Introduction of Internet of Things - IoT Enabling Technologies – IoT Architectures – One M2M, IoT World Forum (IoTWF)- Simplified IoT Architecture and Core IoT Functional Stack -IoT System Building Blocks - Arduino Board Details, IDE Programming - Logical Design using Raspberry PI.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Select the sensors and transducers for different applications.

CO2: Comprehend the design and capability of 8085, 8051 & 8255.

CO3: Comprehend the design and capability of PLC.

CO4: Describe the design of Mechatronics system.

CO5: Build simple IoT system using Raspberry Pi/Arduino.

TEXT BOOKS

1. Willam Bolton., 2008, *Mechatronics A Multidisciplinary Appraoch,* Prentice Hall, 2008.
2. Ramesh S Gaonkar.,2008, *Microprocessor Architecture, Programming, and Applications with the 8085*, 5th Edition, Prentice Hall.
3. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry.,2017, *IoT Fundamentals: Networking Technologies, Protocols and Use Cases Mfor Internet of Things*, Cisco Press.

REFERENCE BOOKS

1. Bradley D.A, Dawson D, Buru N.C and Loader A.J.,1993, *Mechatronics*, Chapman and Hall.

2. Clarence W, de Silva., 2013, *Mechatronics,* CRC Press, First Indian Re-print.
3. Devadas Shetty and Richard A. Kolk.,2007, *Mechatronics Systems Design*, PWS publishing company.
4. Krishna Kant.,2007, *Microprocessors & Microcontrollers*, Prentice Hall of India.
5. Michael B.Histand and Davis G.Alciatore., 2007, *Introduction to Mechatronics and Measurement systems*, McGraw Hill International edition.

ME1733 PRODUCT DESIGN USING VALUE ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the fundamentals of product design and development.
- To understand the concepts of product design steps to develop new product.
- To understand the relationship in product design and value engineering.
- To impart knowledge in the area of value engineering.

UNIT I INTRODUCTION 9

Characteristics of successful product development – Design and development of products – Duration and cost of product development, the challenges of product development – Development Processes and Organizations.

UNIT II PRODUCT DESIGN AND DEVELOPMENT 9

Introduction to Product Design and Development – Product Design Steps and Product Analysis, Profit Consideration – Creative Thinking.

UNIT III PRODUCT DESIGN USING VALUE ENGINEERING 9

Problem Identification and VEJP – Value Engineering (History, Concept and Definitions), Value Engineering vs. Cost Cutting, Types of Product Functions, Functional Analysis – Functional Analysis System Technique.

UNIT IV VALUE ENGINEERING 9

Value Engineering recommendations – Programmes ,advantages – Evaluation of function, determining function, classifying function – Evaluation of costs, evaluation of worth, determining worth, evaluation of value – Job plan.

UNIT V VALUE ENGINEERING TOOLS AND TECHNIQUES 9

Function , Cost relationship – Value Engineering (VE) applications in Product Design – case study – Value Engineering Tools and Techniques – Behavioral Roadblocks.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Outline the fundamentals of product design and development.

CO2: Summarize the concepts of product design steps for develop new product.

CO3: Extend the relationship between product design and value engineering.

CO4: Outline the fundamentals of value engineering.

CO5: Explain the knowledge of tools and techniques using value engineering.

TEXT BOOKS

1. Karl.T.Ulrich, Steven D Eppinger, Anita Goyal Tata.,2009. *Product Design and Development*, 3rd Edition McGrawHill, New Delhi.
2. S.S.Iyer, 2009, *Value Engineering A how to Manual*, New age International Publishers.

REFERENCE BOOKS

1. Kevin otto and Kristini wood.,2004, *Product development*, Pearson Education, 2004.
2. Arthur E. Mudge.,2013, *Value Engineering: A Systematic Approach*, Mc GrawHill.
3. Timjones. Butterworth Heinmann.,1997, *New Product Development*, Oxford. UCI.
4. Lawrence D. Miles., *Techniques of Value Analysis and Engineering*, 2nd Edition, McGraw-Hill Book Company, Inc. New York.
5. Larry W. Zimmerman, Glen D. Hart.,1999, *Value Engineering*, Reprint CBS Publishers and Distributors, New Delhi.

ME1734 **SOLAR ENERGY TECHNOLOGY**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To describe the solar radiation and its measurement.
- To explain the various solar collectors and solar thermal storage.
- To explain the various solar thermal energy technologies and their applications.
- To compare the various solar PV cell materials and conversion techniques.
- To discuss various SPV systems designs and their applications.

UNIT I BASIC SOLAR RADIATION 9

Solar angles – Sun path diagrams – Radiation - extraterrestrial characteristics - measurement and estimation on horizontal and tilted surfaces - Solar charts – Critical radiation- Measurement of global radiation – direct and diffused solar radiation - pyroheliometer, pyranometer, pyrogeometer, sunshine recorder – an overview of solar radiation data in India.

UNIT II SOLAR COLLECTORS AND STORAGE 9

Classification of collectors- flat plate collectors – air heating, liquid heating - Performance parameters - evacuated tubular collectors - concentrator collectors - classification - design and performance parameters - tracking systems - compound parabolic concentrators - parabolic trough concentrators - concentrators with point focus - Heliostats - performance of the collectors. Storage - Sensible Heat Storage - Liquid media storage – Solid media storage – Latent heat storage - Phase change materials – Chemical storage.

UNIT III SOLAR THERMAL APPLICATIONS 9

Principle of working, types, design and operation of - Solar heating and cooling systems - Thermal Energy storage systems - Solar Desalination - Solar cooker: domestic, community - Solar pond - Solar drying - solar chimney - solar thermal electricity conversion - Solar Greenhouse technology.

UNIT IV SOLAR PV FUNDAMENTALS 9

Semiconductor - properties - energy levels - basic equations of semiconductor devices physics. Solar cells - p-n junction: homo and hetero junctions - metal-

semiconductor interface - dark and illumination characteristics - figure of merits of solar cell - efficiency limits - variation of efficiency with band-gap and temperature - efficiency measurements - high efficiency cells – Solar thermo-photovoltaics.

UNIT V SPV SYSTEM DESIGN AND APPLICATIONS 9

Solar cell array system analysis and performance prediction- Shadow analysis: reliability - solar cell array design concepts - PV system design - design process and optimization - detailed array design - storage autonomy - voltage regulation - maximum tracking - centralized and decentralized SPV systems - standalone - hybrid and grid connected system - System installation - operation and maintenances - field experience - PV market analysis and economics of SPV systems- Case study of Solar power in agriculture- Recent developments in solar cells.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Describe the basics of solar radiation and its measurement.

CO2: Explain the various type solar collectors and thermal storage concept.

CO3: Infer the various solar thermal energy technologies and their applications.

CO4: Interpret various solar PV cell materials and conversion techniques.

CO5: Demonstrate the various Solar PV systems designs and their applications .

TEXT BOOKS

1. G.D. Rai, 2018, *Non-Conventional Energy Sources*, Khanna Publishers, New Delhi.
2. Sukhatme S P, Nayak J K, 2019, Solar Energy – *Principle of Thermal Storage and collection*, Tata McGraw Hill.

REFERENCE BOOKS

1. Twidell, J.W. & Weir, A., 2019, *Renewable Energy Resources*, EFN Spon Ltd., UK.
2. Chetan Singh Solanki.,2019, *Solar Photovoltatics – Fundamentals, Technologies and Applications*, PHI Learning Private limited.

3. John A. Duffie, William A. Beckman., 2018,*Solar Engineering of Thermal Processes* John Wiley & Sons.
4. Lovegrove K., Stein W., 2020, *Concentrating Solar Power Technology*, Woodhead Publishing Series in Energy, Elsevier, 1st Edition.
5. Solar Energy International., 2018, *Photovoltaic – Design and Installation Manual*, New Society Publishers.

ME1735	WASTE MANAGEMENT AND ENERGY RECOVERY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide in depth knowledge in Principles of industrial waste management.
- To have an understanding of characterization of wastes.
- To discuss about storage, collection and transport of different wastes.
- To describe various processing technologies of hazardous wastes.
- To demonstrate various waste disposal methods, economics of waste management.

UNIT I SOURCES, CLASSIFICATION AND REGULATORY FRAMEWORK 9

Types and Sources of solid and hazardous wastes - need for solid and hazardous waste management – elements of integrated waste management and roles of stakeholders - Salient features of Indian legislations on management and handling of municipal solid wastes, hazardous wastes, biomedical wastes, lead acid batteries, electronic wastes, plastics and fly ash –financing waste management.

UNIT II WASTE CHARACTERIZATION AND SOURCE REDUCTION 9

Waste generation rates and variation – composition- physical, chemical and biological properties of solid waste moisture content chemical composition-heat value Bulk and material density - Mechanical properties - biodegradability– hazardous characteristics – TCLP tests – waste sampling and characterization plan - source reduction of wastes –waste exchange – extended producer responsibility - Recycling and reuse.

UNIT III STORAGE, COLLECTION AND TRANSPORT OF WASTES 9

Handling and segregation of wastes at source – storage and collection of municipal solid wastes – Analysis of Collection systems - need for transfer and transport – Transfer stations Optimizing waste allocation– compatibility, storage, labelling and handling of hazardous wastes – hazardous waste manifests and transport.

UNIT IV WASTE PROCESSING TECHNOLOGIES 9

Objectives of waste processing – material separation and processing technologies- Conveying –shredding – pulping - crushing – Binary separators - trommel screens- Reciprocating and disc screens-Float / sink separators-air classifiers magnet and electromechanical separators - biological and chemical conversion technologies – methods and controls of composting- thermal conversion technologies and energy recovery – incineration – solidification and stabilization of hazardous wastes - treatment of biomedical wastes.

UNIT V WASTE DISPOSAL, BEST PRACTICES AND ECONOMICS 9

Waste disposal options – Different Disposal methods - Integrated waste management. Decentralized waste management concept, Challenges and approaches in plastic waste management, Concept of zero waste – Case studies, Case studies in different engineering disciplines. Environmental management system - ISO14001, Life cycle assessment, Economic aspects of waste management, Finance model for waste management-, PPP mode- Case studies.

TOTAL: 45 PERIODS

OUTCOMES

CO1: List out the sources of Industrial waste and its regulatory framework.

CO2: Describe the characteristics of wastes and forms of source reduction.

CO3: Explain the methods of waste storage, collection and transport.

CO4: Describe about different waste processing technologies.

CO5: Explain various types of waste disposal methods, best practices and its economics.

TEXT BOOKS

1. William A.Worrell W, P.Aarne Vesilind and Christian Ludwig., 2016, *Solid waste engineering*, CL Engineering, 3rd Edition.
2. T. V. Ramachandra.,2020, *Management of Municipal Solid Waste*, The Energy and Resources Institute.

REFERENCE BOOKS

1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, 2018, *Integrated Solid Waste Management.*
2. Michael D. LaGrega, Philip L Buckingham, and Jeffrey C. Evans.,2020, *Hazardous waste Management*, Waveland press.
3. CPHEEO., 2000*, Manual on Municipal Solid waste management,* Central Public Health and Environmental Engineering Organisation, Government of India, New Delhi.
4. George Tchobanoglous and Frank Kreith.,2002, *Handbook of solid waste management*, Mc-Graw Hill, 2nd Edition.

ME1736 **COMPOSITE MATERIALS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To summarize the classification of composite and effect of reinforcement in composite materials.
- To extend a knowledge of selection and applications of different composites in consideration of the properties and characteristics.
- To understand the processing of composite materials.
- To test the polymer composite materials as per the standards.
- To impart knowledge of composite materials and its application in manufacturing.

UNIT I INTRODUCTION TO COMPOSITE MATERIALS 9

Introduction to Composites: Matrices, Reinforcements - types of reinforcement– Classifications of composite materials - based on matrix and reinforcement – Selection & functional requirements of matrix and reinforcement - Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance – Wettability, Interfaces - Rule of mixture - volume and mass fractions – density - void content - advantages and application of composites.

UNIT II PROCESSING OF POLYMER MATRIX COMPOSITES 9

Thermoset matrix composites: hand layup, spray, filament winding, pultrusion, resin transfer moulding, autoclave moulding - bag moulding, compression moulding- Thermoplastic matrix composites: film stacking, diaphragm forming, thermoplastic tape laying, injection moulding - interfaces in PMCs - application of PMCs - recycling of PMCs. Micro wave assisted polymer processing .

UNIT III PROCESSING OF METAL AND CERAMIC MATRIX COMPOSITES 9

Processing of MMCs: liquid state- infiltration – squeeze, casting – rheo casting – compocasting, solid state– diffusion bonding – powder metallurgy techniques- in situ fabrication techniques- interfaces in MMCs – applications. Processing of CMCs: cold pressing, sintering, reaction bonding, liquid infiltration, lanxide process – in situ

chemical reaction techniques: chemical vapour deposition, chemical vapour impregnation, sol-gel – interfaces in CMCs –applications.

UNIT IV TESTING OF POLYMER COMPOSITE MATERIALS 9

ASTM standards for physical and mechanical testing of polymer composites. Physical testing - density, void content, water absorption, hardness, and scratch resistance. Mechanical Testing – Tensile, Compressive and flexural testing, Impact testing, shear testing, fatigue testing - Friction and Wear testing.

UNIT V ADVANCED COMPOSITE MATERIALS 9

Environmental effects in Composites, advanced composite materials, Green composites, Carbon-carbon Composites, Nanocomposites, Self-Healing Composites, Self-Reinforced Composites, Surface Composites, Laminate composites, Bio-composites, Hybrid Composites.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Explain the matrix, reinforcement and their characteristic performance with functionality.

CO2: Summarize the Thermoset and Thermoplastic processing techniques.

CO3: Comprehend the different processing techniques of MMC's and CMC's.

CO4: Describe the concepts in testing of composite materials.

CO5: Interpret the advanced composite materials such as Green composites, nano composites & hybrid composites.

TEXT BOOKS

1. Krishnan K Chawla., *Composite Materials: Science and Engineering*, International Edition, Springer, 2012.
2. Mallick, P.K. and Newman.S., 2003, *Composite Materials Technology,* Hanser Publishers, 2003.

REFERENCE BOOKS

1. *ASM Handbook Composites*, Vol-21, 2001, ISBN: 978-0-87170-703-1.

2. Peters, S.T., 1988, *Handbook of Composites,* Springer, ISBN 978-1-4615-6389-1.

3. ASTM Annual Book of Standards (2002).

4. Hull D and T.W. Clyne.,1996, *An Introduction to Composites Materials*, Cambridge University Press.

ME1737 **POWER PLANT TECHNOLOGY**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the concepts of thermal power plant and its sub systems.
- To gain the knowledge about working principles of diesel, gas turbine and combined cycle power plants.
- To describe about the various types of nuclear reactors.
- To know about the construction and working principles of power plant utilizes renewable energy sources.
- To study about powerplant economics and environmental issues of powerplants.

UNIT I COAL BASED THERMAL POWER PLANTS 9

Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment.

UNIT II DIESEL, GAS TURBINE AND COMBINED CYCLE POWERPLANTS 9

Components of Diesel and Gas Turbine power plants – Combined Cycle Power Plants – Integrated Gasifier based Combined Cycle systems – Binary Cycles and Cogeneration systems.

UNIT III NUCLEAR POWER PLANTS 9

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors: Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), Canada Deuterium – Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors – Safety measures for Nuclear Power plants.

UNIT IV POWER FROM RENEWABLE ENERGY 9

Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal,

Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.

UNIT V ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS **9**

Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants. Significance of safety measures in power plants.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Explain the basics of Thermal Power Plant and the working principle of various accessories.

CO2: Describe about the diesel, gas turbine and combined cycle power plants.

CO3: Enumerate the basics of nuclear engineering and working of various Nuclear reactors.

CO4: Explain the method of generating power from renewable energies like. hydro, wind, solar, biomass etc.

CO5: Describe about energy economics and environmental issues of power Plants.

TEXT BOOKS

1. Nag. P.K., 2020, *Power Plant Engineering*, Third Edition, Tata McGraw – Hill Publishing Company Ltd.

REFERENCE BOOKS

1. El-Wakil. M.M., 2018, *Power Plant Technology*, Tata McGraw – Hill Publishing Company Ltd.
2. Godfrey BoylE., 2019, *Renewable energy* , Open University, Oxford University Press in association with the Open University.
3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp., 2020, *Power Plant Engineering*, Second Edition, Standard Handbook of McGraw – Hill.

ME1738 **PRECISION MANUFACTURING**

L	T	P	C
3	0	0	3

OBJECTIVES:

- Explaining the need, significance and progress of precision manufacturing and the different levels of manufacturing.
- Explaining the principle and working of different methods of precision machining.
- Explaining the special construction requirements of precision machine tools.
- Explaining the errors involved in precision machine tools and calculate the error budgets for a given situation.
- Selecting a suitable measurement solution to measure and characterize precision machined features.

UNIT I PRECISION ENGINEERING 9

Introduction to Precision Engineering, Need for precision manufacturing, Taniguchi diagram, Four Classes of Achievable Machining Accuracy – Normal, Precision, High-precision, Ultra-precision Processes and Nanotechnology.

UNIT II PRECISION MACHINING 9

Overview of Micro- and Nano-machining, Conventional micro machining techniques - micro-turning, micro-milling, micro-grinding, Ultra-precision diamond turning, Non-conventional micromachining techniques – abrasive jet and water jet micromachining, Ultrasonic micromachining, micro electrical discharge machining, photochemical machining, electro chemical micromachining, laser beam micromachining, Electron beam micromachining, Focused Ion Beam micromachining, etc.

UNIT III MACHINE DESIGN FOR PRECISION MANUFACTURING 9

Philosophy of precision machine design, Ultra-Precision Machine Elements: Guide - ways, Drive Systems, Friction Drive, Linear Motor Drive, Spindle Drive. Bearings: Principle, construction and application of Rolling, Hydrodynamic and Hydrostatic Bearings, Aerostatic Bearings, Magnetic bearings.

UNIT IV MECHANICAL AND THERMAL ERRORS 9

Sources of error, Principles of measurement, Errors due to machine elements, bearings, spindles, Kinematic design, Structural compliance. Vibration, Thermal errors – background, thermal effects, Environmental control of precision machinery. Error mapping and error budgets.

UNIT V MEASUREMENT AND CHARACTERISATION 9

Optical dimensional metrology of precision features – Machine vision, Multi-sensor coordinate metrology, Laser Tracking Systems, Laser scanners, White-Light Interference 3D Microscopes, Focus-Based Optical Metrology – Fringe projection method, Measurement of Typical Nanofeatures Surface metrology – 3D surface topography – Need, Measurement – Chromatic confocal Microscopy, Interferometry, Non-optical Scanning Microscopy – Scanning electron Microscopes, Scanning probe microscopes, Parameters for characterizing 3D surface topography.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Explain the need, significance and progress of precision manufacturing and the different levels of manufacturing.

CO2: Explain the principle and working of different methods of precision machining.

CO3: Explain the special construction requirements of precision machine tools.

CO4: Explain the errors involved in precision machine tools and calculate the error budgets for a given situation.

CO5: Select a suitable measurement solution to measure and characterize precision machined features.

TEXT BOOKS

1. Jain, V.K., 2018, *Introduction to micromachining*, Narosa publishers.
2. Venktesh V.C., Sudin Izman., 2007, *Precision Engineering,* Tata Mc.Graw Hill Publishing Company, New Delhi.

REFERENCE BOOKS

1. David Dornfeld, Dae-Eun Lee.,2008, *Precision Manufacturing, ,* Springer.
2. Jain, V.K. 2012, *Micromanufacturing Processes,* CRC Press.
3. Joseph McGeough, 2002, *Micromachining of Engineered Materials*, Marcel Dekker Inc.
4. Kevin Harding., 2013, *Handbook of Optical Dimensional Metrology,* Series: *Series in Optics and optoelectronics*, Taylor & Francis.
5. Murty, R.L., 2005, *Precision Engineering in Manufacturing*, New Age publishers.

ME1739 PROCESS PLANNING AND COST ESTIMATION

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the process planning methods and its activities.
- To demonstrate economics of process planning.
- To introduce the concept of cost estimation.
- To estimate production cost for various products.
- To find machining time for various manufacturing operations.

UNIT I PROCESS PLANNING METHODS 9

Introduction – Methods of process planning – Process planning activities: Drawing interpretation – Material evaluation – steps in process selection – Production equipment and tooling selection – jigs and fixtures – election of quality assurance methods – Set of documents for process planning.

UNIT II ECONOMICS OF PROCESS PLANNING 9

Importance – Manufacturing cost – Economic order quantity – Break even analysis for process selection – Make or Buy decision and - case studies.

UNIT III INTRODUCTION TO COST ESTIMATION 9

Importance of costing and estimation –methods of costing-elements of cost estimation –Types of estimates – Estimating procedure – Estimation of labor cost, material cost- allocation of overhead charges.

UNIT IV PRODUCTION COST ESTIMATION 9

Estimation of Different Types of Jobs – Estimation of Forging Shop, Estimation of Welding shop, Estimation of Foundry Shop.

UNIT V MACHINING TIME CALCULATION 9

Estimation of Machining Time - Importance of Machine Time Calculation – Calculation of Machining Time for Different Lathe Operations, Drilling and Boring – Machining Time Calculation for Milling, Shaping and Planning – Machining Time Calculation for Grinding.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Explain the procedure for process planning and its activities.

CO2: Describe the concepts of economics of process planning.

CO3: Summarize the procedure for cost estimation and costing of the product.

CO4: Apply the procedure for estimating the cost of different machining operations.

CO5: Apply the procedure for calculating machining time of given component.

TEXT BOOKS

1. Peter Scallan., 2018, *Process Planning:The Design/Manufacture Interface*; Elsevier Science & Technology Books.
2. M Adithan., 2020, *Process Planning and Cost Estimation* New Age International Limited.

REFERENCE BOOKS

1. Upendra Kachru., 2018, *Production and operations management - Text and cases*, Excel books.
2. Kanishka Bedi., 2019, *Production and Operations management,* Oxford University press.
3. Elwood Buffa S, and Rakesh Sarin K..,2020, *Modern Production / Operations Management,* John Wiley and Sons.

ME1740 **SUPPLY CHAIN MANAGEMENT**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide an insight on the fundamentals of supply chain networks, tools and techniques.

UNIT I INTRODUCTON 9

Role of Logistics and Supply chain Management: Scope and Importance- Evolution of Supply Chain -Decision Phases in Supply Chain - Competitive and Supply chain Strategies – Drivers of Supply Chain Performance and Obstacles.

UNIT II SUPPLY CHAIN NETWORK DESIGN 9

Role of Distribution in Supply Chain – Factors influencing Distribution network design – Design options for Distribution Network Distribution Network in Practice-Role of network Design in Supply Chain – Framework for network Decisions.

UNIT III LOGISTICS IN SUPPLY CHAIN 9

Role of transportation in supply chain – factors affecting transportations decision – Design option for transportation network – Tailored transportation – Routing and scheduling in transportation.

UNIT IV SOURCING AND COORDINATION IN SUPPLY CHAIN 9

Role of sourcing supply chain supplier selection assessment and contracts- Design collaboration - sourcing planning and analysis - supply chain co-ordination - Bull whip effect – Effect of lack of co- ordination in supply chain and obstacles – Building strategic partnerships and trust within a supply chain.

UNIT V SUPPLY CHAIN AND INFORMATION TECHNOLOGY 9

The role IT in supply chain- The supply chain IT framework, stack holder management – Internal supply chain management – supplier relationship management – future of IT in supply chain – E-Business in supply chain. Supply chain models.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Explain the Scope and importance of Supply chain management.

CO2: Describe the framework for supply chain network design.

CO3: Explain the logistics concepts in supply chain.

CO4: Describe the sourcing and coordination techniques of supply chain.

CO5: Explain the role of IT in supply chain.

TEXT BOOKS

1. Sunil Chopra, Peter Meindl and Kalra., 2010, *Supply Chain Management, Strategy, Planning, and operation* , Pearson Education.

REFERENCE BOOKS

1. David J.Bloomberg., Stephen Lemay and Joe B.Hanna., 2002, *Logistics*, PHI.
2. James B.Ayers., 2000, *Handbook of Supply chain management*, St.Lucle press.
3. Jeremy F.Shapiro., 2002, *Modeling the supply chain,* Thomson Duxbury.
4. Srinivasan G.S., 2010, *Quantitative models in Operations and Supply Chain Management*, PHI.

ME1741 **ENTREPRENEURSHIP DEVELOPMENT**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To develop and strengthen entrepreneurial quality and motivation in students and to impart basic entrepreneurial skills and understanding to run a business efficiently and effectively.

UNIT I ENTREPRENEURSHIP 9

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

UNIT II MOTIVATION 9

Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self-Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.

UNIT III BUSINESS 9

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies. .

UNIT IV FINANCING AND ACCOUNTING 9

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty – Sales Tax.

UNIT V SUPPORT TO ENTREPRENEURS 9

Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures - Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting. Strategies for Business/Industry start up.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Explain entrepreneurship types, factors affecting its growth, and entrepreneurships significance in economic growth.

CO2: Outline the motives influencing entrepreneur.

CO3: Apply various techniques to prepare project report/setting up business.

CO4: Illustrate various sources of finance, accounting, and taxation.

CO5: Demonstrate the corrective measures for a sick unit, growth strategies for small industries, and government policies for small enterprises.

TEXT BOOKS

1. Donald F Kuratko., 2014, *Entrepreneurship – Theory, Process and Practice*, 9th Edition, Cengage Learning.
2. Khanka. S.S., 2013, *Entrepreneurial Development*, S.Chand & Co. Ltd., Ram Nagar, New Delhi.

REFERENCE BOOKS

1. EDII Faulty and External Experts., 1986, *A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development*, Institute of India, Ahmadabad.
2. Hisrich R D, Peters M P., 2013, *Entrepreneurship*, 8th Edition, Tata McGraw-Hill.
3. Mathew J Manimala., 2005, *Entrepreneurship theory at cross roads: paradigms and praxis*, 2nd Edition Dream tech.
4. Rajeev Roy., 2011, *Entrepreneurship*, 2nd Edition, Oxford University Press.

ME1742 **INTRODUCTION TO INDUSTRY 4.0**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To enable students, understand the fundamentals and the contributing technologies of Industry 4.0.
- To make the students evaluate the suitability of Industry 4.0 technologies for the design and Manufacturing sectors.
- To help the students implement the Industry 4.0 technologies to diverse applications.

UNIT I INTRODUCTION TO INDUSTRY 4.0 9

Introduction – Historical Context – Drivers of Industry 4.0 – Core idea of Industry 4.0 –Origin concept of industry 4.0 – preparedness of Industry 4.0 in India – Introduction to Industry 4.0 to Industry 5.0 Advances.

UNIT II CONTRIBUTING TECHNOLOGIES 9

Brief introduction to the industrial revolutions. Contributing technologies to Industry 4.0: Additive manufacturing, Robotics, Digital twin, Internet of things, Smart sensors, AR and VR, Artificial intelligence, Cloud computing, Block chain, Big Data and Analytics, Cyber Security Challenges and opportunities.

UNIT III UNDERSTANDING OF INDUSTRY 4.0 9

Introduction – Components of Industry 4.0 – Conceptual Framework for Industry 4.0 – Smart and Connected Product Business Models – Lean Production Systems for Industry 4.0 – Maturity and Readiness Model for Industry 4.0 Strategy.

UNIT IV TECHNOLOGY ROADMAP FOR INDUSTRY 4.0 9

Proposed Framework for Technology Roadmap – Strategy Phase – New Product and Process Development Phase – Project Portfolio Optimization Model and its application – Talent Development for Industry 4.0 – Skill Requirements in the Digital World.

UNIT V ADVANCES IN ROBOTICS IN THE ERA OD INDUSTRY 4.O 9

Case studies related to Industry 4.0 applications such as Industrial Automation – Home Automation – Transportation, Energy, Infrastructure, Agriculture, Smart Manufacturing, Additive manufacturing, Bio Engineering, Healthcare, Disaster management and product design sectors – Intellectual Property rights.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Describe Industry 4.0 and scope for Indian Industry.

CO2: Describe the digitalization technologies for design and manufacturing industries and its advantages.

CO3: Demonstrate conceptual framework for Industry 4.0.

CO4: Demonstrate the technological road map of Industry 4.0.

CO5: Describe the advancements in Robotic technology with industry 4.0.

TEXT BOOKS

1. Alp Ustundag and Emre Cevikcan., 2018, *Industry 4.0: Managing the Digital Transformation*, Springer Series in Advanced Manufacturing, Switzerland.
2. Christoph Jan, Bartodziej., 2017, *The Concept Industry 4.0*, Springer Gabler, Germany.

REFERENCE BOOKS

1. Klaus Schwab., 2017, *Fourth Industrial Revolution* , Random House USA Inc, New York, USA.
2. Carlos Toro, Wei Wang, Humza Akhtar., *Implementing Industry 4.0*, Intelligent Systems Reference Library, Springer, Singapore.
3. Oliver Grunow.,2016, *Smart Factory and Industry 4.0*, *The current state of Application Technologies* , Studylab Publications.
4. Christian Schroder , *The Challenges of Industry 4.0 for Small and Medium-sized Enterprises.*

ME1743 **LEAN MANUFACTURING**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce to fundamentals of lean manufacturing.
- To get knowledge of tools & techniques used in lean management.
- To predict the waste in any manufacturing process and reduce the waste.
- To impart knowledge on lean & six sigma background, fundamentals and tools.
- To practice Lean Management at the workplace.
- To impart knowledge about value stream mapping.

UNIT I INTRODUCTION TO LEAN MANUFACTURING 9

The mass production system - Cellular Manufacturing - Origin of lean production system – Necessity - Lean revolution in Toyota - Systems and systems thinking - Principles of Lean Manufacturing - Basic elements of lean production. Types of wastes - 3Ms - Muda, Mura and Muri - Conventional Manufacturing versus Lean Manufacturing – Advantages and Limitations of lean Manufacturing.

UNIT II LEAN TOOLS AND TECHNIQUES 9

Just in Time, Kanban – Pull system, Jidoka, Takt Time, Heijunka, Poka-yoke, Five Whys, 5S, Kaizen, SMED, TPM, Problem Solving (PDCA / PDSA).

UNIT III LEAN & SIX SIGMA BACKGROUND AND FUNDAMENTALS 9

Historical Overview – Definition of quality – What is Six Sigma - TQM and Six Sigma – lean manufacturing and Six Sigma - six sigma and process tolerance – Six sigma and cultural changes – six sigma capability - statistical considerations - variability reduction – six sigma need assessments - implications of quality levels, Cost of Poor Quality (COPQ), Cost of Doing Nothing - Six Sigma implementation.

UNIT IV SIX SIGMA TOOLS AND TECHNIQUES 9

Tools for definition – IPO diagram, SIPOC diagram, Flow diagram, CTQ Tree, Project Charter. Tools for measurement – Check sheets, Histograms, Run Charts, Scatter Diagrams, Cause and effect diagram, Pareto charts, Control charts, Flow process

charts, Process Capability Measurement. Tools for analysis – Process Mapping, Regression analysis, RU/CS analysis, SWOT, PESTLE, interrelationship diagram, overall equipment effectiveness, TRIZ innovative problem solving. Tools for improvement – Affinity diagram, Normal group technique, mistake proofing, forced field analysis. Tools for control – Gantt chart, Activity network diagram, Radar chart, PDCA cycle, Milestone tracker diagram, Earned value management.

UNIT V VALUE STREAM MAPPING & CONTEMPORARY 9

Value stream mapping – Value stream icons - Road map - Procedure and principles – steps to preparing Value stream mapping - Various case studies of implementation of lean manufacturing at industries

TOTAL: 45 PERIODS

OUTCOMES

CO1: Comprehend the Lean Manufacturing Philosophy.

CO2: Discuss the tools to implement Lean Manufacturing system.

CO3: Explain the concept of Lean Six Sigma.

CO4: Relate the tools and techniques of lean sigma.

CO5: Describe the value stream mapping concepts and lean thinking concepts

REFERENCE BOOKS

1. N.Gopalakrishnan., 2010, *Simplified Lean Manufacture Elements, Rules, Tools and implementation,* PHI Learning, New Delhi.
2. Ronald G. Askin & Jeffrey B. Goldberg., 2003, *Design and Analysis of Lean Production Systems*, John Wiley & Sons.
3. Michael L.George, David Rownalds, Bill Kastle., 2003, *What is Lean Six Sigma*, McGraw – Hill.
4. Thomas Pyzdek., 2000, *The Six Sigma Handbook*, McGraw-Hill.
5. Fred Soleimannejed., 2004, Six Sigma, Basic Steps and Implementation, Author House.
6. Don Tapping, Tom Luyster, and Tom Shuker., 2012, *Value stream Management Eight steps to planning, Mapping and sustaining Lean Improvements*, Productivity Press,New York.

ME1744 **MAINTENANCE ENGINEERING**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the principles, functions and practices adapted in industry for the successful management of maintenance activities.
- To explain the different maintenance categories like Preventive maintenance, condition monitoring and repair of machine elements.
- To illustrate the instruments used for condition monitoring in industry.
- To enhance the repair methods for basic machine elements and material handling equipment.
- To expose the maintenance budgeting & human factors.

UNIT I **PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING** **9**

Basic Principles of maintenance planning – Objectives and principles of planned maintenance activity – Importance and benefits of sound Maintenance systems – Reliability and machine availability – MTBF, MTTR and MWT – Factors of availability – Maintenance organization – Maintenance economics.

UNIT II **MAINTENANCE POLICIES – PREVENTIVE MAINTENANCE** **9**

Maintenance categories – Comparative merits of each category – Preventive maintenance, maintenance schedules, repair cycle - Principles and methods of lubrication – TPM.

UNIT III **CONDITION MONITORING** **9**

Condition Monitoring – Cost comparison with and without CM – On-load testing and offload testing – Methods and instruments for CM- vibration monitoring- crack monitoring – corrosion monitoring – lubricant monitoring - wear-debris analysis.

UNIT IV **REPAIR METHODS FOR BASIC MACHINE ELEMENTS AND MATERIAL HANDLING EQUIPMENT** **9**

Repair methods for beds, slide ways, spindles, gears, lead screws and bearings – Belt , conveyer , crane , Forklift - Failures and their development.

UNIT V MAINTENANCE BUDGETING & HUMAN FACTORS 9

Maintenance budgeting – types of maintenance budget – preparation of maintenance budget - Human factors in maintenance – manpower planning for maintenance – objectives and stages of manpower planning – training for maintenance personnel - Computer-aided maintenance management system (CMMS) – functions, applications and advantages of CMMS.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Explain the Principles and Importance of Maintenance Planning, Reliability and also the factors affecting Availability.

CO2: Discuss the Principles of Maintenance Schedule and Repair Schedule for machineries.

CO3: Describe the Condition monitoring techniques and instruments for On-Load and Off-Load Testing of machineries.

CO4: Predict the Failure modes and Repair Methods for basic machine elements and material handling equipment.

CO5: Explain the budgeting methods & human factors for maintenance

TEXT BOOKS

1. Srivastava S.K., 1998, *Maintenance Engineering Principles, Practices & Management* , S. Chand and Co.
2. Venkataraman.K., 2010, *Maintenance Engineering and Management*, PHI Learning, Pvt. Ltd.

REFERENCE BOOKS

1. Bhattacharya S.N.,1995, *Installation, Servicing and Maintenance*, S. Chand and Co.
2. Higgins L.R., 2008, *Maintenance Engineering Hand book,* 5th Edition, McGraw Hill.
3. Armstrong .,1988*, Condition Monitoring,* BSIRSA.
4. Davies .,1996, *Handbook of Condition Monitoring*, Chapman & Hall.

GE1671 **TOTAL QUALITY MANAGEMENT**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn the concepts of quality and quality management, TQM framework, Barriers and Benefits of TQM.
- To apply the Principles and techniques of Quality Management for real time.
- To Understand the need and importance of quality assurance and certification.

UNIT I INTRODUCTION **9**

Concept of Quality and Quality Management- Determinants of quality of product & service - Quality vs. Reliability - Definition of TQM - Basic concepts of TQM - TQM Framework - Barriers to TQM – Benefits of TQM.– Gurus of TQM (Brief introduction)- Quality statements – vision, mission, Policy.

UNIT II PRINCIPLES AND PHILOSOPHIES OF QUALITY MANAGEMENT **9**

Overview of the contributions of Deming , Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa, Taguchi, Shingeo and Walter Shewhart - Concepts of Quality circle, Japanese 5S principles and 8D methodology.

UNIT III TOOLS AND TECHNIQUES FOR QUALITY MANAGEMENT **9**

Quality functions development (QFD) – Benefits, Voice of customer, information Organisation, House of quality (HOQ), building a HOQ, QFD process. Failure mode effect analysis (FMEA) – requirements of reliability, failure rate, FMEA stages, design, process and documentation-Taguchi techniques.

UNIT IV STATISTICAL QUALITY CONTROL **9**

Juran’s concept of quality cost - components of Quality Cost - Statistical Quality Control – Inspection, Sampling, Sample Size, Sampling Plan, AQL, OC curve, Producer Risk, Consumer Risk, AOQ, AOQL, Control Charts & Control Limits – X, R & S charts and their application- causes of variations – Assignable & Random; Runs-Test, Chart - Sensitivity Test and Run-Sum Test; Normal - Distribution curve and concept of Six Sigma.

UNIT V QMS- QUALITY MANAGEMENT SYSTEM 9

Introduction - Benefits of ISO Registration - ISO 9000 Series of Standards-Sector- 23 Specific Standards - AS 9100, TS16949 and TL 9000 - ISO 9001 Requirements Implementation-Documentation – InternalAudits – Registration - ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction - ISO 14000 Series Standards - Concepts of ISO 14001 - Requirements of ISO 14001 - Benefits of EMS.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Apply TQM concepts in a selected enterprise.

CO2: Apply TQM principles in a selected enterprise.

CO3: Explain Taguchi's techniques, Performance Measures,QFD,HOQ.

CO4: Expalin Six Sigma and apply Traditional tools, New tools, Benchmarking.

CO5: Confirm quality standards and implementing QMS in business organization.

TEXT BOOKS

1. L. Suganthi & Dr. Anand Samuel., 2004, *Total Quality Management,* Prentice Hall, Publications.
2. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe.,2013, *Total Quality Management*, Revised 3rd Edition, Pearson Education Asia, Indian Reprint, Sixth Impression.

REFERENCE BOOKS

1. Rose J.E., 1997, *Total Quality Management*, S. Chand & Co
2. Kiran.D.R, 2016, *Total Quality Management: Key concepts and case studies,* Butterworth – Heinemann Ltd.
3. Shridhara Bhat K, 2016, *Total Quality Management: Text and Cases*, Himalaya Publishing House India, 2nd Edition, ISBN: 9789352622399.

OME761 **3D PRINTING AND DESIGN**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To impart knowledge and skills related to 3D printing technologies.
- To select material and equipment for various 3D printing products.
- To develop a 3D printed products.

UNIT I INTRODUCTION 9

Introduction, Process, Classification, Advantages, Additive V/s Conventional Manufacturing processes. CAD Data formats, Data translation, Data loss, STL format. Additive Manufacturing Application Domains: Aerospace, Electronics, Health Care, Defense, Automotive, Construction, Food Processing, Machine Tools.

UNIT II ADDITIVE MANUFACTURING USING POLYMERS 9

Principle, Pre-Build Process, Part-Building and Post Processing Requirement and Techniques, Advantages, Limitations and Applications for Stereo- Lithography, LOM, FDM, SLS, Binder Jet technology- Process, Process parameter, Process Selection for various applications- Defects and their causes - Inspection and Testing of polymer-based AM.

UNIT III METAL ADDITIVE MANUFATURING 9

Principle, Pre-Build Process, Part-Building and Post Processing Requirement and Techniques, Advantages, Limitations and Applications for Selective Laser Melting (SLM), Laser Beam Melting (LBM), Laser Metal Fusion (LMF), Direct Metal Laser Sintering (DMLS), Electron Beam melting (EBM), Laser Cladding, Directed Energy Deposition and Laser Metal Deposition Process, Laser Engineered Net Shaping (LENS), Wire Arc AM, Friction Stir AM - Inspection and Testing metal AM.

UNIT IV AM MATERIALS 9

Polymers, Metals, Non-Metals, Ceramics - Various forms of raw material- Liquid, Solid, Wire, Powder; Powder Preparation and their desired properties, Polymers and their Properties -Support Materials- FGM – Composite Materials in AM - Metallurgy and Properties of Materials for Metal AM.

UNIT V DESIGN OF 3D PRINTING EQUIPMENT 9

Process Equipment- Design and Process Parameters – Design Requirements & Limitations of 3D Printing - Governing Bonding Mechanism – Components and Block Diagram - Design of Low-Cost 3D printers - Components and Block diagram – Electronics Design & Circuit Diagram – Firmware - Common faults and Troubleshooting.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Explain how to select a 3D printing process for an application.

CO2: Explain the principle, process, advantages and disadvantages of various Polymer-based AM techniques.

CO3: Explain the principle, process, advantages and disadvantages of various Metal AM techniques.

CO4: Select a specific AM material for the suitable application.

CO5: Design a 3D printer with suitable mechanism.

TEXT BOOKS

1. Lan Gibson, David W. Rosen and Brent Stucker., 2010, *Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing*, Springer.
2. Soloman S., 2020, *3D Printing and Design*, Khanna Publishing House, Delhi.

REFERENCE BOOKS

1. Andreas Gebhardt., 2011, *Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing*", Hanser Publisher.
2. CK Chua, Kah Fai Leong., 2018, *3D Printing and Rapid Prototyping-Principles and Applications*", World Scientific.
3 J.D. Majumdar and I. Manna., 2013, *Laser-Assisted Fabrication of Materials*, Springer Series in Material Science.
4. Zhiqiang Fan & Frank Liou., 2012, *Numerical Modelling of the Additive Manufacturing (AM) Processes of Titanium Alloy*, InTech.

OME762 **INDUSTRIAL SAFETY**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To enable the students to learn about various functions and activities of safety department.
- To have knowledge about various hazard identification and risk assessment techniques.
- To familiarize students with evaluation of safety performance.
- To enable the students to identify the causes of accidents and its preventions.
- To impart knowledge on OSHAS (Occupational Safety and Health Assessment Series) in engineering Industry.

UNIT I CONCEPTS OF SAFETY MANAGEMENT AND HAZARD IDENTIFICATION **9**

Evolution of modern safety concepts – safety management functions – safety organization, safety department - safety committee - line and staff functions for safety -budgeting for safety - safety audit. Hazard - classification - chemical, physical, mechanical, ergonomic, biological hazards-Identification and Control measures - Electrical hazards – Shock Protection methods.

UNIT II HAZARD ANALYSIS, RISK ASSESSMENT AND CONTROL **9**

Fire hazards of flammable and explosive materials - Fire prevention and control – hazard evaluation techniques - job safety analysis, safety inspection, safety sampling – Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), HAZOP analysis and Risk Assessment – Personal Protective equipment.

UNIT III SAFETY EDUCATION AND TRAINING **9**

Importance of training - identification of training needs-training methods – programme, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations,

safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.

UNIT IV SAFETY PERFORMANCE MONITORING AND ACCIDENT PREVENTION **9**

Reactive and proactive monitoring techniques - Permanent total disabilities, permanent partial disabilities, temporary total disabilities -Calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incident rate, accident rate, safety "t" score, safety activity rate – Total Injury illness incidence rate, Lost work day cases Incidence rate (LWDI), Number of lost work days rate.

UNIT V SAFETY REGULATIONS **9**

Factories act 1948 with special reference to safety, Health and welfare provisions - Indian boiler act – SMPV rules – The environmental protection act – Electricity act – Explosive act – Health and Safety at work act (HASAWA) UK,-Occupational Safety health act (OSHA).

TOTAL: 45 PERIODS

OUTCOMES

CO1: Describe the evolution of modern safety concepts, functions and activities of safety engineering department.

CO2: Identify hazard and assess the risks using suitable techniques.

CO3: Summarize the different safety management training activities involved in industry.

CO4: Explain the safety performance of an organization from accident records.

CO5: List out requirements mentioned in various acts and rules for the prevention of accidents.

TEXT BOOKS

1. John V.Grimaldi and Rollin H.Simonds, 1994, *Safety Management*, Richard D. Irwin publisher.
2. John V.Grimaldi, 2003, *Safety Management*, AITB S Publishers.

REFERENCE BOOKS

1. C.Ray Asfahl, David W. Rieske., 2018, *Industrial Safety and Health Management*, Prentice Hall, 7th Edition.
2. David L.Goetsch., 2016, *Occupational Safety and Health for Technologists*, 5th Edition, Engineers and Managers, Pearson Education Ltd.
3 R.K. Mishra., 2016, *Safety Management*, AITBS publishers.
4 Charles D. Reese., 2015, *Occupational Health and Safety Management: A Practical Approach*, 3rd Edition CRC press.
5 Mark A. Friend, James P. Kohn., 2014, *Fundamentals of Occupational Safety and Health* , 6th Edition Bernan press.
6 Krishnan N.V., 2015, *Safety Management in Industry*, Jaico Publishing House, Bombay.

OME763 **SELECTION OF MATERIALS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- The subject exposes students to the basics parameter for selection of materials and different classes of materials, manufacturing processes and their properties , applications of materials.

UNIT I ENGINEERING MATERIALS 9

Introduction – classification of engineering materials – selection of materials for engineering purposes –selection of materials and shape –classification metal and alloys, polymers, ceramics and glasses, composites, natural materials,-non metallic materials- smart materials - physical,metrical properties of metals.

UNIT II MATERIAL PROPERTIES 9

Mechanical properties – fatigue strength – fracture Toughness - Thermal Properties – Magnetic Properties - Fabrication Properties –electrical , optical properties - Environmental Properties ,Corrosion properties –shape and size - Material Cost and Availability– failure analysis.

UNIT III MANUFACTURING PROCESSING AND ECONOMIC ANALYSIS 9

Interaction of Materials Selection, Design, and Manufacturing Processes - Production Processes and Equipment for Metals - Metal Forming, Shaping, and Casting - Plastic Parts Processing - Composites Fabrication Processes - Advanced Ceramics Processing – surface treatment - Resource -The Price and Availability of Materials.

UNIT IV MATERIALS SELECTION CHARTS AND TESTING 9

Ashby material selection charts-Testing of Metallic Materials - Plastics Testing – Characterization and Identification of Plastics - Professional and Testing Organizations - Ceramics Testing - Nondestructive Inspection.

UNIT V APPLICATIONS AND USES 9

Selection of Materials for Biomedical Applications - Medical Products - Materials in Electronic Packaging - Advanced Materials in Sports Equipment - Materials Selection

for Wear Resistance - Advanced Materials in Telecommunications - Using Composites - Manufacture and Assembly with Plastics, fiber and Diamond Films.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Discuss the different types of Engineering materials.

CO2: Explain the various properties of materials.

CO3: Interpert the manufacturing processes and economic Analysis.

CO4: Describe the material selection by using Ashby charts and material testing procedures.

CO5: Apply the knowledge on the properties of the materials and manufacturing processing to select suitable materials for various application.

TEXT BOOKS

1. Ashby, M. F., 2005, *Materials selection in mechanical design*, 3rd edition. Elsevier.
2. Ashby, M. F. and Johnson, K., 2002, *Materials and design – the art and science of material selection in product design*. Elsevier, 2002.

REFERENCE BOOKS

1. Charles, J. A., Crane, F. A. A. and Furness, J. A. G., 1997, *Selection and use of engineering materials*, 3rd edition. Butterworth-Heinemann.
2. *Handbook of Materials Selection.* Edited by Myer Kutz, 2002 John Wiley & Sons, Inc., NewYork.

OME764 **TESTING OF MATERIALS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the various destructive and non-destructive testing methods of materials and its industrial applications.

UNIT I INTRODUCTION TO MATERIALS TESTING 9

Overview of materials, Classification of material testing, Purpose of testing, Selection of material, Development of testing, Testing organizations and its committee, Testing standards, Result Analysis, Advantages of testing.

UNIT II MECHANICAL TESTING 9

Introduction to mechanical testing, Hardness test (Vickers, Brinell, Rockwell), Tensile test, Impact test (Izod, Charpy) - Principles, Techniques, Methods, Advantages and Limitations, Applications. Bend test, Shear test, Creep and Fatigue test - Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT III NON DESTRUCTIVE TESTING 9

Visual inspection, Liquid penetrant test, Magnetic particle test, Thermography test – Principles Techniques, Advantages and Limitations, Applications. Radiographic test, Eddy current test, Ultrasonic test, Acoustic emission- Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT IV MATERIAL CHARACTERIZATION TESTING 9

Macroscopic and Microscopic observations, Optical and Electron microscopy (SEM and TEM) - Principles, Types, Advantages and Limitations, Applications. Diffraction techniques, Spectroscopic Techniques, Electrical and Magnetic Techniques- Principles, Types, Advantages and Limitations, Applications.

UNIT V OTHER TESTING 9

Thermal Testing: Differential scanning calorimetry, Differential thermal analysis. Thermomechanical and Dynamic mechanical analysis: Principles, Advantages, Applications. Chemical Testing: X-Ray Fluorescence, Elemental Analysis by Inductively Coupled Plasma-Optical Emission Spectroscopy and Plasma-Mass Spectrometry.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Explain the necessary of material testing, classifications and testing standards.

CO2: Identify various parameters for mechanical testing of materials for various applications.

CO3: Differentiate the various types of non-destructive testing methods with its applications, advantages and limitations.

CO4: Explain the principles of inspections and characterization techniques using various equipments.

CO5: Describe Thermal and Chemical based characterization techniques in various applications.

TEXT BOOKS

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu., 2009, *Practical Non-Destructive Testing*, Narosa Publishing House.
2. P. Field Foster, 2007., *The Mechanical Testing of Metals and Alloys.* 7th Edition, Cousens Press.

REFERENCE BOOKS

1. ASM Handbook Committee., 1986, *Metals Handbook: Mechanical testing, (Volume 8),* , 9th Edition, American Society for Metals.
2. Brandon D.G., 1986, *Modern Techniques in Metallography*, Von Nostrand Inc. NJ, USA.