GOVERNMENT COLLEGE OF TECHNOLOGY, Coimbatore – 641 013

DEPARTMENT OF PRODUCTION ENGINEERING (FULL TIME)

2018A REGULATIONS : VERTICALS CURRICULA AND SYLLABI

PROFESSIONAL ELECTIVE COURSES: VERTICALS			
VERTICAL I	**VERTICAL II**	**VERTICAL III**	**VERTICAL IV**
AUTOMATION	**PRODUCT DESIGN AND DEVELOPMENT**	**MANUFACTURING PROCESSES AND CONCEPTS**	**INDUSTRIAL ENGINEERING AND QUALITY CONTROL**
18PPE$01 Mechatronic Systems	18PPE$02 Finite Element Techniques	18PPE$03 Unconventional Manufacturing Processes	18PPE$07 Statistical Quality Control and Reliability Engineering
18PPE$04 CNC Technology	18PPE$06 Robust Design	18PPE$08 Advanced Welding Technology	18PPE$12 Plant Layout and Material Handling
18PPE$23 Robotics and Machine Vision System	18PPE$09 Product Design and Process Engineering	18PPE$16 Lean Manufacturing (common to MECH & PRODN)	18PPE$13 Non Destructive Testing Techniques
18PPE$25 Electronics Manufacturing Technology	18PPE$10 Design for Manufacture and Assembly	18PPE$17 Micro manufacturing Processes	18PPE$14 Supply Chain Management
18PPE$26 Smart Manufacturing	18PPE$22 Computer Aided Design (common to MECH & PRODN)	18PPE$19 Advanced Casting Technology	18PPE$15 Production Management
18PPE$27 Modern Control Technology	18PPE$18 Theory of Metal Cutting (common to MECH & PRODN)	18PPE$21 Green Manufacturing	18PPE$20 Total Productive Maintenance
18PPE$28 Image Processing in Manufacturing	18PPE$29 Introduction to Composite Materials	18PPE$24 Investment Casting	18PPE$05 Power Plant Engineering (common to MECH & PRODN)
-	18PPE$30 Industrial Ergonomics	18PPE$31 Surface Engineering and Tribology	18PPE$11 Human Values and professional Ethics II
-	-	-	18PPE$32 Industrial Safety Engineering

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL I – AUTOMATION

Sl. No.	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	18PPE$01	Mechatronic Systems	PE	40	60	100	3	0	0	3
2	18PPE$04	CNC Technology	PE	40	60	100	3	0	0	3
3	18PPE$23	Robotics and Machine Vision System	PE	40	60	100	3	0	0	3
4	18PPE$25	Electronics Manufacturing Technology	PE	40	60	100	3	0	0	3
5	18PPE$26	Smart Manufacturing	PE	40	60	100	3	0	0	3
6	18PPE$27	Modern Control Technology	PE	40	60	100	3	0	0	3
7	18PPE$28	Image Processing in Manufacturing	PE	40	60	100	3	0	0	3

VERTICAL II - PRODUCT DESIGN AND DEVELOPMENT

Sl. No.	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	18PPE$02	Finite Element Techniques	PE	40	60	100	3	0	0	3
2	18PPE$06	Robust Design	PE	40	60	100	3	0	0	3
3	18PPE$09	Product Design and Process Engineering	PE	40	60	100	3	0	0	3
4	18PPE$10	Design for Manufacture and Assembly	PE	40	60	100	3	0	0	3
5	18PPE$22	Computer Aided Design	PE	40	60	100	3	0	0	3
6	18PPE$18	Theory of Metal Cutting	PE	40	60	100	3	0	0	3
7	18PPE$29	Introduction to Composite Materials	PE	40	60	100	3	0	0	3
8	18PPE$30	Industrial Ergonomics	PE	40	60	100	3	0	0	3

VERTICAL III - MANUFACTURING PROCESSES AND CONCEPTS

Sl. No.	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	18PPE$03	Unconventional Manufacturing Processes	PE	40	60	100	3	0	0	3
2	18PPE$08	Advanced Welding Technology	PE	40	60	100	3	0	0	3
3	18PPE$16	Lean Manufacturing	PE	40	60	100	3	0	0	3
4	18PPE$17	Micro manufacturing Processes	PE	40	60	100	3	0	0	3
5	18PPE$19	Advanced Casting Technology	PE	40	60	100	3	0	0	3
6	18PPE$21	Green Manufacturing	PE	40	60	100	3	0	0	3
7	18PPE$24	Investment Casting	PE	40	60	100	3	0	0	3
8	18PPE$31	Surface Engineering and Tribology	PE	40	60	100	3	0	0	3

VERTICAL IV - INDUSTRIAL ENGINEERING AND QUALITY CONTROL

Sl. No.	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	18PPE$07	Statistical Quality Control and Reliability Engineering	PE	40	60	100	3	0	0	3
2	18PPE$12	Plant Layout and Material Handling	PE	40	60	100	3	0	0	3
3	18PPE$13	Non Destructive Testing Techniques	PE	40	60	100	3	0	0	3
4	18PPE$14	Supply Chain Management	PE	40	60	100	3	0	0	3
5	18PPE$15	Production Management	PE	40	60	100	3	0	0	3
6	18PPE$20	Total Productive Maintenance	PE	40	60	100	3	0	0	3
7	18PPE$05	Power Plant Engineering	PE	40	60	100	3	0	0	3
8	18PPE$11	Human Values and professional Ethics II	PE	40	60	100	3	0	0	3
9	18PPE$32	Industrial Safety Engineering	PE	40	60	100	3	0	0	3

VERTICAL I

AUTOMATION

18PPE$01	MECHATRONIC SYSTEMS

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. Basics of Electrical Engineering
2. Basic Electronics Engineering

COURSE OBJECTIVES:

* Introducing the key elements of mechatronics system and understanding the concepts of integration and design of mechatronics system.

UNIT- I	MECHATRONICS SYSTEMS	(9 Periods)
Introduction to Mechatronics- Basics of actuating systems. Mechanical, pneumatic, hydraulics, electrical systems- control systems- measurements systems- Mechatronics approach.		
UNIT- II	**SENSORS AND TRANSDUCERS**	**(9 Periods)**
Introduction - performance terminology- displacement, position and proximity- velocity and motion- fluid pressure-temperature sensors- light sensors- selection of sensors- signal processing.		
UNIT- III	**8085 MICROPROCESSOR**	**(9 Periods)**
Introduction- architecture- pin configuration- instruction set- programming of microprocessors using 8085 instructions-interfacing input and output devices- interfacing D/A converters and A/D converters- applications- temperature controls-stepper motor control- traffic light controller.		
UNIT- IV	**PROGRAMMABLE LOGIC CONTROLLERS**	**(9 Periods)**
Introduction - basic structure - input/output processing – programming – Mnemonics - timers, internal relays And counters - data handling - analog input/output - selection of a PLC.		
UNIT- V	**DESIGN OF MECHATRONIC SYSTEMS**	**(9 Periods)**
Stages in designing Mechatronics systems - Traditional and Mechatronics design - Possible design – solutions - case studies of Mechatronics systems - pick and place robots - automatic car park systems - engine management systems.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *W.Bolton* ***"Mechatronics",*** *Pearson education., Second Edition, 2007.*
2. *Ramesh S. Gaonkar* ***"Microprocessor Architecture Programming and Applications",*** *Wiley Eastern, 1991.*

REFERENCE BOOKS:

1. *Michel B. Histand and David G. Alciatore,* ***"Introduction to Mechatronics and measurement systems",*** *McGraw Hill International Editions.*
2. *HMT Ltd,* ***"Mechatronics",*** *Tata McGraw Hill publishing Co. Ltd.*
3. *D.A.Bradley, D. Dawson, N.C. Buru and A.J. Loader* ***"Mechatronics",*** *Chapman and Hall.*
4. *K. Ram,.* ***"Fundamantals of Microprocessors and Microcomputers",*** *Dhampat rai publications.*
5. *Dan Necsulescu* ***"Mechatronics",*** *Pearson Education Asia. (Indian reprint).*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Build the basic block diagram of mechatronics system (sensing, measuring controlsand actuation, hardware and software).

CO2: Describe the mechatronic system approach.

CO3: Explain the concepts of transducers, sensors, microprocessor and programmable logic controllers in mechatronics systems.

CO4: Identify critical problems/ design issues and suggest feasible solutions in mechatronics systems.

CO5: Design mechatronic components and systems.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	H	M	M	M	L						L	L	M	
CO2	M	M	M	M	M	L						L	L	M	
CO3	M	M	M	M	M	L						L	L	M	
CO4	M	M	H	H	M	L						L	L	M	
CO5	H	H	H	H	M	L						L	L	M	
18PPE$01	H	H	H	H	M	L						L	L	M	

L- Low, M – Moderate (Medium), H – High

18PPE$04	CNC TECHNOLOGY

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. Machine Tools and Processes

COURSE OBJECTIVES:

- To enable the students to understand CNC machines constructional features, working and programming.

UNIT- I	INTRODUCTION TO CNC MACHINE TOOLS	(9 Periods)
Evolution of CNC Technology, principles, features, advantages, applications, CNC and DNC concept, types of control systems, CNC controllers, characteristics, interpolators, types of CNC Machines – turning centre, machining centre, grinding machine, Vertical turret lathe, turn – mill centre, EDM.		
UNIT- II	**STRUCTURE OF CNC MACHINE TOOL**	**(9 Periods)**
CNC Machine building, structural details, configuration and design, guide ways – Friction, Anti friction and other types of guide ways, elements used to convert the rotary motion to a linear motion – Screw and nut, recirculating ball screw, planetary roller screw, recirculating roller screw, rack and pinion, spindle assembly, torque transmission elements – gears, timing belts, flexible couplings, Bearings.		
UNIT- III	**DRIVES AND CONTROLS**	**(9 Periods)**
Spindle drives, feed drives – stepper motor, servo principle, DC and AC servomotors, Linear motors. Open loop and closed loop control, Axis measuring system – synchro, synchro-resolver, gratings, moiré fringe gratings, encoders, inductosysn, laser interferometer.		
UNIT- IV	**CNC PROGRAMMING**	**(9 Periods)**
Coordinate system, structure of a part program, G & M Codes, tool length compensation, cutter radius and tool nose radius compensation, do loops, subroutines, canned cycles, mirror image, parametric programming, machining cycles, programming for machining centre and turning centre for Fanuc controller - Generation of CNC codes from CAM packages.		
UNIT- V	**TOOLING AND WORK HOLDING DEVICES**	**(9 Periods)**
Cutting tool materials for CNC machine tools – Carbides, Ceramics, CBN, PCD – inserts classification - qualified, semi qualified and preset tooling, tooling for Machining and Turning centre, ATC, APC, work holding devices for rotating and fixed work parts, economics of CNC, maintenance of CNC machines.		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

TEXT BOOKS:

1. *HMT Limited **"Mechatronics",** Tata McGraw-Hill Publishing Company Limited, New Delhi, 2005*
2. *Mike Mattson **"CNC Programming Principles and Applications",** Delmar Cengage learning, 2010*

REFERENCE BOOKS:

1. *Evans K., Polywka J. and Stanley Gabrel.,* ***"Programming of CNC Machines",*** *Third Edition – Industrial Press Inc, New York, 2007*
2. *Madison J.* ***"CNC Machining Hand Book",*** *Industrial Press Inc., 1996.*
3. *Smid P* ***"CNC Programming Hand book",*** *Industrial Press Inc., 2007*
4. *Third Edition Radhakrishnan P* ***"Computer Numerical Control Machines",*** *New Central Book Agency, 2002*
5. *Rao P.N.* ***"CAD/CAM Principles and Applications",*** *Tata McGraw-Hill Publishing Company Limited, New Delhi, 2010.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Describe the evolution and principle of CNC machine tools and types of control systems.

CO2: Apply knowledge in current terminology to describe the CNC machines and its types.

CO3: Describe constructional features of CNC machine tools, drives and positional transducers used in CNC machine tools.

CO4: Generate CNC programs for popular CNC controllers.

CO5: Describe tooling and work holding devices for CNC machine tools.

COURSE ARTICULATION MATRIX:

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L				H								L		
CO2	L				H								L		
CO3	L				M								M		
CO4	L				H							M		H	
CO5	L				M								M		
18PPE$04	L				H							M	M	M	

L- Low, M – Moderate (Medium), H – High

18PPE$23	ROBOTICS AND MACHINE VISION SYSTEM

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

* To familiarize students with the concepts and techniques of robot manipulator, its kinematics, programming and build confidence to evaluate, choose and incorporate robots in engineering systems.

UNIT- I	FUNDAMENTALS OF ROBOT	(9 Periods)
Robotics – Introduction – Basic structure – Classification of robot and Robotic systems – Specifications of Robots - laws of robotics – work space, precision movement. Drives and Controls systems: Hydraulic systems, power supply – servo valve – hydraulic motor – DC servo motors – stepper motors – operation – selection of system – control system – servo control.		
UNIT- II	**ROBOT MOTION ANALYSIS**	**(9 Periods)**
Kinematics of Robot: Introduction, Matrix Representation, homogeneous transformation, forward and inverse kinematics, Inverse kinematics Programming, Degeneracy, dexterity, velocity and static forces, Basics of trajectory planning.		
UNIT- III	**GRIPPERS AND SENSORS**	**(9 Periods)**
Robot end effectors: Types of end effectors – Mechanical grippers – Types of Gripper mechanisms – Grippers force analysis – Other types of grippers – Vacuum cups – Magnetic grippers – Adhesive grippers – Robot end effectors interface. Sensors: Position sensors – Potentiometers, encoders, - LVDT, Velocity sensors, Acceleration Sensors, Force, Pressure and Torque sensors, Touch and Tactile sensors, Proximity, Range and sniff sensors.		
UNIT- IV	**PROGRAMMING AND APPLICATION**	**(9 Periods)**
Types of programming – programming languages sample program for different types of robots – Industrial Applications: Application of robots in processing operations – Assembly and inspections – Material handling – Loading and unloading– AI and Robotics.		
UNIT- V	**MACHINE VISION**	**(9 Periods)**
Introduction – image processing Vs image analysis, image acquisition, digital images – sampling and quantization – image definition, levels of computation. Image processing Techniques: Data reduction –Windowing, digital conversion. Segmentation– Thresholding, Connectivity, Noise reduction, Edge detection, Segmentation, Region growing and Region splitting, Binary morphology and grey morphology operation – feature extraction.		

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Saeed B.Niku* ***"Introduction to Robotics: Analysis, Systems, Applications",*** *2nd edition, Pearson Education India, PHI 2003 (ISBN 81- 7808-677-8)*
2. *M.P.Groover* ***"Industrial Robotics – Technology, Programming and Applications",*** *McGraw- Hill, USA, 1986*

REFERENCE BOOKS:

1. *Janakiraman P.A* ***"Robotics and image processing",*** *Tata McGraw Hill, 1995*
2. *YoremKoren,* ***"Robotics for Engineers",*** *McGraw-Hill, USA, 1992*
3. *Richard D.Klafter, Thomas A.Chmielewski and Michael Negin* ***"Robotic Engineering",*** *An Integrated Approach, Prentice Hall Inc, Englewoods Cliffs, NJ, USA, 1989.*
4. *Ramesh Jam, RangachariKasturi, Brain GSchunck* ***"Machine Vision",*** *Tata McGraw Hill.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Explain the basic concepts like various configurations, classification and parts of robots.

CO2: Explain the concept of kinematics, degeneracy, dexterity and trajectory planning.

CO3: Describe various end effectors (grippers and tools) and sensors used in robots.

CO4: Explain the concept of Artificial Intelligence in robots, various types of robot programming and its applications.

CO5: Demonstrate the image processing and image analysis techniques by machine vision system.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	L	L									L	M		
CO2	M	M	M	M								L	M		
CO3	M	L	L									L	M		
CO4	M	M	H		M							L	M	M	
CO5	H	M	M	L								L	M	M	
18PPE$23	M	M	M	L	L							L	M	M	

L- Low, M – Moderate (Medium), H - High

18PPE$25	ELECTRONICS MANUFACTURING TECHNOLOGY

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. Basic Electronics Engineering

COURSE OBJECTIVES:

* To understand wafer preparation and PCB fabrication, the types of Mounting Technologies and components for electronics assembly & SMT process in detail.
* To know various Defects, Inspection Equipments SMT assembly process and repair, rework and quality aspects of Electronics assemblies.

UNIT- I	INTRODUCTION TO ELECTRONICS MANUFACTURING	(9 Periods)
History, definition, wafer preparation by growing, machining, and polishing, diffusion, microlithography, etching and cleaning, Printed circuit boards, types- single sided, double sided, multi layer and flexible printed circuit board, design, materials, manufacturing, inspection.		
UNIT- II	**COMPONENTS AND PACKAGING**	**(9 Periods)**
Introduction to packaging, types-Through hole technology(THT) and Surface mount technology(SMT), Through hole components – axial, radial, multi leaded, odd form. Surface mount components- active, passive. Interconnections - chip to lead interconnection, die bonding, wire bonding, TAB, flip chip, chip on board, multi chip module, direct chip array module, leaded, leadless, area array and embedded packaging, miniaturization and trends.		
UNIT- III	**SURFACE MOUNT TECHNOLOGY PROCESS**	**(9 Periods)**
Introduction to the SMT Process, SMT equipment and material handling systems, handling of components and assemblies - moisture sensitivity and ESD, safety and precautions needed, IPC and other standards, stencil printing process - solder paste material, storage and handling, stencils and squeegees, process parameters, quality control. Component placement- equipment type, flexibility, accuracy of placement, throughput, packaging of components for automated assembly, Cp and Cpk and process control. soldering- reflow process, process parameters, profile generation and control, solder joint metallurgy, adhesive, underfill and encapsulation process - applications, materials, storage and handling, process and parameters.		
UNIT- IV	**INSPECTION AND TESTING**	**(9 Periods)**
Inspection techniques, equipment and principle - AOI, X-ray. Defects and Corrective action - stencil printing process, component placement process, reflow soldering process, underfill and encapsulation process, electrical testing of PCB assemblies- In circuit test, functional testing, fixtures and jigs.		
UNIT- V	**REPAIR, REWORK, QUALITY AND RELIABILITY OF ELECTRONICS ASSEMBLIES**	**(9 Periods)**
Repair tools, methods, rework criteria and process, thermo-mechanical effects and thermal management, Reliability fundamentals, reliability testing, failure analysis, design for manufacturability, assembly, reworkability, testing, reliability and environment.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Prasad R.* ***"Surface Mount Technology –Principles and practice",*** *Second Edition, Chapman and Hall, 1997, New York*
2. *Tummala R.R.* ***"Fundamentals of microsystem packaging",*** *Mc -Graw Hill, 2001*

REFERENCE BOOKS:

1. *PuligandlaViswanadham and Pratap Singh* ***"Failure Modes and Mechanisms in Electronic Packages",*** *New York, 1997, N.Y. ISBN 0-412-105591-8.*
2. *Totta P., Puttlitz K. and Stalter K.,* ***"Area Array Interconnection Handbook",*** *Kluwer Academic Publishers, Norwell, MA, USA, 2001. ISBN 0-7923-7919-5.*
3. *Lee N.C.,* ***"Reflow Soldering Process and Trouble Shooting SMT,BGA,CSP and Flip Chip Technologies",*** *2001, Elsevier Science*
4. *Zarrow P. and Kopp D.* ***"Surface Mount Technology Terms and Concepts",*** *1997, Elsevier Science and Technology,.ISBN 0750698756.*
5. *Harper C.A.,* ***"Electronic Packaging and Interconnection Handbook",*** *McGraw Hill Inc., New York, N.Y., 1997, ISBN 0-07-026694-8.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Describe wafer preparation and PCB fabrication process.
CO2: Use different types of mounting technologies for electronic assemblies.
CO3: Perform quality inspection on the PCBs
CO4: Repair and rework of Electronics assemblies
CO5: Describe the quality and reliability aspects of Electronics assemblies

COURSE ARTICULATION MATRIX:

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L					L	L					M	H		
CO2	L				L							L	L		
CO3	H	M		M	L			L				L			H
CO4	H	M		M	L			L				L			L
CO5	L			L								L			M
18PPE$25	M	L		M	L	L	L	L				L	M		M

L- Low, M – Moderate (Medium), H – High

18PPE$26	SMART MANUFACTURING

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSEOBJECTIVES:

* To familiarize the students about various components of Intelligent manufacturing systems

UNIT- I	**COMPONENTS OF EXPERT SYSTEMS**	**(9 Periods)**
Expert system concept – comparisons – stages in Expert system - Knowledge Representation – Types - comparison of Knowledge Representation Schemes – Inference engine – Inference models –Forward, backward chaining - Knowledge acquisition – Optimization and Knowledge based systems		
UNIT- II	**INTELLIGENT MANUFACTURING**	**(9 Periods)**
Machine Learning - Intelligent Manufacturing – System Components – System architecture and Data flow – System operation – Flexible Assembly Systems – Tool management.		
UNIT- III	**TECHNOLOGY BASED SYSTEMS**	**(9 Periods)**
Design of mechanical parts – Refinement Approach – Model based approach – Design of mechanisms – Feature based design – Knowledge based design for Automated Assembly – Process planning – Feature recognition – Machining Optimization – Knowledge Based Systems.		
UNIT- IV	**KNOWLEDGE BASED SYSTEM FOR GROUP TECHNOLOGY**	**(9 Periods)**
Models and Algorithms – Cluster Analysis Method – Knowledge based systems for GT – Models and Algorithms for Machine layout – Knowledge based Systems for machine layout – scheduling - Models and Algorithms – Knowledge Based Systems.		
UNIT- V	**INDUSTRIAL APPLICATION AND RECENT ADVANCES**	**(9 Periods)**
Industrial application of Artificial Intelligence and Expert systems – Robotic vision systems, image processing techniques– application to object recognition and inspection - Application of Artificial Neural Networks – Fuzzy Logic and Genetic Algorithms in manufacturing – ANN for tool wear monitoring – Fuzzy control of machine tools.		

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Andrew Kusiak, **"Intelligent Manufacturing Systems",** Prentice Hall, 1998.*
2. *Mohammed Jamshidi, **"Design and Implementation of Intelligent Manufacturing systems",** Prentice Hall, 1995.*

REFERENCE BOOKS:

1. *Mitsugen, Runweicheng **"Genetic Algorithms in Engineering Design",** JohWiley, 1997*
2. *Elaine Rich **"Artificial Intelligence",** TMH, 1995.*
3. *Ibrahim Zeid **"CAD/CAM Theory and Practice",**McGraw Hill, 1998.*
4. *Robert Levine et al **"A Comprehensive guide to AI and Expert Systems",** McGraw Hill Inc, 1986.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Identify various components of expert systems

CO2: Describe the Architecture and components of intelligent manufacturing systems

CO3: Explain the process of designing mechanisms and Process planning with Knowledge based systems

CO4: Discuss the Applications of knowledge based systems in Group Technology

CO5: Discuss the various recent advances and industrial applications of Artificial intelligence an Expert systems

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	L	M	L	M			M	L	L	M	M	L	H	
CO2	H	L	H	L	M			M	L	L	M	M	L	H	
CO3	H	L	H	L	M			M	L	L	M	M	L	H	
CO4	H	L	H	L	M			M	L	L	M	M	L	H	
CO5	H	L	H	L	M			M	L	L	M	M	L	H	
18PPE$26	H	L	H	L	M			M	L	L	M	M	L	H	

L- Low, M – Moderate (Medium), H - High

18PPE$27	MODERN CONTROL TECHNOLOGY

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:NIL

COURSE OBJECTIVES:

* To familiarize the architecture of the modern control techniques.
* To develop an understanding of the basics of control systems, operational amplifiers and mechanical systems.
* To provide an in-depth knowledge on control system components, Feedback Systems and Logic controller systems and their functions.

UNIT - I	INTRODUCTION TO CONTROL SYSTEMS	(9 Periods)
Introduction – control systems – open loop control systems – closed loop control systems - transfer function – analog and digital control systems – classifications of control systems. Microprocessor based control : microprocessor system hardware operation – interfacing a microprocessor controller – basics of controller programming – microprocessor based controllers.		
UNIT - II	**OPERATIONAL AMPLIFIERS AND SIGNAL CONDITIONING**	**(9 Periods)**
Operational amplifiers – special interface circuits – signal transmission. Switches, relays and semi conductors: Switches– toggle switches, Push button switches, and other switches. Relays– electromechanical relays – solid state relays. Power Transistors – silicon controlled rectifiers – Triacs, Trigger devices.		
UNIT - III	**MECHANICAL SYSTEMS AND ACTUATORS**	**(9 Periods)**
Behavior of mechanical components – energy – response of the whole mechanical system – gears – clutches and brakes– other power transmitting techniques. Electrical linear actuators – hydraulic systems – pneumatic systems – flow control valves.		
UNIT - IV	**CONTROL SYSTEM COMPONENTS**	**(9 Periods)**
Potentiometer – error detector – magnetic amplifier – hydraulic elements – synchros – stepper motors – tachogenerators– servomechanisms – modulators and demodulators – PID controllers – servo motors.		
UNIT - V	**FEED BACK AND LOGIC CONTROL SYSTEMS**	**(9 Periods)**
On – off controllers – fuzzy logic controllers – Programmable logic controller: overview of PLC systems – input and output modules – power supplies – general PLC programming procedures – auxiliary commands and functions – ladder diagrams – timer functions – counter functions.		

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Kilian,* ***"Modern Control Technology Components and Design"****, 2nd edition, Delmar Publication Ltd., 2008.*
2. *Sivanandam S.N.,* ***"Control Systems Engineering"****, Vikas Publishing House Pvt.Ltd., New Delhi, 2001.*

REFERENCE BOOKS:

1. *Gopal M., **"Control Systems – Principles and Design"**, 2nd edition, Tata McGraw Hill Publishing Co.Ltd,, New Delhi, 2006.*
2. *John.W.Webb and Ronald A.Reis, **"Programmable Logic Controllers – Principles and Applications"**, Prentice Hall Inc., New Jersy, 2003.*

COURSE OUTCOMES:

On completion of this course, students will be able to

C01: Apply the modern control techniques in present engineering scenario.

C02: Describe basics of control systems, operational amplifiers and mechanical systems.

C03: Explain control system components, Feedback Systems and Logic Controller systems and their functions.

C04: Explain various components of the control system

C05: Program a PLC circuit based on the feedback and control system

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M				M	L		L	L			L	L		
CO2	L					L		L	L			L	L		
CO3	M	M	M	M		L		L	L			L	M	M	M
CO4	L					L		L	L			L	L		
CO5	M	H	H	H	H	M		L	L		M	L	H	H	M
18PPE$27	M	M	M	M	M	L		L	L		M	L	M	M	M

L- Low, M – Moderate (Medium), H – High

18PPE$28	IMAGE PROCESSING IN MANUFACTURING

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

* To provide knowledge on computer vision, Image acquisition, distribution, processing and analysis

UNIT - I	COMPUTER VISION	(9 Periods)
Computer Imaging. Computer Vision and Image Processing. Human Visual Perception. Image Representation. Image Geometry. Sampling and Quantization. Levels of computation; Point level, Local level, Global level and object level. Digital Image Properties.		
UNIT – II	**IMAGE ACQUISITION**	**(9 Periods)**
Charge coupled devices: Principle, Surface channel CCD.s, Buried channel CCD.s, sensitivity and resolution, Noise and Hot Pixels, Blooming, Image Smear, Linear CCD Sensors, Image Sensors . Line scan cameras. CMOS image sensors. Video standards. Colour images: various colour models. Other Image Sources: Ultrasound imaging devices, computer tomography, Magnetic resonance imaging. Optics: Lens equation, Image resolution, Depth of field, View volume and Exposure.		
UNIT - III	**IMAGE DISTRIBUTION**	**(9 Periods)**
Frame Grabbing. Camera interfaces and protocols. Compression Techniques. Lossless compression: Run Length Encoding, Huffman coding, Arithmetic coding - Lossy compression: Discrete cosine transform, JPEG coding, Discrete wavelet transform. Image Standards: BMP, GIF, TIFF, PNG, PCX, JPG, DICOM standard.		
UNIT - IV	**IMAGE PROCESSING**	**(9 Periods)**
Gray scale operations: Histogram, Look up tables. Spatial Image filtering: smoothing, Guassian, Gradient, Laplacian. Frequency Filtering: FFT, Morphology Functions: Thresolding, Binary Morphology and Gray level Morpology.		
UNIT - V	**IMAGE ANALYSIS**	**(9 Periods)**
Pixel value analysis: Line profile, Quantify areas, Centroid function, Linear averages, Edge detection and enhancement, Segmentation and labeling. Quantitative analysis: Counting objects, Measuring Distances, Complex particle measurements. Image calibration. Pattern matching techniques. Character recognition. Applications in Manufacturing.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Ramesh Jain, Rangachar Kasthuri, Brain Gschunch, "**Machine Vision",** McGraw Hill International Edition, 2016.*
2. *Thomas Klinger, "**Image processing with LabView and IMAQ Vision**", Prentice Hall, 2003.*
3. *Scott E Umbaugh, "**Computer Vision and Image Processing : A Practical approach using CVIP tools**", Prentice Hall International Inc., 1998.*

REFERENCE BOOKS:

1. *Milan Sonka, Vaclav Hlavac, Roger Boyle,* ***"Image Processing, Analysis and Machine Vision"****, PWS Publishing, 1995.*
2. *Rafeal C Gonzalez, Richard E Woods,* ***"Digital Image Processing"****, Second Edition, Pearson Education, 1992.*
3. *Janaki Raman P.A,* ***"Robotics and Image Processing"****, Tata McGraw Hill, 1995.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

C01: Describe the basic principles of computer vision and image formation in the manufacturing system.

C02: Explain the concepts of various image distribution and image transform techniques.

C03: Describe the basic concepts of image perception and representation, image processing and analysis.

C04: Apply various image analysis techniques in manufacturing applications.

C05: Analyze the images using various analyzing methods

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L														
CO2	M				L										
CO3	M	L													
CO4	M	M	M		M	L		L				M	M		
CO5	H	H	M	M	M	M		L	M		M	M	M	M	M
18PPE$28	M	M	M	L	M	L		L	L		L	M	M	L	L

L-Low, M-Moderate(Medium), H-High

VERTICAL II

PRODUCT DESIGN AND DEVELOPMENT

18PPE$02	FINITE ELEMENT TECHNIQUES

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. Mechanics of Materials

COURSE OBJECTIVES:

- To familiarize the students in principles involved in discretization, finite element approach and can solve the simple engineering problems.

UNIT- I	INTRODUCTION TO FINITE ELEMENT METHOD (FEM)	(9 Periods)
Historical background; Basic concept of FEM; Discrete and continuous models; Boundary and Initial value problems; Discretization - Convergence requirements.		
UNIT- II	**FORMULATION OF ELEMENT CHARACTERISTIC MATRICES**	**(9 Periods)**
One dimensional governing equations - Structural and heat transfer problems; Variational method; Weighted residual methods; Principle of minimization of potential energy.		
UNIT-III	**ONE DIMENSIONAL PROBLEMS**	**(9 Periods)**
Shape functions; Problems in axial loaded members, trusses, beams, heat transfer through composite walls and fins; Gauss elimination and Cholesky method of solving equations.		
UNIT-IV	**TWO DIMENSIONAL PROBLEMS**	**(9 Periods)**
Linear triangular and rectangular elements – Shape functions:Pascal's triangle - Concept of plane stress and plane strain. Solution of simple problems in structural and heat transfer models.		
UNIT- V	**HIGHER ORDER ELEMENTS**	**(9 Periods)**
Applications of higher order elements; Lagrangian and serendipity elements; Isoparametric elements - Jacobian transformation.		

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *J.N.Reddy* ***"Introduction to Finite Element Method",*** *McGraw Hill, Intl, 3rd edition, 2006.*
2. *Larry J. Segerlind* ***"Applied Finite Element Analysis",*** *John Wiley and Sons., 2nd edition, 1985.*
3. *SingiresuS.Rao* ***"The Finite Element Method in Engineering",*** *Butterworth Heinemann., 5thedition, 2011.*

REFERENCE BOOKS:

1. *Tirupathi R. Chandrupatala and Ashok D. Belegundu* ***"Introduction to Finite Elements in Engineering",*** *Pearson Education, 4th edition, 2011.*
2. *David V. Hutton,* ***"Fundamentals of Finite Element Analysis",*** *Tata McGraw Hill, 3rd edition, 2005*.
3. *ChandrakantS.Desai,* ***"Elementary Finite Element Method",*** *Prentice Hall Inc., 1979.*
4. *Logan, D.L.,* ***"A first course in Finite Element Method",*** *Thomson Asia Pvt. Ltd., 2002.*
5. *Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt,* ***"Concepts and Applications of Finite Element Analysis",*** *4th Edition, Wiley Student Edition, 2002.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Describe the fundamentals of finite element technique
CO2: Formulate the structural and heat transfer problems
CO3: Solve the simple structural and heat transfer problems
CO4: Describe the shape function and element characteristics
CO5: Describe the higher order elements

COURSE ARTICULATION MATRIX:

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	H	M				M					M		M	
CO2	M	M	L	M			L			M		L		M	
CO3	M		M	M			M			M		L		H	
CO4	M	M		M						H		M		H	
CO5	M	M	L							L		L		M	
18PPE$02	M	M	L	M			M			M		L		M	

L- Low, M – Moderate (Medium), H - High

18PPE$06	ROBUST DESIGN

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. Engineering Mechanics

COURSE OBJECTIVES:

* To impart knowledge to design experiments to a problem situation using traditional experimental designs as well as Taguchi Methods.

UNIT- I	**EXPERIMENTAL DESIGN FUNDAMENTALS**	**(9 Periods)**
Importance of experiments, experimental strategies, basic principles of design, terminology, ANOVA, steps in experimentation, sample size, normal probability plot and linear regression models.		
UNIT- II	**SINGLE FACTOR EXPERIMENTS**	**(9 Periods)**
Completely randomized design, Randomized block design, Latin square design - Statistical analysis, estimation of model parameters, model adequacy checking, pair wise comparison tests		
UNIT- III	**MULTIFACTOR EXPERIMENTS**	**(9 Periods)**
Two and three factor full factorial experiments, Randomized block factorial design, Experiments with random factors, rules for expected mean squares, approximate F - tests. 2K factorial Experiments		
UNIT- IV	**SPECIAL EXPERIMENTAL DESIGNS**	**(9 Periods)**
Blocking and confounding in 2k designs. Two level Fractional factorial design, nested designs, Split plot design, Response Surface Methods		
UNIT- V	**TAGUCHI METHODS**	**(9 Periods)**
Steps in experimentation, design using Orthogonal Arrays, data analysis, Robust design- control and noise factors, S/N ratios, parameter design, Multi-level experiments, Multi - response optimization		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *A. Mitra* ***"Fundamentals of Quality Control and Improvement",*** *Pearson Publication, 1998*
2. *Phillip J.Rose* ***"Taguchi techniques for quality engineering",*** *McGraw Hill, 1996*

REFERENCE BOOKS:

1. *Montgomery, D.C.,* ***"Designand Analysis of experiments",*** *John Wiley and Sons, Eighth edition, 2012*
2. *Krishnaiah, K. and Shahabudeen, P.* ***"Applied Design of Experiments and Taguchi Methods",*** *PHI learning private Ltd., 2012.*
3. *NicoloBelavendram* ***"Quality by Design; Taguchi techniques for industrial experimentation",*** *Prentice Hall, 1995.*
4. *J. Krottmaier* ***"Optimizing Engineering Design",*** *McGraw Hill Ltd, 1993*
5. *MadhavShridharPhadke,* ***"Quality Engineering Using Robust Design",*** *Prentice Hall, 1985*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Select appropriate tools for robust design.

CO2: Identify and implement single factor experiments

CO3: Identify and implement multi factor experiments

CO4: Apply the concepts of .special experiment designs

CO5: Apply the concepts of Taguchi experiment design for practical problems.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	L	M	H		L				L		L		L	L	L
CO 2	L	M	H		L				L		L		L	L	L
CO 3	L	M	H		L				L		L		L	L	L
CO 4	L	M	H		L				L		L		L	L	L
CO 5	L	M	H		L				L		L		L	L	L
18PPE$06	L	M	H		L				L		L		L	L	L

L- Low, M – Moderate (Medium), H - High

18PPE$09	PRODUCT DESIGN AND PROCESS ENGINEERING

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. Engineering Metallurgy
2. Manufacturing Technology
3. Machine Tools and Processes
4. Metrology and Computer Aided Inspection

COURSE OBJECTIVES:

* To train the students to design the product and to develop the feasible processing technique for specific need.

UNIT- I	PRODUCT ENGINEERING	(9 Periods)
Nature and scope of product engineering; creative and organizing for product innovation criteria for product success in life cycle of a product; maintainability engineering.		
UNIT- II	**MODELING AND SIMULATION**	**(9 Periods)**
Modeling and simulation; the role of models in product design mathematical modeling similitude relations; Weighted property index.		
UNIT- III	**MATERIAL SELECTION**	**(9 Periods)**
Material selection; Problems of material selection; Performance characteristics of materials; the materials selection process; economics of materials; Cost versus performance relations; Weighted property index.		
UNIT- IV	**DESIGN CONSIDERATIONS**	**(9 Periods)**
Functional and production design; form design; influence of basis design - mechanical loading and material on form design - form design of gray castings, malleable iron castings, aluminum castings, pressure die castings, plastic mounding, welded fabrications, forging and manufacture by machining methods.		
UNIT- V	**AESTHETIC AND ERGONOMIC CONSIDERATIONS**	**(9 Periods)**
Influence of space, size, weight, etc. on form design; aesthetic and ergonomic considerations; geometric dimensioning and tolerance of product; functional production and inspection datum; tolerance analysis.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *George E.DieterandLinda C. Schmidt **"Engineering design",** McGraw HillEducation, 5th edition, 2012*
2. *Robert Matousek **"Engineering Design",** Blacke and Sons Ltd, 1972*

REFERENCE BOOKS:

1. *Jones J **"Design Methods",** Wiley, 2nd edition,1992*
2. *Buhl H.R, **"Creative Engineering design",** Iowa state university press, 1960.*
3. *Benjamin W.Niebel and Alan B.Draper **"Product Design and process Engineering",** McGraw HillInc., US, 1st edition, 1974.*
4. *Harry peck **"Designingfor Manufacturing",** Sir Issac Pitman and Sons Ltd, 1973.*
5. *Gladman C.A **"Manual for Geometric Analysis of Engineering Designs",** Australian Trade publications Ltd, 1966.*
6. *Oliver R. Wade, **"Tolerance Control in Design and Manufacturing",**Industrial Press, New York publications, 1967.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1*:* Describe the product innovation

CO2: Describe the analytical evaluation of the products

CO3: Select the appropriate material for the product

CO4: Develop the appropriate processing technique for the product

CO5: Incorporate the aesthetic and ergonomic values

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	M	H			H	L		H	L		M	H		
CO2	M	H	M			M	M		M				M		
CO3	L	M	M	M		M	M		M			M	M		
CO4	M		L	M		H	L		H				M		
CO5		L	L			L	M		M				L		
18PPE$09	M	M	M	M		M	M		M	L		M	M		

L- Low, M – Moderate (Medium), H – High

18PPE$10	DESIGN FOR MANUFACTURE AND ASSEMBLY

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

* To acquire knowledge of the general design principles of Manufacturing.
* To familiarize various assembly methods and processes and design for assembly guidelines.

UNIT- I	DESIGN PRINCIPLE	(9 Periods)
Economics of process selection – general design principles of manufacturability – proper material selections – strength and mechanical factors – Geometric tolerances – Design for serviceability – Tolerance Charting Techniques. General aspects of the designers work - design factors – systematic working plan – basic design.		
UNIT- II	**FORM DESIGN**	**(9 Periods)**
Factors affecting casting design - Grey iron castings, steel castings, malleable iron castings – Non ferrous alloys: Aluminium castings – Pressure die castings – factors affecting weldment design – Gas and Arc welding.		
UNIT- III	**FORMED METAL COMPONENTS AND NON-METALLIC PARTS DESIGN**	**(9 Periods)**
Metal extrusion – cold headed pats – fine blanking – Tube and section bends – powder metal parts – thermo setting plastic parts – reinforced - plastic/composite parts.		
UNIT- IV	**MACHINED COMPONENTS DESIGN**	**(9 Periods)**
Design for machinability – design for economy – design for clampability – design for accessibility. Turned parts – drilled parts – milled parts, planned, shaped and slotted parts – Ground parts – parts produced by EDM.		
UNIT- V	**TECHNOLOGY REQUIREMENT AND ASSEMBLY**	**(9 Periods)**
Product design requirements for group technology concepts and CNC machining – part family concept – mechanical assemblies – general recommendations - design rules for rivets, screw fasteners, gaskets and seals. Press and snap fits.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *James GBralla* ***"Hand book of product design for manufacture",*** *Mc Graw Hill Book Co., Second edition, 1999.*
2. *Robert Matousek* ***"Engineering Design – A systematic approach",*** *Blackie and Son Ltd, London*
3. *Geoffrey Boothroyd, PeterDewhurst, Winston A. Knight* ***"Product design for manufacture and assembly",*** *Taylor and Francis group, 2011.*

REFERENCE BOOKS:

1. *Harry Peck,* ***"Design for manufacture",*** *Pitman publications, 1983.*
2. *Trucks H.E.,* ***"Design for Economic Production, Society of Manufacturing engineers",*** *Michigan 2nd Edition1987*
3. *Karl T.Ulrich and Steven D Eppinger* ***"Product Design and Development",*** *Tata McGraw Hill, 3rd edition, 2008*
4. *Oliver R.Wade,* ***"Tolerance Control in design and Manufacturing",*** *Industrial Press Inc., New York Publications, 1967.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Explain the basic design principles and use of tolerances in manufacturing.
CO2: Describe the concepts of form design for various metals and alloys involving in casting process.
CO3: Describe the design concepts of formed metals and plastic components.
CO4: Explain the concepts of various machined parts design for manufacturing.
CO5: Explain the assembly concepts for manufacturing and its technology requirements.

COURSE ARTICULATION MATRIX:

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	M	M	L									L		
CO2	M	L	M	L									L		
CO3	M	L	M	L									L		
CO4	M	L	M	L									L		
CO5	M	L	M	L									L		
18PPE$10	M	L	M	L									L		

L- Low, M – Moderate (Medium), H – High

18PPE$22	**COMPUTER AIDED DESIGN** *(Common to MECH & PRODN Branches)*

Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES :

1. Engineering Graphics
2. Production Drawing

COURSE OBJECTIVES:

* To provide an overview of how computers can be employed to in design the mechanical component

UNIT- I	**INTRODUCTION**	**(9 Periods)**
Fundamentals of Computer Graphics-Product cycle- Design process- sequential and concurrent engineering- Computer aided design – CAD system architecture- Computer graphics – co-ordinate systems- 2D and 3D transformations homogeneous coordinates - Line drawing -Clipping- viewing transformation.		
UNIT- II	**GEOMETRIC MODELING**	**(9 Periods)**
Representation of curves- Hermite curve- Bezier curve- B-spline curves-rational curves-Techniques for surface modeling – surface patch- Coons and bicubic patches- Bezier and B-spline surfaces. Solid modeling techniques- CSG and B-rep.		
UNIT- III	**VISUAL REALISM**	**(9 Periods)**
Hidden line-surface removal algorithms, shading, colouring, computer animation		
UNIT- IV	**ASSEMBLY PARTS**	**(9 Periods)**
Assembly modeling, interference position and orientation, Geometric tolerance, tolerance analysis, tolerance synthesis, mechanism simulation and interface checking.		
UNIT- V	**CAD STANDARDS**	**(9 Periods)**
Standards for computer graphics- Graphical Kernel System (GKS) - standards for exchange images Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALS etc. - communication standards.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Ibrahim Zeid **"Mastering CAD CAM",** Tata McGraw-Hill PublishingCo.2007*
2. *D.Hearn and M.P.Baker **"Design of Computer Graphics",** Prentice Hall Inc., 1992*
3. *C.McMohan and J.Browne, **"CAD/CAM Principles",**II edition, Pearson Education,1999*

REFERENCE BOOKS:

1. *Chris McMahon and Jimmie Browne* ***"CAD/CAM Principles",*** *Practice and Manufacturing management "Second Edition, Pearson Education, 1999.*
2. *Radhakrishnan P, SubramanyanS. and RajuV.,* ***"CAD/CAM/CIM",*** *2nd Edition, New Age International (P) Ltd, New Delhi,2000.*
3. *Donald Hearn and M. Pauline Baker* ***"Computer Graphics",*** *Prentice Hall, Inc,1992*
4. *Foley, Wan Dam, Feiner and Hughes* ***"Computer graphics principles & practice",*** *Pearson Education -2003*
5. *William M Neumann and Robert F.Sproul* ***"Principles of Computer Graphics",*** *McGraw Hill Book Co. Singapore, 1989.*

COURSE OUTCOMES:

Upon completion of the course, students will be able to

- **CO 1:** Understand the fundamental of computer graphics and 2D and 3D transformation
- **CO2:** Familiar about the geometric, surface and solid modeling technique
- **CO3:** Develop the line , surface and solid removal algorithm and creation of computer animation
- **CO4:** Identify the importance of tolerance during assembly of components
- **CO5:** Summarize the various standards used in CAD

.

COURSE ARTICULATION MATRIX :

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L		H							M				M	M
CO2		L			M									M	M
CO3		L			H			L		L				M	M
CO4		L		L					L	L				M	M
CO5					H						M			L	M
18PPE$22	L	L	H	L	M			L	L	L	M			M	M

L- Low, M – Moderate (Medium), H – High

18PPE$18	**THEORY OF METAL CUTTING** *(Use of approved data book is permitted)* *(Common to MECH & PRODN Branches)*

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. Engineering Mechanics
2. Thermal Sciences

COURSE OBJECTIVES:

* To familiarize students about the basic mechanics, thermal, wear and chatter mechanisms in metal cutting processes.

UNIT- I	ORTHOGONAL CUTTING	(9 Periods)
Basic mechanism of chip formation, Techniques for study of chip formation, types of chips, Chip breaker, Orthogonal verses Oblique cutting, Shear plane angle, Cutting force and velocity relationship in orthogonal cutting, Modern theories in Mechanics of cutting, Review of Merchant and Lee Shaffer Theories- limitations, applications.		
UNIT- II	**OBLIQUE CUTTING**	**(9 Periods)**
Direction of Chip flow, Normal Velocity and Effective Rake angles, Relationship between rake angles, values of various angles for machining of brittle, ductile and elastic materials, Cutting ratios in oblique cutting, Shear angle and Velocity relationship, Stabler's rule, Oblique cutting applications.		
UNIT- III	**THERMAL ASPECTS OF MACHINING**	**(9 Periods)**
Heat distributions in machining, Experimental determination and analytical calculation of cutting tool temperature, measurement of temperature, Heat in primary shear Zone, Heat in Tool and Work Interface, Heat in Areas of Sliding, effects of various parameters on temperature, Cutting fluids; Effects of cutting fluid, functions, requirements, types and selection, commercially available cutting fluids.		
UNIT- IV	**CUTTING TOOL MATERIALS, TOOL LIFE AND TOOL WEAR**	**(9 Periods)**
Essential requirements of tool materials, Structure and properties of High speed steel and Cemented carbides, development in tool materials, ISO specification for inserts and tool holders, tool life, conventional and accelerated tool life tests, concept of machinability index, economics of machining, Reasons for failure of cutting tools and mechanisms and measurements of wear in single and multi-point cutting tools		
UNIT- V	**DESIGN OF CUTTING TOOLS**	**(9 Periods)**
Nomenclature of Single point and Multi point cutting tools - Design of Turning tool, Drills, Milling cutters and tool holders.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Shaw.M.C.* ***"Metal cutting principles",*** *oxford Clare don press, 2005.*
2. *Bhattacharya.A.* ***"Metal Cutting Theory and practice",*** *Central Book Publishers, India, 2012.*

REFERENCE BOOKS:

1. *Boothroid D.G & Knight W.A.,* ***"Fundamentals of machining and machine tools",*** *Marcel Dekker, Newyork, 1989.*
2. *HMT* ***"Production Technology",*** *HMT publication, 2017*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Elaborate the mechanisms of chip formation in different metal cutting processes

CO2: Understand the difference between Orthogonal and Oblique cutting and its uses

CO3: Realize the thermal effects of cutting process and its removal methods

CO4: Predict the effects of cutting parameters on Tool life

CO5: Design a cutting tool for various cutting process

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	L								M		M	L		M
CO2	M	L	L							M		M	M	M	
CO3	M		L									M			
CO4	M		M									M	L	L	
CO5	M				M			M		M	M	M	M	H	M
18PPE$18	M	L	L		M			M		M	M	M	M	M	M

L- Low, M – Moderate (Medium), H - High

18PPE$29	INTRODUCTION TO COMPOSITE MATERIALS

PRE-REQUISITES :

CATEGORY : PE

1. Engineering Metallurgy
2. Manufacturing Technology

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

*To understand the fundamentals, mechanical behavior of composite materials, analysis of fiber reinforced Laminates, design and manufacturing of metal, ceramic, carbon and advanced composites.

UNIT - I	INTRODUCTION TO COMPOSITE MATERIALS	(9 Periods)
Types and characteristics of composite materials-Mechanical behavior-Basic terminology and Manufacture of laminated fiber-Reinforced composite materials-Current and potential advantages-Applications of composite materials.		
UNIT - II	**REINFORCEMENT AND MATRICES**	**(9 Periods)**
Different types of Matrix and Reinforcement-Selection -Properties and applications of matrix and Reinforcement - Thermoset matrix-Thermoplastic matrix.		
UNIT - III	**INTRODUCTION TO COMPOSITE STRUCTURES DESIGN**	**(9 Periods)**
Elements of Design-Steps in design process-Elements of analysis in design-Analysis iterations-Design analysis stages-Material selection-Configuration selection-Laminate joints-Design requirements and design failure criteria.		
UNIT - IV	**MANUFACURING OF ADVANCED COMPOSITES**	**(9 Periods)**
Bag-Molding process-Compression molding-Pultrusion-Filament winding-Liquid composite molding processes-Resin film infusion-Elastic reservoir molding-Tube rolling-Forming methods for thermoplastic matrix composites.		
UNIT - V	**METAL, CERAMIC AND CARBON MATRIX COMPOSITES**	**(9 Periods)**
Metal matrix and Ceramic matrix composites -Manufacturing processes- -Mechanical properties- Carbon matrix composites-Fabrication methods-Applications.		

Contact Periods: 45
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Krishnan K. Chawla,* ***"Composite Materials Science and Engineering",*** *Springer (India) Private Limited, 2009*
2. *P.K.Mallick,* ***"Fiber Reinforced Composite materials, Manufacturing and Design",*** *CRC Press, Taylor and Francis Group,Boca Raton, London,Newyork 2010*
3. *A.K.Bhargava,* ***"Engineering Materials: Polymers, ceramics and composites",*** *Prentice Hall of India Limited, 2005.*

REFERENCE BOOKS:

1. *Madhujit Mukhopadhyay,* ***"Mechanics of Composite Materials and Structures ",*** *Universities Press (India) Private Limited, 2009*
2. *Robert M.Jones, "* ***Mechanics of Composite Materials",*** *Taylor & Francis Group, 2010.*
3. *Web Portal:* ***Composite Materials*** *{Nptel 3.1.2 Civil Engineering}*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

C01: Explain the conventional materials and the need for composite materials.

C02: Describe the role of various types of matrix and reinforcement in a composite.

C03: Apply the knowledge learned in making components from the constituents of the composite materials

C04: Explain the concepts of advanced manufacturing process

C05: Describe about the manufacturing of MMC and CMC.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L						L	L							
CO2	L							L							
CO3	M	M	H	M				L			L	L	M	M	M
CO4	L							L						L	
CO5	L					L		L				L		L	
18PPE$29	M	M	L	M		L	L	L			L	L	M	M	M

L-Low, M-Moderate (Medium), H-High

18PPE$30	INDUSTRIAL ERGONOMICS

PRE-REQUISITES : NIL **CATEGORY : PE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

* Understand human-machine interaction in the form of human input modalities.
* Design a workplace considering anthropometric data.
* Describe psychophysiological methods for measuring human work output.
* Choose human required amount of light, sound and vibration for an industry.
* Evaluate human-machine interaction in virtual environmental.

UNIT- I	INPUT MODALITIES	(9 Periods)
Ergonomics for productivity, safety, health and comfort, history of ergonomics, multi-disciplinary engineering, human machine system - characteristics, information theory, coding, compatibility, memory, decision making, attention, text, graphics, symbols, selection of display modality - visual and auditory display, representational display, tactual and olfactory display, design of controls.		
UNIT- II	**ANTHROPOMETRY**	**(9 Periods)**
Need for anthropometry, sources of human variability, data collection methodology, measuring procedures and tools, statistical analysis of measured data - percentile calculation, principles of applied anthropometry, ergonomic design guidelines for products, equipment and accessories, applications of anthropometry.		
UNIT- III	**WORK ERGONOMICS**	**(9 Periods)**
Work station design for standing and seated workers, manual material handling, design of hand tools, muscles, structure, function and capacity, physical work capacity, measurement of physiological work, stress and fatigue, work related musculoskeletal disorders, ergonomic interventions to prevent injuries, human thermoregulation, measurement, protection and thermal comfort.		
UNIT- IV	**ILLUMINATION, NOISE AND VIBRATION**	**(9 Periods)**
Vision and the eye, measurement of light, lighting design, visual fatigue, eyestrain, psychological aspects of indoor lighting, the ear, measurement of sound, ear protection, design of acoustic environment, industrial noise control, auditory environment outdoors, effects of noise on task performance and health, vibration, human error, safety and equipment design.		
UNIT- V	**VIRTUAL ERGONOMICS**	**(9 Periods)**
Digital Human Modeling (DHM), anthropometric models, models for production design, biomechanical and anatomical models, DHM packages – selection strategies and functionalities, virtual ergonomics evaluation techniques – Rapid Upper Limb Assessment (RULA), field of vision, reach envelopes, accessibility and clearance analysis, discomfort analysis, Applications of DHM.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Bridger R S,* ***"Introduction to Human Factors and Ergonomics"****, CRC Press, Taylor & Francis Group, 2017.*
2. *Martin Helander,* ***"A Guide to Human Factors and Ergonomics"****, CRC Press, Taylor & Francis Group, 2005.*

REFERENCE BOOKS:

1. *Christopher Nemeth,* ***"Human Factors Methods for Design"****, CRC Press, Taylor & Francis Group, 2004.*
2. *D Chakrabarti,* ***"Indian Anthropometric Dimensions for ergonomic design practice"****, National Institute of Design, Ahmedabad, 1997.*
3. *Duffy V G,* ***"Hand book of digital human modeling: Research for Applied Ergonomics and Human Factor Engineering"****, CRC Press, Taylor & Francis Group, 2009.*
4. *Mark S Sanders,* ***"Human Factors in Engineering and Design"****, McGraw Hill Education, 2013.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

C01: Select appropriate input modalities for human machine interaction.

C02: Apply anthropometric principles for industrial workspace design.

C03: Measure and evaluate human work output by psychophysiological methods.

C04: Design industrial workspace with required amount of light, sound and vibration.

C05: Evaluate human machine interaction using virtual ergonomics.

COURSE ARTICULATION MATRIX:

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L														
CO2	M	M	L	L				M							
CO3	M	M	M	M	M	M	M	M			M		M	M	
CO4	M	L	M	L		M	M	M					H	M	M
CO5	M	H	H	M	M	M	M		M		M		M	H	
18PPE$30	M	M	H	M	M	M	M	M	M		M		M	H	M

L-Low, M-Moderate (Medium), H-High

VERTICAL III

MANUFACTURING PROCESSES AND CONCEPTS

18PPE$03	UNCONVENTIONAL MANUFACTURING PROCESSES

Category: PE

L T P C

3 0 0 3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

* To understand the working principles of various non-traditional machining processes, applications, advantages and limitations.

UNIT- I	MECHANICAL ENERGYMETAL REMOVAL PROCESSES	(9 Periods)
Need of modern machining processes – classification and selection of technology. Mechanical processes - Abrasive jet machining (AJM), water jet machining (WJM), Abrasive water jet machining (AWJM), Ultrasonic machining (USM) – working principles, equipment, effect of process parameters, applications, advantages and limitations.		
UNIT- II	**ELECTROCHEMICAL AND CHEMICAL METAL REMOVAL PROCESSES**	**(9 Periods)**
Electrochemical machining (ECM), electrochemical grinding (ECG), electrochemical deburring and honing – chemical machining (CHM) – working principles, equipment, effect of process parameters, applications, advantages and limitations.		
UNIT- III	**THERMAL METAL REMOVAL PROCESSES**	**(9 Periods)**
Electric discharge machining (EDM), wire cut electric discharge machining (WEDM), Plasma arc machining (PAM), Electron beam machining (EBM), Laser beam machining (LBM), Ion beam machining (IBM) – working principles, equipment, effect of process parameters, applications, advantages and limitations.		
UNIT- IV	**FORMING PROCESSES AND FOUNDRY TECHNIQUES**	**(9 Periods)**
Explosive forming, Electro – hydraulic forming, electro – magnetic forming. Dynapak machine -high pressure moulding, squeeze casting, vacuum castings.		
UNIT- V	**RAPID PROTOTYPING**	**(9 Periods)**
Introduction – advantages – limitations – principle. Rapid prototyping systems – stereo-lithography(SLA), selective laser sintering(SLS), fused deposition modeling(FDM), laminated object manufacturing (LOM), solid ground curing (SGC), three dimensional printing. Application of reverse engineering in rapid prototyping.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *P.C.Pandey **"Modern machining processes",** Tata McGraw Hill publishing company Ltd. 2008.*
2. *P.C.Sharma, **"A TEXT BOOKS of Production Technology",** S.Chand & Company Ltd. 2009.*

REFERENCE BOOKS:

1. *Bhattacharya,* ***"New Technology",*** *Institution of Engineers, 1997*
2. *Gary.F.Benedict* ***"Nontraditional machining Processes",*** *Marcell Dekker Inc, 2001*
3. *HMT* ***"Production Technology",*** *Tata McGraw Hill Publishers, 2001.*
4. *V.K.Jain* ***"Advanced Machining Process",*** *Allied Publishers PVT Ltd 2007*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: describe the mechanical energy based newer production processes.

CO2: describe the electrochemical energy based newer production processes.

CO3: describe the thermal energy based newer production processes.

CO4: explain the explosive forming and high pressure casting processes.

CO5: describe various Rapid Prototyping techniques

COURSE ARTICULATION MATRIX:

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	H		M	M				M	L	L	L	H		L
CO2	M	H		M	M				M	L	L	M	H		L
CO3	M	H		M	L				M	L	L	M	H		L
CO4	M	H		M	L				M	L	L	M	H		L
CO5	L	H		M	L				L	L	L	M	H		L
18PPE$03	M	H		M	L				M	L	L	M	H		L

L – Low, M- Moderate (Medium), H – High

18PPE$08	ADVANCED WELDING TECHNOLOGY

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. Engineering Metallurgy
2. Manufacturing Technology

COURSE OBJECTIVES:

* To impart knowledge of basic concepts, principle, procedure, applications and advances in welding processes.

UNIT- I	SOLID STATE WELDING PROCESSES	(9 Periods)
Review of the various pressure welding processes and their applications. Friction, explosive, diffusion, and Ultrasonic welding – principles of operation, process characteristics and application.		
UNIT- II	**HIGH ENERGY BEAM WELDING**	**(9 Periods)**
Electron Beam welding and Laser Welding: Principles of operation, Heat generation and regulation - Equipment details in typical setup - advantages, disadvantages and applications.		
UNIT- III	**ELECTRO SLAG WELDING**	**(9 Periods)**
Heat generation, principles of operations, wire and consumables, guide techniques, selection of current, voltage and other process variables, nature of fluxes and their selection. Electro-gas welding Principle of operation and applications, Narrow gap welding.		
UNIT- IV	**PLASMA ARC WELDING**	**(9 Periods)**
Special features of plasma arc- transferred and non transferred arc, key hole and puddle mode of operation, micro, low and high current plasma arc welding and their applications. Plasma cutting and surfacing and their applications.		
UNIT- V	**SPECIALWELDING PROCESSES**	**(9 Periods)**
Adhesive bonding and Welding of plastics, Cold pressure welding, High frequency Welding, Stud welding, Under Water welding, Welding automation.		

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

TEXT BOOKS:

1. *Parmer R.S **"Welding Engineering and Technology",** Khanna Publishers, New Delhi,2ndedition, 2010*
2. *Parmer R.S. **"Welding Processes and Technology",** Khanna Publishers, New Delhi, 3rd edition, 2003*
3. *Little R.L **"Welding and welding Technology",** Tata McGraw Hill Publishing Co., Ltd., New Delhi, 34th reprint, 2008.*

REFERENCE BOOKS:

1. *Schwartz M.M* ***"Metals Joining Manual",*** *McGraw Hill Books, 1979.*
2. *Tylecote R.F.* ***"The Solid Phase Welding of Metals",*** *New York, St. Martin's Press,1968.*
3. *Nadkarni S.V* ***"Modern Arc Welding Technology",*** *Oxford IBH Publishers, 2nd edition, 2005*
4. *Christopher Davis* ***"Laser Welding- Practical Guide",*** *Jaico Publishing House, 1994.*
5. *Davis A.C.,* ***"The Science and Practice of Welding",*** *Cambridge University Press, Cambridge, 10th edition 1993.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Describe the solid state welding processes

CO2: Describe the high energy beam welding processes

CO3: Describe the Elctro-slag and Elctro-gas welding processes

CO4: Describe the plasma arc welding processes

CO5: Describe the special welding techniques for plastics and underwater welding processes

COURSE ARTICULATION MATRIX:

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M				M		H		L			M	M		
CO2	H		H		L		M		L	M	L		M		M
CO3	M	L	M		M		M				M	M	L		
CO4	M				L		M		L	M					
CO5	M	L	M		L		L					L			M
18PPE$08	M	L	M		L		M		L	M	L	M	M		M

L- Low, M – Moderate (Medium), H - High

18PPE$16	LEAN MANUFACTURING *(Common to MECH & PRODN)*

Category: PE

PRE-REQUISITES:

1. Manufacturing Technology
2. Machine Tools and Processes

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

* To craft the students to acquire knowledge in lean manufacturing tools, understand various phases involved and methodology in implementing lean in manufacturing scenario.

UNIT- I	**FOUNDATION AND CONCEPTS OF LEAN**	**(9 Periods)**
Historical evolution of lean manufacturing - Objectives of lean manufacturing - Key principles and implications of lean manufacturing - Traditional verses lean manufacturing. – Ford System – Growing Dysfunction –– Ten steps to lean production - Necessity of Lean Production – Systems and lean thinking – Construction of Lean Production - Lean images and Lean Activities		
UNIT- II	**LEAN TOOLS AND METHODOLOGY**	**(9 Periods)**
Primary tools – Implementing 5S, Workplace organization – Stability - Just-In-Time –Takt time - One piece flow – Pull, Cellular systems, , Six Sigma. SMED: Single minute exchange of dies – theory and practice of the SMED system - TPM, Pillars of TPM, Conditions for TPM success, TPM implementation process - Overall Equipment Effectiveness - computation of OEE.		
UNIT- III	**VALUE STREAM MAPPING**	**(9 Periods)**
Process Mapping and Value Stream Mapping - Current state map – Future state map – VSM symbols – Mapping tips - Need for process maps - types and its construction - steps in preparing VSM - Comparison of CSVAM and FSVSA – Simulation scenario case studies		
UNIT- IV	**INTEGRATED QUALITY**	**(9 Periods)**
Development and necessity – Poke Yoke – mistake proofing - quality improvement – Leveling and Visual management. Common errors – Inspection system and Zone control – Using Poke Yokes – Jidoka implementation -Process capability study – Lean six sigma.		
UNIT- V	**LEAN INVOLVEMENT AND CULTURE**	**(9 Periods)**
Necessity of involvement – Waste of Humanity – Activities supporting involvement – Kaizen Circle Activity – Practical Kaizen Training – Key factors in Practical Kaizen Training – Lean Culture – Standardization – Standards and abnormality control – 'Five Why' analysis.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Dennis P* ***"Lean Production Simplified: A Plain Language Guide to the World's Most Powerful Production System",*** *Productivity Press, New York, 2009.*
2. *Liker, J and Meier, D* ***"The Toyota Way",*** *Field book, McGraw-Hill, 2010*
3. *N.Gopalakrishnan,* ***"Simplifed Lean Manufacture",*** *PHI, 2010*

REFERENCE BOOKS:

1. *Devadasan S R, Mohan Sivakumar V, Murugesh R and Shalij P R,* ***"Lean and Agile Manufacturing: Theoretical, Practical and Research Futurities",*** *Prentice Hall of India Learning Limited, New Delhi, 2012.*
2. *Gopalakrishnan N,* ***"Simplified Lean Manufacture: Elements, Rules, Tools and Implementation",*** *Prentice Hall of India Learning Private Limited, India, 2010.*
3. *Bill Carreira,* ***"Lean Manufacturing that Works: Powerful Tools for Dramatically Reducing Wastes and Maximizing Profits",*** *Prentice Hall of India Learning Private Limited, India, 2009*
4. *Don Tapping, Tom Luyster and Tom Shuker* ***"Value Stream Management: Eight Steps to Planning, Mapping and Sustaining Lean Improvements",*** *Productivity Press, New York, USA, 2007*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Describe about the origin and foundation of lean production.
CO2: Describe about stability and standards in lean system.
CO3: Describe about Just In Time (JIT) and its application in lean.
CO4: Describe about Jidoka and Poke Yoke.
CO5: Describe about lean involvement and culture.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	L		M		L	H	M				L	L		L	
CO 2	M	L		M	L	M	L		L			M	M	M	
CO 3			H	L					L	M				L	M
CO 4	H	L		M		M		L				M	L	H	
CO 5		M	H		L		L		L						
18PPE$16	M	L	M	M	L	M	L	L	L	M	L	M	L	M	L

L- Low, M – Moderate (Medium), H - High

18PPE$17	MICRO MANUFACTURING PROCESSES

Category: PE

PRE-REQUISITES:

1. Manufacturing Technology
2. Machine Tools and Processes

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

* To be familiar with the principles, basic machine tools, and developments in the micro manufacturing process and research trends in the area of micro manufacturing process.

UNIT- I	MICRO MACHINING I	(9 Periods)
Mechanical Micro machining – Ultra Sonic Micro Machining – Abrasive Jet Micro Machining – Water Jet Micro Machining – Abrasive Water Jet Micro Machining – Micro turning – Chemical and Electro Chemical Micro Machining – Electric discharge micro machining.		
UNIT- II	**MICRO MACHINING II**	**(9 Periods)**
Beam Energy based micro machining – Electron Beam Micro Machining – Laser Beam Micro Machining – Electric Discharge Micro Machining – Ion Beam Micro Machining –Plasma Beam Micro Machining – Electro Discharge Grinding – Electro Chemical spark micro machining.		
UNIT- III	**NANO POLISHING**	**(9 Periods)**
Abrasive Flow finishing – Magnetic Abrasive Finishing – Magneto rheological finishing – Magneto Rheological abrasive flow finishing - Magnetic Float polishing – Elastic Emission Machining – chemo-mechanical Polishing.		
UNIT- IV	**MICRO FORMING AND WELDING**	**(9 Periods)**
Micro extrusion – Micro and Nano structured surface development by Nano plastic forming and Roller Imprinting – Micro bending with LASER – LASER micro welding – Electron beam for micro welding.		
UNIT- V	**RECENT TRENDS AND APPLICATIONS**	**(9 Periods)**
Metrology for micro machined components – Ductile regime machining– AE based tool wear compensation– Machining of Micro gear, micro nozzle, micro pins – Applications.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Jain V. K.* ***"Micro Manufacturing Processes",*** *CRC Press, Taylor & Francis Group, 2012*

REFERENCE BOOKS:

1. *Jain V.K.,* ***"Introduction to Micro machining"*** *Narosa Publishing House, 2011*
2. *Bharat Bhushan* ***"Handbook of nanotechnology",*** *springer, Germany, 2010*
3. *Jain V.K* ***"Advanced Machining Processes",*** *Allied Publishers, Delhi, 2002*
4. *Mcgeough.J.A.,* ***"Micromachining of Engineering", Materials",*** *CRC press 2001.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Describe various mechanical micro machining processes

CO2: Describe various beam energy based micro machining processes.

CO3: Explain various methods of nano polishing techniques.

CO4: Understand and explain the micro forming and welding processes.

CO5: Use the knowledge of micro manufacturing processes into engineering applications.

COURSE ARTICULATION MATRIX:

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M				H			M	L	M		M	M		
CO2	M				H			M	M	M		M	M		
CO3	M				H				M	M		M	M		
CO4					M				L	M		M	M		
CO5	H				H	M		M	M	M			M		
18PPE$17	M				H	M		M	M	M		M	M		

L- Low, M – Moderate (Medium), H - High

18PPE$19	ADVANCED CASTING TECHNOLOGY

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

* To impart knowledge on various advanced casting techniques.

UNIT- I	CASTING OF METALS	(9 Periods)
Factors influencing casting of cast iron, steel, aluminium, magnesium, copper - factors influencing the casting practice - casting quality control. X-ray, sand control method - control of casting and casting defects.		
UNIT- II	**ROBOTICS IN METAL CASTING**	**(9 Periods)**
Structure and classification of Industrial Robots, Terminology of robot motion, Die cast Robots and Foundry Robots- advantages , applications. Robotic automation in permanent mold foundries.		
UNIT- III	**ADVANCES IN METAL CASTING**	**(9 Periods)**
Hcasting, shell moulding, investment casting, foam casting, centrifugal casting, Die casting, continuous casting,squeeze casting - processes and parameters.		
UNIT- IV	**CASTING METALLURGY**	**(9 Periods)**
Solidification of pure metals, alloys, dendritic growth, homogeneous and heterogeneous nucleation, constitutional under cooling, defects in casting causes and remedies. Long range and short range solidifying alloys.		
UNIT- V	**COMPUTER AIDED METAL CASTING**	**(9 Periods)**
Use of computer in runner and riser design, solidification front monitoring, expert system in casting defects, software mine-spectroscopy and chemical analysis.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Jain P.L **"Principles of Foundry Technology",** Tata McGraw-Hill Publishers, 4th edition 2008.*
2. *Heineloper& Rosenthal **"Principles of Metal Casting",** Tata McGraw Hill Publishers,2nd edition, 2000.*

REFERENCE BOOKS:

1. *Jain R.K. and Gupta S.C.* ***"Production Technology",*** *Khanna Publishers, New Delhi,17th edition, 2004*
2. *Rao, P. N* ***"Manufacturing Technology",*** *McGraw Hill Publishers , 3rd edition ,2010*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Explain the factors influencing casting of metals.

CO2: Explain the robots in metal casting.

CO3: Explain various advanced casting processes.

CO 4: Describe the thermal, metallurgical aspects during solidification in casting.

CO 5: Explain the applications of computer in metal casting.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	M		L		L	L	L	L	L		L	H		L
CO2	L	M	H			M	M	L	L	L		L	H		L
CO3	M	M	L	L	L	M	L	L	L	L		L	H		L
CO4	L	H	M	L	L	M	L			L		L	H		L
CO5	L	M	M	M	M	L	L	L	L	L		L	H		L
18PPE$19	L	M	M	L	L	M	L	L	L	L		L	H		L

L – Low, M- Moderate (Medium), H - High

18PPE$21	GREEN MANUFACTURING

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

* To introduce the basic concepts needed to proceed green manufacturing

UNIT- I	OUR ENVIRONMENT	(9 Periods)
The human population and the environment, the human population's effects on the earth, the ecosystem, chemical cycling and succession, the biogeochemical cycles, major global biogeochemical cycles - carbon, carbon-silicate, nitrogen and phosphorus cycles, global warming, greenhouse effect, major greenhouse gases.		
UNIT- II	**MANUFACTURING SYSTEMS**	**(9 Periods)**
Levels of manufacturing systems, environmentally conscious manufacturing- components, system effects and assessment		
UNIT- III	**WATER POLLUTION IN MANUFACTURING SYSTEMS**	**(9 Periods)**
Metalworking fluids- environmental and health impact, Heavy metals in water, MWF pollution prevention through process planning, process modification and in process recycling, water footprint analysis.		
UNIT- IV	**AIR AND SOLID POLLUTION IN MANUFACTURING SYSTEMS**	**(9 Periods)**
Origin of airborne particles in manufacturing, traditional and modern particulates mitigation/elimination techniques. Industrial solid and hazardous waste management, Carbon footprint analysis.		
UNIT- V	**ENVIRONMENTAL MANAGEMENT SYSTEMS**	**(9 Periods)**
Eco-labeling - Design for the Environment, Concepts of ISO 14001 - requirements of ISO 14001 – Environmental Management System – frame work and benefits.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Daniel B Botkin and Edward A Keller* ***"Environmental Science",*** *John Wiley & Sons, Chichester, 2010*
2. *Madu. C.N* ***"Handbook of Environmentally Conscious Manufacturing",****N Kluwer Academic Publisher, 2001.*

REFERENCE BOOKS:

1. *Swamidass, P.M.,* ***"Encyclopedia of Production and Manufacturing Management",*** *Kluwer Academic Publisher, 2000.*
2. *Kutz, M* ***"Environmentally Conscious Mechanical Design*** *John Wiley & Sons, 2007*
3. *Davim, J.P* ***Sustainable Manufacturing",*** *John Wiley & Sons, 2010.Koontz and Odonnel-Essentials of Management, McGraw Hill 1992*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Explain about the effect of humans on ecosystems and various phenomenon of Eco systems

CO2: Explain about the environmentally conscious manufacturing systems.

CO3: Evaluate the effects of water pollution by manufacturing systems and their prevention

CO4: Discuss the effects of air and solid pollution in manufacturing systems

CO5: Explain about environmental management systems

COURSE ARTICULATION MATRIX:

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L					H	H	M	L	M	L	H			L
CO2	L	L	M	L		H	H	M	L	M	L	H			L
CO3	L	L	L	L		H	H	M	L	M	L	H			L
CO4	L	L	M	L		H	H	M	L	M	L	H			L
CO5	L	M	M	L		H	H	M	L	M	L	H			L
18PPE$21	L	L	M	L		H	H	M	L	M	L	H			L

L- Low, M – Moderate (Medium), H - High

18PPE$24	INVESTMENT CASTING

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. Manufacturing Technology

COURSEOBJECTIVES:

* To enable the students to understand the difference between investment casting and other casting processes and familiarize them in design and product development, casting process, wax materials and destructive and non destructive testing used in industries.

UNIT- I	INTRODUCTION	(9 Periods)
Overview of investment casting and comparison with other casting processes, Advantages, Disadvantages, Limitations and Applications.		
UNIT- II	**DESIGN AND PRODUCT DEVELOPMENT**	**(9 Periods)**
Product design- Tool design, Feeder design, Gate Design – spruing techniques – wax tree assembly- Cost estimation of product - Estimation of alloy constituents, wax to metal conversion ratios – Selection of equipments for moulding process- simulation software for metal pouring (Precast, Magma)		
UNIT- III	**CASTING PROCESS**	**(9 Periods)**
Preparation of wax pattern- inversion, wax injection, wax pattern assembly; Shelling – Ceramic coating, Dewaxing; Shell firing – Metal melting, Spectrometer analysis - Pouring; Fettling – Knockout, Cutoff, Grinding, Heat treatment, Shot blasting – Process control		
UNIT- IV	**MATERIALS AND INSPECTION**	**(9 Periods)**
Types of wax, properties, specification and testing for wax materials – Binders and refractory filler materials – testing of binders, slurry and refractory materials – Material standards- ASTM, BIS, JIS, DIN - Destructive and Non-Destructive testing of castings		
UNIT- V	**INDUSTRIAL PRACTICES**	**(9 Periods)**
Quotation – Follow-up – Costing – Receipt of Purchase order – MRP - PPC – Quality system standards and product certification standards – ISO 9001:2008, Pressure Equipment Directive (Valves) – API(American Petroleum Institute), CE(European Standards), AS(Aerospace).		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Investment Casting Institute staff* ***"Investment casting Handbook",*** *1997*
2. *P.R. Beeley, R.F. Smart* ***"Investment Casting",*** *1995*

REFERENCE BOOKS:

1. *James E. Sopcak,* ***"Handbook of Lost Wax Or Investment Casting",*** *Gembooks, 1968*
2. *C. W. Ammen* ***"Lost Wax Investment Casting",*** *Tab Books 1977*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Compare investment casting process with other casting processes.
CO2: Explain the investment casting process.
CO3: Write types of wax, properties and specifications.
CO4: Explain various destructive and non-destructive testing of investment castings.

COURSE ARTICULATION MATRIX

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	M	H		L						H	M	H	L	L
CO2	H	M	H	H	L	M	M	M	M		M	M	M	L	L
CO3	H	H	H	L		L	M	L		L	L		M	L	
CO4	M	M	L	L		L	M	L	M	L	L	M	H	L	
18PPE$24	H	M	H	L		L	M	L	M	L	L	M	H	L	L

L- Low, M – Moderate (Medium), H - High

18PPE$31	SURFACE ENGINEERING AND TRIBOLOGY

PRE-REQUISITES : **CATEGORY : PE**

1. Engineering Metallurgy
2. Manufacturing Technology

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

* To enable the students to select and apply various surface engineering techniques.

UNIT I	FUNDAMENTALS OF SURFACE ENGINEERING	(9 Periods)
Topography of Engineering surfaces - Importance and necessity of surface engineering - Contact between surfaces, Classification and scope of surface engineering in metals – ceramics - polymers and composites, Tailoring of surfaces of advanced materials. Surface protection (Physical) - Surface dependent engineering properties, viz., wear, friction, corrosion, fatigue, reflectivity, and emissivity. Common surface initiated engineering failures - mechanism of surface degradation.		
UNIT II	**VARIOUS SURFACE CLEANING PROCESSES**	**(9 Periods)**
General cleaning process for ferrous - non ferrous metals and alloys, Classification and Selection of Cleaning processes Acid and Alkaline - Salt bath - emulsion cleaning – Ultrasonic - Mechanical cleaning - Pickling and de-scaling Process, Abrasive bath cleaning - polishing and buffing, shot peening – Applications		
UNIT III	**SURFACE TREATMENT TECHNIQUES**	**(9 Periods)**
Surface modification techniques - classification, principles, methods, and technology used, conventional surface engineering methods - Diffusion coatings like carburizing – nitriding – cyaniding - hot dipping – galvanizing – anodizing – Aluminizing – Phosphetising – Passivation. Thermal spraying - Vapour deposition - ion implantation, Diamond and Diamond like carbon thin films and coatings for engineering surfaces. Diffusion bonding.		
UNIT IV	**THIN LAYER ENGINEERING PROCESSES**	**(9 Periods)**
Other processes used in surface engineering - Laser and Electron Beam hardening - Effect of process variables such as power and scan speed – Physical vapor deposition (PVD) - Chemical vapor deposition (CVD) - Thermal evaporation - Arc vaporizations - Sputtering, Coating of tools, TiC, TiN, Al_2O_3 and Diamond - coating properties and applications of thin coatings. Surface engineering problems related to substrate characteristics. Plasma enhanced surface engineering		
UNIT V	**EVALUATION, TESTING AND SELECTION OF COATINGS**	**(9 Periods)**
Measurement of mechanical properties of engineered surface in nano scale, Evaluation of tribological characteristics of engineered surface in macro - micro and nano scale, Surface geometry – characterization techniques, the quality plan - design - testing and inspection - thickness and porosity measurement - adhesion measurement – selection of coatings - Industrial applications of engineering coatings.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Bharat Bhushan, **"Introduction to Tribology"**, JohnWiley and sons, Newyork, 2002.*
2. *K. Chopra, L. Malhotra, **"Thin film deposition"**, McGraw Hill.*

REFERENCE BOOKS:

1. *Frank Philip Bowden,* ***"The Friction and Lubrication of Solids"****, Oxford Classic Texts, 2011.*
2. *Gwidon Stachowiak, A W Batchelor,* ***"Engineering Tribology"****, 3rd edition, Elsevierine, 2005.*
3. *ASM Hand Book, Vol. 5,* ***"Surface Engineering"****, 10th Edition, 1994.*
4. *Tool and Manufacturing Engineers Hand book, Vol.3, '****Materials, Finishing and Coating",*** *Society of Manufacturing Engineers, 1984.*
5. *Kammeth G Budinski,* ***"Surface Engineering for Wear resistance",*** *Prentice Hall, 1988.*

COURSE OUTCOME:

Upon completion of the course, the student will be able to

C01: Demonstrate the understanding of the concepts of surface engineering

C02: Select suitable surface cleaning process for different types of materials.

C03: Identify different surface treatment techniques.

C04: Describe various thin layer coating processes

C05: Select suitable coatings based on applications and evaluate the quality of coatings.

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COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L											M			
CO2	M												L		
CO3	M												L		
CO4	M	L	L	L									L	L	
CO5	M	M	M	M	M	L	L	L			L	M	M	M	M
18PPE$31	M	M	M	M	M	L	L	L			L	M	L	M	M

L-Low, M-Moderate (Medium), H-High

VERTICAL IV

INDUSTRIAL ENGINEERING AND QUALITY CONTROL

18PPE$07	STATISTICAL QUALITY CONTROL AND RELIABILITY ENGINEERING

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. Production Planning and Control

COURSE OBJECTIVES:

* To introduce the concept of SQC, understand process control, acceptance sampling procedure and to learn the concept of reliability.

UNIT- I	INTRODUCTION AND PROCESS CONTROL FOR VARIABLES	(9 Periods)
Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality cost-Variation in process- factors – process capability – process capability studies and simple problems – Theory of control chart- uses of control chart – Control chart for variables – X chart, R chart and σ chart.		
UNIT- II	**PROCESS CONTROL FOR ATTRIBUTES**	**(9 Periods)**
Control chart for attributes – control chart for proportion or fraction defectives – p chart and np chart – control chart for defects – C and U charts, State of control and process out of control identification in charts.		
UNIT- III	**ACCEPTANCE SAMPLING**	**(9 Periods)**
Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producer's Risk and consumer's Risk. AQL, LTPD, AOQL concepts- standard sampling plans for AQL and LTPD- uses of standard sampling plans.		
UNIT- IV	**LIFE TESTING - RELIABILITY**	**(9 Periods)**
Life testing – Objective – failure data analysis, Mean failure rate, mean time to failure, mean time between failure, hazard rate, system reliability, series, parallel and mixed configuration – simple problems. Maintainability and availability – simple problems. Acceptance sampling based on reliability test – O.C Curves.		
UNIT- V	**QUALITY AND RELIABILITY**	**(9 Periods)**
Reliability improvements – techniques- use of Pareto analysis – design for reliability – redundancy unit and standby redundancy – Optimization in reliability – Product design – Product analysis – Product development – Product life cycles.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Grant, Eugene.L **"Statistical Quality Control",** McGraw-Hill, 7th edition, 2008.*
2. *L.S.Srinath **"Reliability Engineering",** Affiliated East west press, 1991.*

REFERENCE BOOKS:

1. *Monohar Mahajan,* ***"Statistical Quality Control",*** *Dhanpat Rai and Sons, 2001.*
2. *R.C.Gupta,* ***"Statistical Quality control",*** *Khanna Publishers, 1997*
3. *Besterfield D.H* ***"Quality Control",*** *Prentice Hall, 1993.*
4. *Sharma S.C.,* ***"Inspection Quality Control and Reliability",*** *Khanna Publishers, 1998*
5. *Connor, P.D.T.O* ***"Practical Reliability Engineering",*** *John Wiley, 1993.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: describe the basic concepts involved in manufacturing process control for variables.
CO2: describe various process control charts for attributes.
CO3: explain the concepts of acceptance sampling.
CO4: explain the life testing techniques, failure data analysis and mean failure rate.
CO5: describe Pareto analysis and product design, development and life cycle concepts.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	M	L	L									M		M
CO2	M	M	L	L									M		M
CO3	M	L	L	L									M		M
CO4	M	L	M	M									M		M
CO5	M	M	M	M									M		M
18PPE$07	M	M	M	M									M		M

L- Low, M – Moderate (Medium), H – High

18PPE$12	PLANT LAYOUT AND MATERIAL HANDLING

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

* To understand basic layout and the usage of material handling equipments for industries and gain knowledge on industrial buildings and utilities.

UNIT- I	INTRODUCTION	(9 Periods)
Factors to be considered for plant layout - physical facilities - equipments required for plant operation. Capacity, serviceability and flexibility and analysis in selection of equipments space requirements, man power requirements		
UNIT- II	**PLANT LAYOUT**	**(9 Periods)**
Plant layout - need for layout, factors influencing product, process, fixed and combination layout - tools and techniques for developing layout, process chart, flow diagram, string diagram, template and scale models machine data. Layout planning procedure. Visualization of layout revision and improving existing layout, balancing of fabricating and assembly lines.		
UNIT- III	**MATERIAL HANDLING**	**(9 Periods)**
Principles, importance and scope of material handling. Planning, operation and costing principles types of material handling systems, factors influencing their choice.		
UNIT- IV	**UTILITIES**	**(9 Periods)**
Industrial buildings and utilities - centralized electrical pneumatic water line systems. Types of building, lighting heating, ventilation and air-conditioning utilities. Planning and maintenance of waste handling statutory requirements. Packing and storage of materials - layout for packaging -packaging machinery - wrapping and packing of materials, cushion materials		
UNIT- V	**ANALYSIS OF MATERIAL HANDLING**	**(9 Periods)**
Analysis of material handling - factors involved, motion analysis, flow analysis, safety analysis, and equipment cost analysis, analysis of operation and material handling surveys.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *James, M. Apple **"Plant Layout and Material Handling",** Kreiger Publishing Company, 1991*
2. *Rudenko. N **"Materials handling equipment",** Mir Publishers, 1969*

REFERENCE BOOKS:

1. *James, M. Moore* ***"Plant Layout and Design",*** *Macmillan Company, NY, 1963*
2. *Muther, R.* ***"Practical Plant Layout",*** *McGraw Hill Book Company, NY, 1955*
3. *Colin Hardie* ***"Material Handling in Machine Shops",*** *Machinery Publication Co. Ltd., London, 1970*
4. *Alexandrov, M* ***"Materials Handling Equipments",*** *MIR Publishers, 1981.*
5. *Boltzharol, A.* ***"Materials Handling Handbook",*** *The Ronald Press Company, 1958*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Design plant layout for any type of industries.

CO2: Perform effective selection and utilization of buildings and utilities.

CO3: Select and utilize suitable material handling equipment.

CO4: Plan appropriate HVAC system for industrial buildings.

CO5: Analyze the usage of material handling equipments.

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COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	L	M		L	L		L	L		L		L	L	L
CO2	M	L	M			L		L	L		L		L	M	L
CO3	M	L	M			L		L	L		L		L	L	L
CO4	H	L	M			L		L	L		L		L	L	L
CO5	M	L	M		M	L		L	L		L		L	L	L
18PPE$12	M	L	M		L	L		L	L		L		L	L	L

L- Low, M – Moderate (Medium), H - High

18PPE$13	NON DESTRUCTIVE TESTING TECHNIQUES

Category : PE

L T P C

PRE-REQUISITES: **3 0 0 3**

1. Manufacturing Technology

COURSE OBJECTIVES:

- To understand principle behind various NDT techniques.
- To study about NDT equipments and accessories.
- To learn working procedures of various NDT techniques.

UNIT- I	INTRODUCTION	(9 Periods)
NDT Versus Mechanical testing, Overview of the Non-Destructive Testing Methods for the detection of manufacturing defects as well as material characterization. Relative merits and limitations, Visual methods: Optical aids, In-situ metallography, Optical holographic methods, Dynamic inspection.		
UNIT- II	**LIQUID PENETRANT & MAGNETIC INSPECTION**	**(9 Periods)**
Penetrant systems: Principles – Process - Liquid penetrant materials – Emulsifiers - cleaners developers – sensitivity - Advantages, Limitations and Applications. Magnetic methods: Advantages, Limitations - Methods of generating fields: magnetic particles and suspending liquids. Magnetography - field sensitive probes: applications. Measurement of metal properties.		
UNIT- III	**RADIOGRAPHIC METHODS**	**(9 Periods)**
Principles of radiography - sources of radiation - Ionising radiation – sources - X-rays, gamma rays Recording of radiation-Radiographic sensitivity - Fluoroscopic methods - special techniques. Radiation safety. Advantages, Limitations and Applications.		
UNIT- IV	**ULTRASONIC TESTING OF MATERIALS**	**(9 Periods)**
Ultrasonic testing: Principle - Advantages, Disadvantages, Applications - Generation of Ultrasonic waves - general characteristics of ultrasonic waves: methods and instruments for ultrasonic materials testing: special techniques.		
UNIT- V	**ELECTRICAL AND SPECIAL METHODS**	**(9 Periods)**
Electrical methods: Eddy current methods: potential - drop methods, applications - Other methods: Acoustic Emission methods, Acoustic methods: Leak detection: Thermal inspection.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Baldev Raj, T.Jayakumar, M.Thavasimuthu **"Practical Non-Destructive Testing",** Narosa Publishing House, 2009.*
2. *Ravi Prakash **"Non-Destructive Testing Techniques",** New Age International Publishers, 2010*

REFERENCE BOOKS:

1. *ASM Metals Handbook* ***"Non-Destructive Evaluation and Quality Control",*** *American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.*
2. *Paul E Mix,* ***"Introduction to Non-destructive testing: a training guide",*** *Wiley, 2nd Edition New Jersey, 2005*
3. *Charles, J. Hellier,* ***"Handbook of Nondestructive evaluation",*** *McGraw Hill, New York 2001.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Classify various non-destructive testing and choose the right method of testing for detection of defects on various materials.

CO2: Check different metals and alloys by visual inspection method.

CO3: Explain and perform non-destructive tests like: Liquid penetrant test, Magnetic particle test, Ultrasonic test, X-ray and Gamma ray radiography, Leak Test, Eddy current test.

CO4: Describe the safety procedures of operating the NDT equipments and follow them.

CO5: Detect the flow and other defects using NDT procedure for industrial component.

COURSE ARTICULATION MATRIX:

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1		M											L		M
CO2		M													M
CO3		M	M	H	M							M			
CO4						M									H
CO5			M			L									M
18PPE$13		M	M	H	M	M						M	L		M

L- Low, M – Moderate (Medium), H – High

18PPE$14	SUPPLY CHAIN MANAGEMENT

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To develop the students in the dynamics of inter-organizational collaboration and coordination towards building supply chains.

UNIT- I	INTRODUCTION TO SUPPLY CHAIN MANAGEMENT	(9 Periods)
Meaning and definition of supply chain management, Difficulties of managing supply chains, the development chain, global optimization, Key issues in of supply chain management.		
UNIT- II	**INVENTORY MANAGEMENT AND RISK POOLING**	**(9 Periods)**
Introduction, single stage Inventory control, The economic lot size model, effect of demand uncertainty. Risk pooling, centralized and decentralized system, managing inventory in the supply chain, forecasting.		
UNIT- III	**VALUE OF INFORMATION**	**(9 Periods)**
Introduction, Bullwhip effect-Quantifying the bullwhip effect-impact of centralized information on the bullwhip effect-supply chain with centralized demand information and decentralized demand information=managerial insights in the value of centralized information. Methods for coping with the bullwhip effect. Supply chain integration - push, pull and push-pull system. Demand driven strategies.		
UNIT- IV	**GLOBALISATION OF SCM**	**(9 Periods)**
Introduction,-Global market forces, Technological forces, global cost forces, political and economic forces. Managing global risks-speculative strategies, hedge strategies, flexible strategies- requirements for global strategy implementation. Issues in international supply chain management- International versus regional products, region-specific products, true global products. Supplies integration into to new product development- spectrum of supplier integration, keys to effective supplier integration, bookshelf of technologies and suppliers. Mass customization-Meaning, making mass customization work, mass customization and supply chain management.		
UNIT- V	**INFORMATION TECHNOLOGY FOR SCM**	**(9 Periods)**
Goals of supply chain IT, IT standards, It infrastructure, IT for supply chain excellence.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Simchi-Levi David, Kaminsky Philip, Simchi-Levi Edith and Ravi Shankar.* ***"Designing and Managing the Supply Chain: Concepts, Strategies and Case Studies",*** *Third Edition, Tata McGraw Hill Education Private Limited, New Delhi, Tenth reprint, 2012.*
2. *Chopra S and Meindl P* ***"Supply Chain Management: Strategy, Planning and Operation",*** *Second Edition, Prentice Hall India Private Limited, 2005.*

REFERENCE BOOKS:

1. *Robert Jacobs F, William Berry and Clay Whybark D* ***"Manufacturing Planning and Control for Supply Chain Management",*** *Tata McGraw Hill, New Delhi, 2011.*
2. *Christopher* ***"Logistics and Supply Chain Management",*** *Pearson Education Asia, New Delhi*
3. *Taylor and Brunt,* ***"Manufacturing Operations and Supply Chain Management (The Lean Approach)",*** *Business Press Thomson Learning, NY*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Describe the objectives of supply chain management.

CO2: Describe the inventory management and risk pooling.

CO3: Describe about value of information.

CO4: Describe about globalization of SCM.

CO5: Describe about information technology for SCM.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M					M						L		L	
CO2	H	L			L	M			L				M	M	
CO3									L	M		M			M
CO4	H	L				L		L					L		
CO5		H			L				L			M		M	
18PPE$14	M	M			L	M		L	L	L		M	L	M	L

L- Low, M – Moderate (Medium), H - High

18PPE$15	PRODUCTION MANAGEMENT

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

* To introduce various management methods in production industries.

UNIT- I	BASICS OF MANAGEMENT	(9 Periods)
Evolution of management - General principles of management – management functions – organization –types – comparison – functions of personnel management – recruitment – training – leadership - motivation – communication – conflict – Industrial relations – trade union.		
UNIT- II	**OPERATIONS MANAGEMENT**	**(9 Periods)**
Plant Location – Layout – Materials Handling – Method study – Time study – Ergonomics – Aggregate Planning – Value Analysis.		
UNIT- III	**MATERIALS MANAGEMENT**	**(9 Periods)**
Materials management - Purchasing – Objectives – parameters – procedure. Supplier selection – Stores management – codification – Waste management – Reasons for waste generation – identification and control of waste – scrap disposal.		
UNIT- IV	**INVENTORY MANAGEMENT**	**(9 Periods)**
Purpose of inventory – Cost related to inventory – Basic EOQ model – variations in EOQ model – Finite Production, quantity discounts – ABC Analysis – MRP - Introduction to MRP II and ERP.		
UNIT- V	**MARKETING MANAGEMENT**	**(9 Periods)**
Functions of marketing – Sales promotion methods – advertising – product packaging – marketing variables – distribution channels – organization – market research – market research techniques.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *R. Panneerselvam **"Production and Operations Management",** Prentice Hall of India, 2012.*

REFERENCE BOOKS:

1. *Koontz and Weihrich **"Essentials of Management",** McGraw Hill 2015*
2. *Philips Kotler **"Marketing management",** Pearson, 2015*
3. *Martand T. Telesang **"Production Management",** S.Chand& Co., 2007*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Illustrate the functions of management and personnel management.

CO2: Explain various ways of managing operations in engineering industries.

CO3: Identify the methods for managing materials in engineering industries.

CO4: Describe the importance of inventory and the ways of managing inventory.

CO5: Explain the various processes involved in marketing.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L								M	M	H	M			
CO2	M	M		M	L					L	H	L	L		H
CO3	L	M	L	L	L					L	M	L			L
CO4	M	L	L	L	L					L	H	L			M
CO5		L								H	M	L			
18PPE$15	L	M	L	L	L				L	L	H	L	L		M

L- Low, M – Moderate (Medium), H - High

18PPE$20	TOTAL PRODUCTIVE MAINTENANCE

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

* To enable the students to understand basic concepts of Total Productive Maintenance.
* Expose the students to the objectives, maintenance models, group activities, logistics, condition monitoring and implementation of Total Productive Maintenance.

UNIT- I	MAINTENANCE CONCEPTS	(9 Periods)
Introduction - Objectives and functions – Productivity, Quality, Reliability and Maintainability (PQRM) - Terotechnology - Reliability Centered Maintenance - Predictive Maintenance - Condition Based Maintenance - maintainability prediction - availability and system effectiveness- maintenance costs - maintenance organization.		
UNIT- II	**MAINTENANCE MODELS**	**(9 Periods)**
Minimal repair - As Good As New policy - maintenance types - balancing Preventive Maintenance and breakdown maintenance – Preventive Maintenance schedules: deviations on both sides of target values - PM schedules: functional characteristics - replacement models.		
UNIT- III	**FUNDAMENTALS OF TPM**	**(9 Periods)**
Zero breakdowns - Zero Defects and TPM - maximizing equipment effectiveness – Autonomous maintenance program - five pillars of TPM - TPM small group activities - TPM organization - Management Decision - Educational campaign - Creation of Organizations - Establishment of basic policies and goals - Formation of master plan **-** TPM implementation.		
UNIT- IV	**MAINTENANCE LOGISTICS**	**(9 Periods)**
Human factors in maintenance - maintenance manuals - maintenance staffing methods - queuing applications - simulation - spare parts management - maintenance planning and scheduling.		
UNIT- V	**ONLINE MONITORING**	**(9 Periods)**
Condition monitoring - Infrared Thermography, Oil Analysis, acoustic emissions testing, Motor Current Analysis, Vibration Measurement and Analysis, Wear Debris Monitoring, Visual checks - corrosion control - Maintenance Management Information System - Expert system applications.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Nakajima S.* ***"Introduction to TPM",*** *Productivity Press, Chennai, 1992*
2. *Srivastava S.K.* ***"Maintenance Engineering (Pri.Practices& Management)",*** *S. Chand Group, 2011*

REFERENCE BOOKS:

1. *Wireman T* ***"Total Productive Maintenance",*** *Industrial Press Inc., New york, 2004*
2. *Goto F* ***"Equipment planning for TPM Maintenance Prevention Design",*** *Productivity Press,1992*
3. *Shirose K.,* ***"Total Productive Maintenance for Workshop Leaders",*** *Productivity Press, 1992*
4. *Kelly A.,* ***"Maintenance planning and control",*** *Butterworths, London, 1991*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Describe the concept of total productive maintenance used in the industries.

CO2: Describe how TPM improves operations by preventing equipment breakdowns and prevention of product defects and rejects.

CO3: Understand the usage of tools for TPM implementation and able to identify and eliminate loss through TPM implementation.

CO4: Describe the logistics involved in Total productive Maintenance.

CO5: Effectively use the total productive maintenance for online monitoring of processes.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1								M	M	H		M			
CO2	M	H				M		M	M	M	M	M			L
CO3	L				M			M	M	M		M	M		M
CO4								M	M			H			
CO5					L			M	M			M			L
18PPE$20	L	L			L	M		M	M	M	M	M	M		L

L- Low, M – Moderate (Medium), H – High

18PPE$05	**POWER PLANT ENGINEERING** *(Common to MECH & PRODN)*

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. Thermal Sciences

COURSE OBJECTIVES:

- To learn the economics of power generation.
- To understand the working of power plants components.

UNIT- I	ECONOMICS OF POWER GENERATION	(9 Periods)
Load and load duration curves. Electricity billing – costing of electrical energy – Tariff structures. Economics of power plant – Fixed and variable cost. Payback period. Net Present Value, Internal Rate of Return. Emission calculation and carbon credit.		
UNIT- II	**HYDRO POWER PLANTS**	**(9 Periods)**
Energy scenario – Global and National. Essential elements and classification of hydro power plants. Typical Layout and associated components. Selection of turbines. Pumped storage plants.		
UNIT- III	**THERMAL AND GAS TURBINE POWER PLANTS**	**(9 Periods)**
Cycle analysis - Layout of modern coal based power plant. Super Critical Boilers - FBC Boilers. Subsystems – Water and Steam, Fuel and ash handling, Air and Gas, Draught system. Diesel and Gas Turbine power plants- Layout and Functioning. Environmental impact and Control.		
UNIT- IV	**NUCLEAR POWER PLANTS**	**(9 Periods)**
Layout and subsystems. Fuels and Nuclear reactions. Boiling Water Reactor, Pressurized Water Reactor, Fast Breeder Reactor, Gas Cooled and Liquid Metal Cooled Reactors – working and Comparison. Safety measures. Environmental aspects.		
UNIT- V	**RENEWABLE ENERGY POWER PLANTS**	**(9 Periods)**
Solar power plants – Photovoltaic and Thermal. Wind power plants – Vertical and Horizontal axes Wind Turbines. Biomass power plants – Gasification and combustion. Tidal and Ocean Thermal Energy plants. Geothermal plants. Fuel cell – Types. Hybrid power plants.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. M.*GR. Nagpal **"Power Plant Engineering",** Khanna publishers, 2012*
2. *S.C. Arora and S. Domkundwar **"A Course in Power Plant Engineering",** Dhanpat Rai and sons, 2014.*

REFERENCE BOOKS:

1. *P.K.Nag, **"Power Plant Engineering",** Tata McGraw Hill, 2014*
2. *Paul Breeze **"Power Generation Technologies",** Elsevier Ltd., 2014.*
3. *M.M.El.Wakil **"Power Plant Technology",** Tata McGraw Hill, 2010*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Arrive at cost of power generation, electricity billing and rate of return on power plant investments.

CO2: Understand the working of Hydro-electric power plants.

CO3: Analyze the working of Conventional power plants such as Thermal and Gas Turbines.

CO4: Understand the working of nuclear power plants and its functional components.

CO5: Understand the different types of renewable energy systems and its functional components.

COURSE ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	M	L	H	M	H	L	M	L	L	L	M	H	M		M
CO 2	L	M	H	L	M	L	H	M	M	L	H	L	L		M
CO 3	M	M	H	M	M	H	M	L	L	H	M	M	M		L
CO 4	H	M	L	M	H	M	L	M	L	H	H	M	M		M
CO 5	M	L	L	H	M	M	L	H	H	M	H	H	M		M
18PPE$05	M	M	M	M	M	M	M	M	M	M	H	M	M		M

L- Low, M – Moderate (Medium), H - High

18PPE$11	HUMAN VALUES AND PROFESSIONAL ETHICS II

Category: PE

PRE-REQUISITES: NIL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

* To develop the capacity of making value judgments in real life situations and to overcome the crisis of values encountered in professional life.

UNIT - I	HUMAN VALUES AND INTRODUCTION TO ETHICS	(9 Periods)
Morals, Values and Ethics – Integrity – Work Ethic – Respect for Others – Living Peacefully – caring – Sharing – Honesty – Courage – Valuing Time – Co-operation – Commitment – Empathy – Self-Confidence – Character – Spirituality - Senses of 'Engineering Ethics' - variety of moral issues - types of inquiry.		
UNIT - II	**ETHICAL THEORIES AND PROFESSIONALISM**	**(9 Periods)**
Moral dilemmas - moral autonomy - Kohlberg's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest - customs and religion - uses of ethical theories.		
UNIT - III	**ENGINEERING AS SOCIAL EXPERIMENTATION**	**(9 Periods)**
Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - the challenger case study.		
UNIT - IV	**SAFETY,RESPONSIBILITY AND RIGHTS**	**(9 Periods)**
Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - three mile island and chernobyl case studies. Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination.		
UNIT - V	**GLOBAL ISSUES**	**(9 Periods)**
Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership-sample code of Ethics like ASME, SAE India, Institution of Engineers (India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers (IETE),India.		

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Mike Martin and Roland Schinzinger* ***"Ethics in Engineering",*** *McGraw-Hill, New York, 3rd edition, reprint 2007*
2. *Govindarajan M, Natarajan S, Senthil Kumar V. S* ***"Engineering Ethics",*** *Prentice Hall of India, New Delhi, 2004*
3. *Tripathi A N* ***"Human values",*** *New Age international Pvt. Ltd., New Delhi, 2002*

REFERENCE BOOKS:

1. *Charles D. Fleddermann* ***"Engineering Ethics",*** *Pearson Education / Prentice Hall, New Jersey, 2004*
2. *Charles E Harris, Michael S. Protchard and Michael J Rabins* ***"Engineering Ethics – Concepts and Cases",*** Wadsworth Thompson Learning, United States, 2000 .
3. *John R Boatright* ***"Ethics and the Conduct of Business",****Pearson Education, New Delhi, 2003.*
4. *Edmund G Seebauer and Robert L Barry* ***"Fundamentals of Ethics for Scientists and Engineers",*** *Oxford University Press, Oxford, 2001.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: recognize the basic concepts of Human values and ethics.

CO2: express the ethical theories.

CO3: identify the concept of professionalism

CO4: identify and implement the safety aspects in social experimentation

CO5: understand the impact of technical development in environmental and societal context.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L	L	H			H	H	H	H			M	H		
CO2	L	L	H			H	H	H	H			M	H		
CO3	L	L	H			H	H	H	H	H	H	M	H		
CO4	L	L	H			H	H	H	H	H		M	H	H	
CO5	L	L	H			H	H	H	H	H		M	H	H	
18PPE$11	L	L	H			H	H	H	H	H	H	M	H		

L- Low, M – Moderate (Medium), H - High

18PPE$32	INDUSTRIAL SAFETY ENGINEERING

PRE-REQUISITES : NIL **CATEGORY : PE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

* To study the concept of industrial safety, accident investigation and reporting, and, safety education and training, and, safety management, and, safety audit and safety regulation.

UNIT – I	SAFETY CONCEPT	(9 Periods)
Evolution of modern safety concept- History of safety movement- influence of environmental safety – Hazards –safety policy –safety survey, safety inspection safety culture and Behavioral safety.		
UNIT - II	**ACCIDENT INVESTIGATION AND REPORTING**	**(9 Periods)**
Concept of an accident, reportable and non reportable accidents- principles of accident prevention-accident investigation and analysis- documentation of accidents- unsafe act and unsafe condition-domino sequence- role of safety committee and cost of accident.		
UNIT - III	**SAFETY EDUCATION AND TRAINING**	**(9 Periods)**
Importance of training – training methods - method of promoting safe practice-motivation-role of government agencies and private consulting agencies in safety training- Creating awareness- safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign.		
UNIT - IV	**SAFETY MANAGEMENT**	**(9 Periods)**
General concept of safety management-National Safety Council-OSHA, their roles in safety propagation - Evolution of modern safety concept-planning for safety for optimization of productivity-line and staff functions for safety-safety sampling, fault tree analysis..		
UNIT - V	**SAFETY AUDIT AND SAFETY REGULATION**	**(9 Periods)**
Components of safety audit, types of audit, audit methodology, non-conformity reporting(NCR),audit checklist and report-review of inspection, safety measures in factories act, pollution control act for water, air, land . OSHAS18001, ISO14001		

Contact Periods: 45
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Heinrich H.W, **"Industrial accident Prevention",** McGraw-Hill company,New york,1980.*
2. *Krishnan N.V, **"Safety management in Industry"**,Jaico Publishing House,Bombay,1997.*

REFERENCE BOOKS:

1. *Dan Petersen, **"Techniques of Safety Management"**, Mc Graw-Hill Company,Tokyo, 1981*
2. ***"Accident Prevention Manual For Industrial Operations"**, N.S.C Chicago, 1980.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

C01: Anticipate, identify, evaluate, and control workplace hazardous conditions and practices.

C02: Develop effective safe operating procedures and comprehensive safety and health programs.

C03: Address identified hazards, conditions, and practices in a cost effective manner

C04: Apply the general concept of safety management and planning for safety for optimization of productivity.

C05: Measure and evaluate occupational safety and health performance.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L					L	L	L							
CO2	M	M	M	M		M	M	M		L			M		
CO3	M	L				M	M	M		M		L	L	M	
CO4	M	M	M	M	L	M	L	M			M				
CO5	M	L			M	M	M	M		M	M	L	M	M	M
18PPE$32	M	M	M	M	M	M	M	M		M	M	L	M	M	M

L-Low, M-Moderate(Medium), H-High