SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
21ME701T	Automation In Production	3	-	-	3	30	70	100

Course Objectives	Course Outcomes
To develop in the engineering students the ability to analyze any engineering problem in a simple and logical manner and to apply to its solution a few, well understood basic principles	1. Get Acquainted With Automation, Its Type's, Strategies , Assembly Line Balancing And Its Analysis. 2. Recognize fundamentals and constructional features of N.C,CNC and D.N.C machines and prepare a CNC program for given part. 3. Get Acquainted With theconcept of CAD/CAM,CIM,FMS,SFC. 4. Cultivate Information About Automated Material Handling Systems, Automated Storage And Retrieval System (AGVS,AS/RS) Its Analysis. 5. Get Acquainted With Automated Inspection (CAPP, CAQC, CMM) and Group Technology.

Unit I	**[8Hrs]**
Automation- Definition, types, reasons for automating, arguments for and against automation. Organization and information processing in manufacturing. Automated Flow 'Lines- Methods of workpart transport, Transfer mechanisms, Buffer storage. Analysis of flow linesGeneral terminology and analysis, analysis of transfer lines without storage ,line balancing.	
Unit II	**[7Hrs]**
Numerical Control Production Systems- Basic concepts, coordinate system and machine motion- Types of NCsystems- Point to point, straight cut and continuous path. Machine control unit and other components, .NC part programming, NC words, methods of part programming APT programming, Direct numerical control. Computer numerical control.	
Unit III	**[7Hrs]**
CAD/CAM,FMS,CAPP -. Computer aided manufacturing -Manufacturing planning, manufacturing control ; Computer integrated manufacturing ; Flexible manufacturing systems -Components, Types of systems, FMS layout configuration computer functions, data files, system reports, FMS benefits. Computer aided process planning: Retrieval CAPP systems, generative CAPP systems, benefits of CAPP. Shop floor control. Computer Process Control.	
Unit IV	**[8Hrs]**
Automated material handling & storage-Conveyor systems: Automated Guided Vehicle Systems -Types: - Driverless trains, AGVS pallet trucks, AGVS unit-load carriers. Vehicle guidance & Routing, Traffic control & safety, System management, Analysis of AGVS systems, AGVS applications. Automated Storage & Retrieval System -Types :- Unit load AS/RS , mini load AS/I{S , man on board AS/RS , automated item retrieval system, deep lane AS/RS -Basic components & special features of AS/RS , Carousel storage systems , Work in process storage, quantitative analysis.	
Unit V	**[7Hrs]**
Automated inspection & Group technology: - Automated inspection principles & methods - coordinate measuring machines - construction, operation & benefits; Machine vision -image aquisition&digitigation, image processing & analysis, interpretation, Introduction to Group Technology. Group Technology: Part families, parts classification & coding, Opitz classification systems production flow analysis; Machine cell design -composite pat concept, types of cell design, benefits of group technology	

Text Books

S.N	Title	Authors	Edition	Publisher
1.	Automation, production System & CIMS	M P, Groover	Third edition (2007)	PHI Prentice Hall
2.	CAD/CAM	Zimmers & Groover	Fifth edition (2008)	PIII Pearson Education India

Reference Books

S.N	Title	Authors	Edition	Publisher
1.	Numerical Control And Computer Aided Manufacturing	Rao, N K Tiwari, T K Kundra	13th edition (2007)	Tata McGraw-Hill Education
2.	Computer Control of Manufacturing Systems	Koren	2005	Mcgraw Hill

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
21ME701P	Automation In Production Lab	-	-	2	1	25	25	50

Course Objectives	Course Outcomes
To develop in the engineering students the ability to analyze any engineering problem in a simple and logical manner and to apply to its solution a few, well understood basic principles	1. Recognize automation, corroborating these knowledge with case studies on automation systems. study and analyze the material handling systems, robots and GT, 2. Able to demonstrate NC programming (Manual/APT). 3. Get acquainted with simulating program on CNC milling/ lathe. 4. Get acquainted with working on CNC milling/ lathe

Minimum 8 practical to be performed

Expt. No.	Title of the experiment
1	Practice Programming on APT
2	Practice Programming on Manual Part.
3	Performance, Simulation on lathe (atleast two Complex Geometric)
4	Performance, Simulation on CNC milling (atleast two Complex Geometries)
5	Performance, on CNC lathe (atleast two Complex Geometric)
6	Performance, on CNC Milling (atleast two Complex Geometric)
7	Case Study on Automated System of any Industry.
8	Performance/ Practical on Robot.
9	Part Coding and Group Technology
10	Study of FMS

Text Books

S.N	Title	Authors	Edition	Publisher
1.	Automation, production System & CIMS	M P, Groover	Third edition (2007)	PHI Prentice Hall
2.	CAD/CAM	Zimmers & Groover	Fifth edition (2008)	PIII Pearson Education India

Reference Books

S.N	Title	Authors	Edition	Publisher
1.	Numerical Control And Computer Aided Manufacturing	Rao, N K Tiwari, T K Kundra	13th edition (2007)	Tata McGraw-Hill Education
2.	Computer Control of Manufacturing Systems	Koren	2005	Mcgraw Hill

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
21ME702T(i)	Professional Elective - V : HVAC System Design Using BIM Software	3	-	-	3	30	70	100

Course Objectives	Course Outcomes
1. To provide overview of the HVAC sector, components, Codes & standards in HVAC systems to the students. 2. To enhances the analytical and design skills of the students on heating, refrigeration, ventilation and air distribution system design.	• Explain the most important concepts, components, Codes & standards related to HVAC systems. • Explain and classify chillars, AHU's and design AHU room • Calculate heat load for given building • Design ducting for HVAC system • Select pumps, fans and piping system

Unit I	**[7Hrs]**
Introduction to HVAC systems: An Overview of HVAC Systems, Scope of HVAC Engineering, Standards and codes used in HVAC,Modes of heat transfer,Basic Laws for HVAC designing,study on psychrometric charts {manual and software),Psychrometric properties	
Unit II	**[9Hrs]**
Chillars and AHU's: Introduction, classification, selection of chillar, Installation of chillars, chillar plant layout, Accessories, chillar valves & fittings. Introduction to AHU, classification of AHU, AHU process, accessories, AHU room design	
Unit III	**[8Hrs]**
Heat Load Calculation:-Methods for Heat load calculation, manual heat load calculation, building survey, material survey, U-factor, tonnage calculation, hehumidified flow rate, hourly Analysis Program (HAP),E20 sheet Calculation.	
Unit IV	**[9Hrs]**
HVAC Ducting:- Introduction to Duct Family, classification, duct material, installation of duct, duct joining methods, leakproof test, acoustic insulation, Manual Duct Design, McQuay Duct Sizer,constant friction method, velocity reduction method, thumb rule, sheet metal calculation	
Unit V	**[7Hrs]**
Air Terminals: Diffusers, grills, dampers, types. **Piping:** Introduction, Refrigerant Piping, insulation, piping accessories, chiller water piping, condensor piping, drain piping, pipe testing, sizing. **Pumps and Fans:** Pump selection, pump head calculation, selection of fan, ststic pressure calculation.	

Text Books:

S.N	Title	Authors	Edition	Publisher
1.	Principles of Heating, Ventilation And Air Conditioning With Worked Examples.	Nihal E Wijeysundera.	2016	World Scientific.
2.	Handbook Heating, Ventilating, And Air-Conditioning Applications.	ASHRAE	2015	ASHRAE, Atlanta, GA.

Reference Books:

S.N	Title	Authors	Edition	Publisher
	Principles of Heating, Ventilation, and Air Conditioning in Buildings	John W. Mitchell, James E. Braun	2013	John Wiley & Sons, Inc.

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
21ME702P(i)	Professional Elective - V : HVAC System Design Using BIM Software (Lab)	-	-	2	1	25	25	50

Course Objectives	Course Outcomes
3. To provide overview of the HVAC sector, components, Codes & standards in HVAC systems to the students. 4. To enhances the analytical and design skills of the students on heating, refrigeration, ventilation and air distribution system design.	• Perform hands-on design of HVAC system using Autocad. • Perform hands-on design of HVAC system using Autodesk Revit software. • Prepare estimate of HVAC system using Revit software.

LIST OF PRACTICALS

Minimum 5 practical to be performed

Experiment No.	Title of the Experiments
1	Hands-on on AutoCad interface
2	Drawing Civil layout, creating blocks, drawing line diagram of HVAC system, machine placing, duct routing
3	2-D drafting of complete HVAC system using AutoCad Software
4	Hands-on on Revit software interface
5	Creating Revit Civil layout, starting HVAC project,insert mechanical system, energy analysis using revit
6	Complete HVAC project on Revit
7	Estimation: Prepare estimation of HVAC equipment, material, prepare project quotations, bill of quantity using revit.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Autodesk Autocad user manual	Autodesk		Autodesk
2	Autodesk Revit 2022 MEP fubdamentals	-		SDC
3	Exploring Autodesk Revit 2022 for MEP	Prof. Sham Tickoo Purdue Univ. and CADCIM Technologies	8th	Autodesk

Reference Books

S.N	Title	Authors	Edition	Publisher

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
21ME702T(ii)	Professional Elective – V: Industrial Robotics	3	-	-	3	30	70	100

Course Objectives	Course Outcomes
This course is intended To explore the evolution and principles of robotics, classify robotic systems, analyze resolution and dexterity, select robots based on usage, examine grippers and sensors including types and design guidelines, discuss robot cell layout programming methods and languages, and consider socio-economic impacts, safety standards, and AI integration.	Student will be able to ● Interpret terminologies related to Robotics technology. ● Understand various grippers and sensors for robotics. ● Apply logic for selection of robotic systems, cell layout and its programing. ● Integrate knowledge of AI techniques in the area of robotic technology.

Unit I	**[7Hrs]**
Introduction to robotics : Brief History, Basic Concepts of Robotics such as Definition , Elements of Robotic Systems i.e. Robot anatomy, DOF, etc., Classification of Robotic systems such as work volume, typeS of drive, Associated parameters i.e., accuracy, repeatability. Introduction to Principles & Strategies of Automation, Types & Levels of Automations, Need of automation, Industrial applications of robot.	
Unit II	**[8 Hrs]**
Grippers and Sensors for Robotics: Grippers for Robotics - Types of Grippers and applications. Sensors for Robots - Types of Sensors used in Robotics, Classification and applications of sensors, Characteristics of sensing devices, Selections of sensors. Need for sensors and vision system in the working and control of a robot.	
Unit III	**[7 Hrs]**
Drives and Control for Robotics: Drive - Types of Drives, Types of transmission systems, Actuators and its selection while designing a robot system. Control Systems: Types of Controllers, Introduction to closed loop control.	
Unit IV	**[7 Hrs]**
Robot Cell layouts and Languages for Robotics: Robot Cell layouts, multiple robots and machine interface, other considerations in work cell design. Robot Programming: Methods of robot programming, Programming Languages: Generations of Robotic Languages, Introduction to various types such as VAL, RAIL, AML, ROS	
Unit V	**[7 Hrs]**
Economical trends & Future aspects in Robotics: Socio-Economic aspect of robotisation. Economical aspects for robot design, Safety for robot and standards, Introduction to Artificial Intelligence, AI techniques, Need and application of AI, New trends & recent updates in robotics.	

Text Books

S.N	Title	Authors	Edition	Publisher
1.	Industrial Robotics	Groover.M.P.	1996.	McGraw – Hill International edition
2.	Introduction to Robotics	S. K. Saha	2014	TATA McGraw Hills Education
3.	Robotics and Control	R. K. Mittal, I. J. Nagrath	2003	TATA McGraw Hill Publishing Co Ltd

Reference Books

S.N	Title	Authors	Edition	Publisher
1.	Robotics Technology and Flexible Automation	Deb S R	1994	Tata McGraw Hill, New Delhi,
2.	Fundamentals of Robotics	Dilip Kumar Pratihar,	2019	Narosa Publishing House

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
21ME702P(ii)	Professional Elective –II: Industrial Robotics Lab	-	-	2	1	25	25	50

Course Objectives	Course Outcomes
• Familiarize students with robotic systems and sensors. • Develop practical skills in robotics and automation. • Provide hands-on experience with industrial automation tasks. • Cultivate proficiency in programming and controlling robotic devices.	● Acquire proficiency in various robotic operations including pick and place, object detection, and palletizing. ● Develop skills in utilizing sensors such as photoelectric and color sensors for automation tasks. ● Design and implement conveyor belt systems for efficient material handling. ● Integrate multiple components to develop complex automation systems, showcasing skills in system integration and control.

LIST OF EXPERIMENTS

Minimum 8 practical to be performed

Exp. No.	Title of the Experiments
1	Performance based on pick and place using Dobot magician robot
2	Performance based on to detect objects in front of the photoelectric switch (Proximity Sensor).
3	Performance based on to categorize red, blue and green objects using color sensor.
4	Performance based on palletizing cubical box.
5	Performance based on mini conveyor belt for material handling.
6	Performance based on writing/drawing/laser engraving using dobot magician robot
7	Performance based on to integrate color sensor, converyour belt and robotic arm.
8	Performance based on milling operation using cartesian coordinate robot.

Text Books

S.N	Title	Authors	Edition	Publisher
1.	Industrial Robotics	Groover.M.P.	1996.	McGraw – Hill International edition
2.	Introduction to Robotics	S. K. Saha	2014	TATA McGraw Hills Education
3.	Robotics and Control	R. K. Mittal, I. J. Nagrath	2003	TATA McGraw Hill Publishing Co Ltd

Reference Books

S.N	Title	Authors	Edition	Publisher
1.	Robotics Technology and Flexible Automation	Deb S R	1994	Tata McGraw Hill, New Delhi,
2.	Fundamentals of Robotics	Dilip Kumar Pratihar,	2019	Narosa Publishing House

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
21ME702T(iii)	Professional Elective-V : Finite Element Methods	3	-	-	3	30	70	100

Course Objectives	Course Outcomes
• The objective of the course is to teach the fundamentals of finite element method with emphasize on the underlying theory, assumption, and modeling issues as well as providing hands-on experience using finite element software for modeling & analyzing stresses, strains, deformations, natural frequencies, modal shapes, etc. for machine/structural components.	• Identify the application of fundamentals of solid mechanics for evaluation of structural problems subjected to Point load, body force, and torsional loads. • Study the application and finite elements formulation for truss. • Formulate mathematical models for the solution of common engineering problems using beams, its finite element formulation and understand the load distribution. • Understand the application and need of using 2D finite element to formulate simple in plane loading problem. • Identify the significance and difference between the formulation and application of thermal engineering problems using 1D finite elements.

Unit I **[8Hrs]**

Introduction: Theoretical background, Brief History of FEM, General FEM procedure, Applications of FEM in various fields, Advantages and disadvantages of FEM. Finite element modeling: Concept of Node, Element, (types of Finite elements), Coordinate systems – global, local (natural) coordinate systems, Types of loads, Concept of Degrees of freedom, field and dependent variables.
Principle of Minimum Potential Energy (Rayleigh-Ritz Method), mathematical formulation and application in 1D finite element formulation. Shape functions – linear, properties of shape functions. Assembly of global stiffness matrix and load vector, Properties of stiffness matrix, Boundary conditions. FE Problems on 1D bar element and composite element. Finite element formulation of Point load, self-weight and torsion.

Unit II **[7Hrs]**

Truss: Introduction Plane truss, formulation of stiffness matrix for truss, problem on truss. Axisymmetric formulation for truss assembly.

Unit III **[7Hrs]**

Beam: Finite Element formulation of Beams – Introduction, element formulation, load vector for point load, UDL & UVL, boundary conditions, problems on beam.

Unit IV **[7Hrs]**

CST: 2D CST ELEMENT: Coordinate Mapping Global and local coordinates. Formulation of stiffness matrix, load vector. Plane stress problem formulation and numerical.

Unit V **[7Hrs]**

ThermalLoad Formulation: 1D Thermal Load problem using the coefficient of Thermal expansion, 1D Steady State Heat Conduction using Fourier's law, Finite Element formulation of 1D Steady-State Heat Transfer.

Text Books

S.N	Title	Authors	Edition	Publisher
1.	Introduction to Finite Elements in Engineering	Chandrupatla.T.R., Belegunda A. D.,	4th	Pearson Education India
2.	A First Course in the Finite Element Methods	Daryl Logan	5th	Cengage Learning India Private Limited

Reference Books

S.N	Title	Authors	Edition	Publisher
1.	Practical Finite Element Analysis	Nitin S.Gokhale		Finite To Infinite

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
21ME702P(iii)	Professional Elective-V Finite Element Methods Lab	-	-	2	1	25	25	50

Course Objectives	Course Outcomes
• The objective of the course is to teach the fundamentals of finite element method with emphasize on the underlying theory, assumption, and modeling issues as well as providing hands-on experience using finite element software for modeling & analyzing stresses, strains, deformations, natural frequencies, modal shapes, etc. for machine/structural components.	• Model finite element problems using commercial software and understand the fundamental use of finite element preprocessor, solver and post-processor. • Demonstrate the ability to evaluate and interpret Finite Element Analysis results for the design and evaluation of 1D finite element formulations. • Understand the Finite Element Modeling aspects of 2DFinite Element problem for solving in-plane loading problems.

Practical: All the practical have to be

1. Static structural analysis of Axially loaded bar with 1-D finite elements.
2. Static structural analysis of bar under the influence of self-weight.
3. Static structural analysis of bar under applied torque.
4. Static structural analysis of 1D truss.
5. Static structural analysis with 2-D Plate (CST)element..
6. Static structural analysis of a beam under transverse loading.
7. 1D Steady State Heat Transfer to estimate temperature distribution within composite wall.

Text Books

S.N	Title	Authors	Edition	Publisher
1.	Introduction to Finite Elements in Engineering	Chandrupatla.T.R.,Belegunda A. D.,	4th	Pearson Education India
2.	A First Course in the Finite Element Methods	Daryl Logan	5th	Cengage Learning India Private Limited

Reference Books

S.N	Title	Authors	Edition	Publisher
1.	Practical Finite Element Analysis	Nitin S.Gokhale		Finite To Infinite

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
21ME703T(i)	Professional Elective - VI : Heating Ventilation and Air Conditioning systems	3	-	-	3	30	70	100

Course Objectives	Course Outcomes
5. To provide overview of the HVAC sector, components, Codes & standards in HVAC systems to the students. 6. To enhances the analytical and design skills of the students on heating, refrigeration, ventilation and air distribution system design.	• Explain the most important concepts, components, Codes & standards related to HVAC systems. • Explain and apply steady heat and moisture transfer processes for estimating heat transfer in buildings • Analyze performance of air washers and cooling towers • Analyze and design air distribution systems for HVAC applications. • Analyze and design water distribution systems for HVAC applications.

Unit I	**[7Hrs]**
Introduction to HVAC systems and components: An Overview of HVAC Systems, Some Optional Designs of HVAC Systems, HVAC system using air as the energy transport medium, HVAC system using water as the energy transport medium, HVAC system using water and air as energy transport media, Packaged and unitary systems, Reversible heat pumps for heating and cooling, Overview of HVAC Design Procedure, Codes & standards for HVAC systems.	
Unit II	**[9Hrs]**
Steady Heat and Moisture Transfer Processes in Buildings:- Introduction, Steady Heat Transfer through Multi-Layered Structures, Parallel path method, Isothermal plane method, Zone method, Steady Heat Transfer through Fenestrations, Windows and doors, Below Grade Heat Transfer in Buildings, Heat transfer through basement walls, Heat transfer through basement floors, Heat transfer through surfaces at grade level, Infiltration in Buildings, Heating load due to infiltration, Infiltration air flow rates, Estimation of infiltration flow rates, Moisture Transport in Building Structures, Fick's law.	
Unit III	**[8Hrs]**
Direct-Contact Transfer Processes and Systems: Review of Mass Transfer Principles, Steady mass diffusion through a plane wall, Steady convection mass transfer, Simplified Model for Simultaneous Heat and Mass Transfer, Air Washers or Humidifiers, Analysis of air washers, Efficiency and number of transfer units (NTU), Cooling Towers, Analysis of cooling towers, Enthalpy potential based model for cooling towers, Approach and range of cooling towers.	
Unit IV	**[9Hrs]**
Air Distribution Systems:- Introduction, Total Pressure Distribution, Pressure Loss in Duct Networks, Pressure loss in straight ducts, Pressure loss in fittings, Total pressure loss in duct sections, Air Distribution Fans, Axial flow and centrifugal fans, Fan characteristics, Fan laws, Fan–Duct Network Interaction, Design Methods for Duct Systems, Equal friction method, Static regain method, Optimization of Duct Systems, Air Distribution in Zones, Air flow from diffusers, Air diffusion performance index, Design aspects of air distribution systems.	
Unit V	**[7Hrs]**
Water Distribution Systems:- Introduction, Energy Equation for Hydronic Systems, Head Losses in Hydronic Systems, Friction head loss in pipes, Dynamic head loss in fittings, Pump Characteristics, System–Pump Interaction and Flow Control, Design of Water Distribution Systems, Direct-return and reverse-return systems, Design of pipe networks.	

Text Books:

S.N	Title	Authors	Edition	Publisher
1.	Principles of Heating, Ventilation And Air Conditioning With Worked Examples.	Nihal E Wijeysundera.	2016	World Scientific.
2.	Handbook Heating, Ventilating, And Air-Conditioning Applications.	ASHRAE	2015	ASHRAE, Atlanta, GA.

Reference Books:

S.N	Title	Authors	Edition	Publisher
1.	Principles of Heating, Ventilation, and Air Conditioning in Buildings	John W. Mitchell, James E. Braun	2013	John Wiley & Sons, Inc.

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Chairman - BoS	Dean – Academics	Date of Release	Version	

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
21ME703T(ii)	PE-VI Smart Manufacturing and production system	3	-	-	3	30	70	100

Course Objectives	Course Outcomes
1: Impart knowledge of smart manufacturing for industry 4.0 for making student innovative.	1. Become Comfortable with terminology and practices in Smart Manufacturing 2. Able to face the challenges in Industry & also contribute towards advancement. 3.Become Active part of Industry 4.0 (Fourth Industrial Revolution) 4.Create smart production and co-created product development concepts in planning and controlling company's operations. 5. Design real time data analytics and software systems to support planning, scheduling and control of smart production processes and systems

Unit I	**[7Hrs]**
Industry 4.0 Concept, The Fourth Revolution, LEAN manufacturing, Smart and connected business perspectives, Smart factories.	
Unit II	**[7Hrs]**
Nine Pillars of Smart Manufacturing ,Big Data & analytics ,Autonomous Robots ,Simulation ,Universal System Integration ,IIOT – Industrial Internet of Things ,3 D Printing – Additive Manufacturing ,cloud Computing ,Augmented Reality.	
Unit III	**[7Hrs]**
Convergence of Nine Pillars ,Business Propositions delivered with Smart Manufacturing ,Adding Smartness to Manufacturing – Adoption & Scaling ,Economic Aspects ,Ecosystem Required for Smart Manufacturing ,Skill set Required for Smart Manufacturing ,Effects on 4 M- Man, Machine, Materials & Methods in Smart Manufacturing.	
Unit IV	**[7Hrs]**
Operation management strategy in industry 4.0 context,Impact of industry 4.0 on modern operation management in strategic level, Smart product and co-created design concept and tools, The design of smart production planning system and supply chain model	
Unit V	**[7Hrs]**
Intelligent ERP and integration of IoT, massive data analytics. Cognitive and process automation, Integrated planning system including aggregated planning, master production schedule (MPS), material requirement planning (MRP), and capacity planning (CRP) by utilizing real-time data, Advanced shop floor control	

Text Books

S. N	Title	Authors	Edition	Publisher
1.	Smart Manufacturing	Shoukat Ali	2016	LAP LAMBERT Academic Publishing
2.	Industry 4.0 Data Analytics31	Rajesh Agnihotri and Samuel	2016	CreateSpace Independent Publishing Platform
3.	Operations and Supply Chain Strategy in the Industry 4.0 Era	Guilherme Frederico	2018	Independently Published,

Reference Books

S. N	Title	Authors	Edition	Publisher
1.	Shaping the Future of the Fourth Industrial Revolution	Klaus Schwab and Nicholas Davis	2018	Crown Publishing Group
2.	Handbook of Industry 4.0 and SMART Systems,	Diego Galar Pascual, Pasquale Daponte and Uday Kumar	2018	CRC Press

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
21ME703T(iii)	Professional Elective VI- Tool Design	3	-	-	3	30	70	100

Course Objectives	Course Outcomes
Objectives of this course are : ● To make students aware about various types of tools. ● Make students well conversent with design of tools used in metal cutting process, press working operations. ● To make students well conversent with design of jigs and fixture. ● To provide awareness about forging operation die design.	• Design tool shank for single point cutting tool, boring tool and perform calculations for multipoint cutting tool. • Desing press working cutting operation dies and calculate cutting forces in press working operation. • Explain press working bending, drawing operations operation, evaluate various parameters and design drawing dies. • Explain and classify forging operation dies, apply various design factors for forging dies and understand design procedure for closed and open die forging. • Design jigs and fixture for given component using general principles of design, location, clamping etc.

Unit I	**[8Hrs]**
Design of single Point Cutting Tool: Design of tool shank for turning operation, Design of boring bar Form tools- Introduction, types of form tools. Multipoint cutting tools: Drills- Introduction, Types, Geometry, calculations of moment, thrust, power, MRR etc. Milling cutters - Introduction, Types, Geometry, calculations of MRR, power, cutting time, torque, number of teeth etc.	
Unit II	**[8Hrs]**
Press working (Cutting operation): Introduction, types of press tool cutting operations, tonnage of press, cutting force calculations, methods of reducing cutting forces, Types of cutting operation dies (construction and working), Design of blaking and piercing dies.	
Unit III	**[8Hrs]**
Press Working (Bending& Drawing operation): Introduction and types to bending operations, calculation of blank development, spring back effect, calculation of bending force. Press working (Drawing operation): Introduction, calculation of number of draws, drawing force, blank holdong force, design of drawing die.	
Unit IV	**[8Hrs]**
Forging operation: Introduction, types of forging operations, various allowances in forging die, classification of forging dies, forging die design factors, Preliminary forging operation - fullering, edging, bending, drawing, flattering, blacking finishing, cutoff. Die design procedure for machine forging in closed & open die forging, materials of forging dies.	
Unit V	**[8Hrs]**
Jigs and Fixture: Introduction, general principles for design of jigs and fixtures, principle of location, principle for clamping, clamping devices, types of jig bushes, design of drill jig. Design of Milling Fixtures and lathe fixtures.	

Text Books

S.N	Title	Authors	Edition	Publisher
1.	Production Engineering	P.C. Sharma		S.Chand Publication
2.	Tool Design	Donaldson		Tata McGraw Hill, New Delhi
3.	Jigs and Fixtures	P.H.Joshi		Tata McGraw Hill, New Delhi

Reference Books

S.N	Title	Authors	Edition	Publisher
1.	Fundamentals of the Tool Design	ASTME		Prentice-Hall of India Private Ltd., New Delhi
2.	Manual of Jigs and Fixtures Design	Henrickson		Industrial Press Inc., New York.

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
21ME761O	Open Elective – III -Renewable Energy Resources	3	-	-	3	30	70	100

Course Objectives	Course Outcomes
1. The non-conventional energy sources and their utilization to harness power. 2. The students will learn the solar energy utilization with its applications. 3. The students will also understand the various methods by which energy can be generated from wind, ocean tides, geothermal phenomenon, biogas and MHD. 4. Will appreciate the importance of renewable energy systems.	● Understanding and define basic characteristics, properties of renewable sources of energy and technologies for their utilization. ● Describe main elements of concentration type of collectors used for utilization of renewable sources of energy. Explain various applications of solar energy. ● Explain sources of energy such as biomass and biogas. Various sources of obtaining it, fuel properties and its utilization. ● Identify various methods by which energy can be generated such as wind, ocean, tides, its advantages and disadvantages. ● Explain types of geothermal energy, applications of geothermal energy, operational & environmental problems. Magneto Hydro Dynamic power generation.

Unit I	**[7Hrs]**
SolarEnergy:Introduction,solarconstant,spectraldistributionofsolarradiation, beam & diffuse radiation, solar radiation measuring instruments.Solar radiation geometry and solar angles. Solar flat plate collectors: Types of collectors, liquid flat plate collectors, solarair heaters, collector efficiency, analysis of flat plate collector,noveldesigns of collector.	
Unit II	**[7Hrs]**
Concentric collectors: line focusing, point focusing and non focusing type,central receiver concept of power generations, compound parabolic collector, and comparison of flat &concentric collectors. Applications of solar energy to water heating, space heating, space cooling,dryingrefrigeration, distillation,pumping.Solarfurnaces,solarcookers,solarthermalelectricconversion, solar photo-voltaics. Solar energy storage, solarpond.	
Unit III	**[7Hrs]**
Biogas: - Introduction, bio gas generation, fixed dome & floating drum biogasplants, their constructional details, raw material for biogas production, fuelproperties ofbiogasand utilizationof biogas. Biomass: Introduction,methodsof obtainingenergy from biomass, Incineration, thermal gasification, classification of gasifiers & constructionaldetails,applications ofgasifiers.	
Unit IV	**[7Hrs]**
WindandOceanenergy:Powerinwind,forcesonblades.Basicprinciple of wind energy conversion, site selection consideration, wind data and energy estimation.BasiccomponentsofWECS,classificationofWECsystems. Ocean energy: Introduction, ocean thermal electric conversion, openand closed cycle of OTEC, energy from tides, basic principles of tidal power &components of tidal power plants.	
Unit V	**[7Hrs]**
Geothermal energy: Introduction,classificationofgeothermalsystems,vapourdominated&liquiddominatedsystem,petro-thermalsystems,and magmaresources,applicationsofgeothermaloperational&environmental problems. Magneto Hydro Dynamic power generation: Introduction, principles ofMHD powergeneration,MHDopenandclosedsystems,poweroutputfromMHDgenerators.	

Text Books

S.N	Title	Authors	Edition	Publisher
1.	Renewable Energy Recourses: Basic Principle and Applications	G.N.Tiwari, M.K.Ghosal		Narosa publication
2.	Non- Conventional Energy Resources	B.H.Khan		Tata McGraw Hill

Reference Books

S.N	Title	Authors	Edition	Publisher
1.	Non-Conventional Energy Sources	G.D.Rai		Khanna publishers
2.	Renewable Energy Sources and Emerging Tech.	D. P. Kothari		Prentice Hall India

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