PAAVAI ENGINEERING COLLEGE

(AUTONOMOUS)

B.E. MECHATRONICS

REGULATIONS – 2016

CHOICE BASED CREDIT SYSTEM

CURRICULUM

SEMESTER VII

S. No	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PC	MT16701	Computer Integrated Manufacturing	3	0	0	3
2	PC	MT16702	Robotics and Machine Vision System	3	0	0	3
3	PC	MT16703	Automobile Engineering	3	0	0	3
4	PE	*******	Programme Elective - II*	3	0	0	3
5	PE	*******	Programme Elective - III*	3	0	0	3
6	OE	MT169**	Open Elective - II*	3	0	0	3
Practical							
7	PC	MT16704	CAD/CAM Laboratory	0	0	2	1
8	PC	MT16705	Robotics Laboratory	0	0	2	1
9	EE	MT16706	Project Work Phase I	0	0	4	2
			Total	**18**	**0**	**8**	**22**

SEMESTER VIII

S. No	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PC	MT16801	Autotronics	3	0	0	3
2	PE	*******	Programme Elective - IV*	3	0	0	3
3	PE	MT1655*	Programme Elective - V*	3	0	0	3
Practical							
4	EE	MT16802	Project Work Phase II	0	0	12	6
			Total	**9**	**0**	**12**	**15**

PROGRAMME ELECTIVE COURSES (PE)

PROGRAMME ELECTIVE - II

S. No	Category	Course Code	Course Title	L	T	P	C
1	PE	MT16251	Engineering Economics and Cost Analysis	3	0	0	3
2	PE	MT16252	Additive Manufacturing	3	0	0	3
3	PE	MT16253	Embedded System Design	3	0	0	3
4	PE	MT16254	Design of Jigs, Fixtures and Press Tools	3	0	0	3
5	PE	IT16255	Computer Networks	3	0	0	3

PROGRAMME ELECTIVE - III

S. No	Category	Course Code	Course Title	L	T	P	C
1	PE	MT16351	Mechatronics Systems Design	3	0	0	3
2	PE	MT16352	Finite Element Analysis	3	0	0	3
3	PE	MT16353	Non-Traditional Machining Processes	3	0	0	3
4	PE	MT16354	Industrial Electronics and Applications	3	0	0	3
5	PE	BA16254	Principles of Management	3	0	0	3

PROGRAMME ELECTIVE - IV

S. No	Category	Course Code	Course Title	L	T	P	C
1	PE	MT16451	Computational Fluid Dynamics	3	0	0	3
2	PE	MT16452	Advanced Sensor Technology	3	0	0	3
3	PE	MT16453	Renewable Energy Sources	3	0	0	3
4	PE	BA16253	Total Quality Management	3	0	0	3
5	PE	IT16456	Database Management Systems	3	0	0	3

PROGRAMME ELECTIVE - V

S. No	Category	Course Code	Course Title	L	T	P	C
1	PE	MT16551	Intellectual Property Rights	3	0	0	3
2	PE	MT16552	Artificial Intelligence	3	0	0	3
3	PE	MT16553	Concepts of Engineering Design	3	0	0	3
4	PE	MT16554	Internal Combustion Engines	3	0	0	3
5	PE	MT16555	Flexible Manufacturing Systems	3	0	0	3

OPEN ELECTIVES (OE)

OPEN ELECTIVE-II

S. No	Category	Course Code	Course Title	L	T	P	C
1	OE	MT16906	Vetronics	3	0	0	3
2	OE	MT16907	Industrial Automation	3	0	0	3
3	OE	MT16908	Advanced Manufacturing Management	3	0	0	3
4	OE	MT16909	Intelligent Manufacturing Technology	3	0	0	3
5	OE	MT16910	Nano Technology	3	0	0	3

SEMESTER VII

MT16701 COMPUTER INTEGRATED MANUFACTURING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the concept of automation and rapid prototyping processes.
- classify the different types of material handling & storage system with principles and applications.
- know the importance of group technology and cellular manufacturing.
- summarize the fundamentals of flexible manufacturing systems.
- make use of computers to prepare the product and process plan.

UNIT I INTRODUCTION 9

Brief introduction to CAD and CAM - Manufacturing Planning, Manufacturing control; CIM Definition - CIM wheel - CIM components - Evolution of CIM - needs of CIM - Benefits of CIM; Automation in Production Systems - Automation Principles and Strategies - Basic Elements of an Automated system - Advanced Automation Functions - Levels of Automation.

UNIT II MATERIAL HANDLING SYSTEMS 9

Introduction - material handling systems - principles and design - material transport system - transfer mechanisms automated feed cut of components - performance analysis; types of handling systems - Automated Guided Vehicles and its various guiding technologies.

UNIT III AUTOMATED MANUFACTURING SYSTEMS 9

Group technology (GT) - classification - components - an overview; Part families - parts classification and coding - product flow analysis - cellular manufacturing - composite part concept - machine cell design and layout; Flexible Manufacturing Systems - introduction - components - planning and implementation - application.

UNIT IV MONITORING AND QUALITY CONTROL 9

Types of production monitoring system, process control and strategies, direct digital control - Supervisory computer control - computer aided quality control - QC and CIM - inspection and testing - objectives of CAQC - role of computer in QC - post process metrology - computer aided inspection using robots - integration of CAD/CAM with inspection system - Flexible Inspection System (FIS).

UNIT V MANUFACTURING SUPPORT SYSTEMS 9

Process planning and Concurrent Engineering - Computer Aided Process Planning (CAPP) - design for manufacturing - advanced manufacturing planning - production planning and control system - master production schedule - capacity planning; Shop floor control - inventory control - MRP - MRP-II – ERP - J.I.T production systems; Agile manufacturing.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- select a suitable production system.
- associate the production system with manufacturing operations.
- infer the concepts of group technology.
- apply the basic concepts of machine tools and computer control systems.
- understand automated production planning and control.

TEXT BOOKS

1. M.P. Groover, Automation, "Production Systems and Computer Integrated manufacturing", 4th Edition, Pearson Education, 2016.
2. Radhakrishnan P, Subramanyan S, And Raju V., "CAD/CAM/CIM", 4th Edition New Age International (P) Ltd., New Delhi, 2018.

REFERENCES

1. Yoremkoren, "Computer Integrated Manufacturing System", McGraw-Hill,2007.
2. Pham D.T & Dimov.S.S, "Rapid manufacturing", Springer-Verlag, London,2011.
3. Chua C.K, K F Leong, C S Lim, "Rapid Prototyping: Principles and Applications"World Scientific Pub Co Inc; 3rd edition, 2010.
4. Zeid I., "CAD/CAM: Theory & Practice", McGraw Hill India, 2nd edition, 2006.

Mapping of Course Outcomes with Programme Outcomes:
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programme Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	1		-	-	-	1	-	-	1	2	3	3
CO2	1	-	3		1	-	-	3	-	-	1	3	-	1
CO3	2	-	-		-	-	-	2	-	-	1	-	3	2
CO4	-	-	2		3	-	-	1	-	-	3	2	-	3
CO5	1	-	-		1	-	-	-	-	-	-	1	2	-

MT16702 ROBOTICS AND MACHINE VISION SYSTEM 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- learn the fundamentals of robotics and components of robots.
- impart knowledge on end effectors and its design.
- familiarize with the robot kinematic equations.
- impart knowledge on machine vision and its fundamentals.
- learn about basics of robot programming and applications in robots.

UNIT I INTRODUCTION AND ROBOT COMPONENTS 9

Introduction; Basic components of robot; Laws of robotics; Classifications of robot; Specifications of robot; Power transmission system - rotary to rotary motion - rotary to linear motion; Harmonics drives.

UNIT II ROBOT END EFFECTORS 9

Introduction; Types of End effectors - Mechanical gripper; Types of gripper mechanism; Gripper force analysis; Other types of gripper; Special purpose grippers.

UNIT III KINEMATICS OF ROBOT 9

Introduction; Matrix representation; Homogeneous transformation matrices; Representation of transformations; Inverse of transformation matrices; Forward and inverse kinematics of robots.

UNIT IV MACHINE VISION SYSTEM 9

Machine vision; Image acquisition - digital images - sampling and quantization; Levels of computation feature extraction - windowing techniques - segmentation - thresholding - edge detection; Binary morphology and grey morphology.

UNIT V ROBOT PROGRAMMING AND APPLICATIONS 9

Robot programming; Generations of languages - classification of robot language; VAL system and languages; Robot software; Applications of robots.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- understand the different types of robots and its various components.
- develop the basic design selection of robot grippers.
- solve the homogeneous transformation matrix for different types of robots.
- summarize the image processing techniques.
- apply the basic engineering knowledge for the design of robots.

TEXT BOOKS

1. M.P.Groover, M.Weiss, R.N. Nagal, N.G.Odrey, Ashish Dutta, "Industrial Robotics Technology, Programming and Applications" Tata , McGraw-Hill Education Pvt Limited, 2nd edition, 2012.
2. S. R. Deb, Sankha Deb, "Robotics Technology and flexible Automation" 2nd edition, Tata McGraw - Hill Publication, 2009.

REFERENCES

1. Saeed B. Niku, "Introduction to Robotics: Analysis, Systems, Applications", 2nd edition, Pearson Education India, 2013.
2. K.S.Fu, R.C.Gonzalez, C.S.G.Lee, "Robotics: Control, Sensing, Vision and Intelligence", Tata McGraw-Hill Publication, 1st edition, 2008.
3. John.J.Craig, "Introduction to Robotics: Mechanics & control", Second edition, 2002.
4. S K Saha, "Introduction to Robotics", Tata McGraw-Hill Publication, 2nd edition, 2014.

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes (POs)**													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	2	-	3	2	1	-	-	3
CO2	2	1	2	-	-	-	2	-	3	2	3	-	-	1
CO3	1	3	2	-	-	-	-	-	3	-	2	-	-	2
CO4	3	2	2	-	-	-	2	-	-	3	2	-	-	2
CO5	1	2	2	-	-	-	2	-	3	-	2	-	-	2

MT16703 AUTOMOBILE ENGINEERING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the construction and working principle of various parts of an automobile.
- study the different types of ignition systems, injection systems used in automobiles.
- impart knowledge of assembling and dismantling of engine parts and transmission system.
- learn the principles of operation and constructional details of the steering system.
- enhance the knowledge in the field of alternative fuel sources.

UNIT I VEHICLE STRUCTURE AND ENGINES 9

Types of automobiles - vehicle construction and different layouts - chassis - frame and body; Vehicle aerodynamics (various resistances and moments involved); IC engines - components - functions and materials - Variable Valve Timing (VVT).

UNIT II ENGINE AUXILIARY SYSTEMS 9

Electronically controlled gasoline injection system for SI engines - Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system); Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system); Turbochargers (WGT, VGT); Engine emission control by three - way catalytic converter system - emission norms (Euro and BS).

UNIT III TRANSMISSION SYSTEMS 9

Clutch - types and construction; Gearboxes- manual and automatic - gear shift mechanisms; Overdrive; Transfer box; Fluid flywheel; Torque converter; Propeller shaft; Slip joints; Universal joints; Differential and rear axle - Hotchkiss drive and torque tube drive.

UNIT IV STEERING, BRAKES AND SUSPENSION SYSTEMS 9

Steering geometry and types of steering gear box - power steering; Types of front axle; Types of suspension Systems; Pneumatic and Hydraulic Braking Systems - Antilock Braking System (ABS) - Electronic Brake Force distribution (EBD) and Traction Control.

UNIT V ALTERNATIVE ENERGY SOURCES 9

Use of natural gas - Liquefied Petroleum Gas - Bio-diesel - Bio-ethanol - Gasohol and Hydrogen in automobiles; Engine modifications required - performance - combustion and emission characteristics of SI engines and CI engines using alternate fuels; Electric and Hybrid Vehicles; Fuel Cell.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- learn about the principles of operation and constructional details of various automobile components and subsystems.
- demonstrate the starting systems, ignition systems and an engine control systems.
- understand the various components in the transmission system.
- classify various steering systems, brake systems and an engine control systems.
- acquire knowledge in the field of alternative fuel sources.

TEXT BOOKS

1. Kirpal Singh, "Automobile Engineering", Vol 1 and 2, Seventh Edition, Standard Publishes, New Delhi, 13th Edition, 2014.
2. R.K. Rajput, "A Textbook of Automobile Engineering" Laxmi Publications, 1st edition, 2015.

REFERENCES

1. F. K. Sully, "Motor Vehicle Mechanic's Textbook", Butterworth-Heinemann, 5th edition, 2014.
2. William Crouse and Donald Anglin, "Automotive Mechanics," 10th Edition, McGraw Hill Education, 2017.
3. Martin W Stockel, Martin T Stockle and Chris Johanson, "Auto Fundamentals," Goodheart-Wilcox Publisher, 12th Edition, 2018.
4. Heinz Heisler, " Advanced Vehicle Technology," 2nd Edition, SAE International Publications USA, 2018.
5. Ganesan V. "Internal Combustion Engines", 4th Edition, Tata McGraw-Hill, 2017.

Mapping of Course Outcomes with Programme Outcomes:
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programme Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	2	2	3	-	2	-	-	-	1	-
CO2	-	-	-	-	2	1	-	3	3	2	-	-	2	1
CO3	2	2	-	-	-	2	3	2	-	-	-	-	-	2
CO4	2	3	-	-	2	-	2	-	1	-	-	-	1	1
CO5	2	2	-	-	2	3	1	1	2	2	-	-	-	-

MT16704 **CAD/CAM LABORATORY** **0 0 2 1**

COURSE OBJECTIVES

To enable the students to

- provide an overview of how computers are being used in design.
- know the usage of G codes and M codes.
- do manual part programming.
- gain practical experience in computer assisted part programming.

LIST OF EXPERIMENTS

1. Modeling of a given part using design software.
2. Modeling the component of flange coupling using design software.
3. Assembly the component of screw jack using design software.
4. Assembly the component of universal coupling using design software.
5. Study the specification of CNC machines.
6. Study the functions of G codes, M codes and procedures for manual part programming.
7. Milling - manual part programs and simulation verification - linear and circular interpolation and contour motions.
8. Lathe - manual part programs and simulation verification - peck drilling, chamfering, grooving, canned cycle turning, and canned cycle facing, taper turning, thread turning cycle, turning linear and circular interpolation.

TOTAL PERIODS 30

COURSE OUTCOMES

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

- assemble the various modelled components.
- familiar about the functions of G and M codes.
- generate code for lathe and milling operations.
- verify the programming through simulation.

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes (POs)**													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	2	-	-	-	3	2	-	-	3	-	2
CO2	3	-	-	2	-	-	-	3	-	-	-	3	-	1
CO3	3	-	-	-	2	-	-	3	1	-	-	3	-	-
CO4	3	-	-	2	2	-	-	3	-	-	-	3	-	-

MT16705 **ROBOTICS LABORATORY** **0 0 2 1**

COURSE OBJECTIVES

To enable the students to

- understand the different types of robots and its applications.
- learn the different types of links, drives, joints and end effectors used in robots.
- verify transformation with respect to gripper.
- program point to point and continuous path robots.

LIST OF EXPERIMENTS

1. Study of robots configuration and application.
2. Study of different types of robots links and joints.
3. Study of components of robots with drive system and end effectors.
4. Verification of transformation (position and orientation) with respect to gripper and world coordinate system.
5. Determination of maximum and minimum position of links.
6. Robot programming for point to point path and continuous path.
7. Estimation of accuracy, repeatability and resolution of robot performance.
8. Programming a pick and place robot using point to point for palletizing.
9. Programming a pick and place robot using continuous path for palletizing.
10. Programming the robot for a drilling application.

TOTAL PERIODS 30

COURSE OUTCOMES

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

- control mobile robots using different sensors and actuators.
- manipulate an industrial robot using a machine vision system and HMI's.
- handle a robot model using the robotics simulation software.
- analyze and present the findings of experimental observations in both written and oral format.

Mapping of Course Outcomes with Programme Outcomes:
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programme Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	3	-	-	-		3	2	-	-	3	-	2
CO2	3	-	2	-	-	-		3	-	-	-	3	-	1
CO3	3	-	2	-	2	-		3	1	-	-	3	-	-
CO4	3	-	2	-	2	-		3	-	-	-	3	-	-

MT16706 **PROJECT WORK PHASE I** **0 0 4 2**

COURSE OBJECTIVES

To enable the students to

- design, analyze, realize / simulate a physical system by using the technology they learnt during the program.
- integrate various systems into one mechatronics product.
- work in a team with confined time duration.
- disseminate his work both in oral and written format.

GUIDELINE FOR REVIEW AND EVALUATION

- Students in the form of group, not exceeding 3 members in a group to carry out their main project.
- It should be a mechatronics project. However, special considerations can be given for interdisciplinary measurement and computer-based simulation projects. This exception should be recorded and approved by the department committee.
- Management related projects will not be allowed.
- The interdisciplinary projects will carry more weightage.
- It is mandatory to publish their main project in national/international level conferences to appear in the viva-voce exam.

TOTAL PERIODS 60

COURSE OUTCOMES

upon the completion of the course, the students will be able to

- identify feasible problems to solve through project works.
- collect literature through research journals and identify the gap in selected area.
- devise the methodology to find solution through gathering complete knowledge on materials/design procedure/analysis and optimization techniques/ availability of experimental setup/ company permission and other documentation procedures to execute the project.
- prepare project report as per format and confidently face viva voce with proper PPT for presentation.

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes (POs)**													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	2	-	-	-	-	-	3	3	-	-	2	2
CO2	3	-	2	-	-	-	-	-	3	3	-	-	2	2
CO3	3	-	2	-	-	-	-	-	3	3	-	-	2	2
CO4	3	-	2	-	-	-	-	-	3	3	-	-	2	2

SEMESTER VIII

MT16801 **AUTOTRONICS** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- learn basics of electronics, emission standards in automobiles.
- identify the fundamentals of ignition and injection system.
- select and use various sensors and actuators in automobiles.
- understand the different control modes of engine management, networking in vehicles.
- know the comfort and safety systems in automobiles.

UNIT I INTRODUCTION **9**

Evolution of electronics in automobiles; Emission laws - introduction to Euro I, Euro II, Euro III, Euro IV, Euro V standards; Equivalent Bharat Standards. Charging systems - charging circuit diagram; Alternators; Starting system - starter motors and starter circuits.

UNIT II IGNITION AND INJECTION SYSTEM **9**

Ignition systems - Ignition fundamentals - Electronic and Programmed Ignition - Distribution less ignition - Direct ignition - Spark plugs; Electronic fuel control - basics of combustion - Engine fueling and exhaust emissions; Electronic control of carburetion; Petrol fuel injection; Diesel fuel injection.

UNIT III SENSORS AND ACTUATORS **9**

Working principle and characteristics of airflow rate; Engine crankshaft angular position - Hall effect; Automobile sensors - throttle angle, temperature and exhaust gas oxygen sensors; Study of the fuel injector; Actuators - exhaust gas recirculation actuators - stepper motor actuator - vacuum operated actuator.

UNIT IV ENGINE CONTROL SYSTEM **9**

Control modes for fuel control - Engine control subsystems; Ignition control methodologies; Engine management system - different ECU's used in the engine management; In-vehicle networks - CAN standard - CAN standard format; Diagnostics systems in modern automobiles.

UNIT V CHASSIS AND SAFETY SYSTEM **9**

Traction control system; Cruise control system; Electronic control of automatic transmission; Electronic suspension system; Power Train Control; Safety System Control - Antilock braking system - Airbag system -Seat Belt Tensioners; Steering System Control.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of the course, students should be able to

- describe the importance of emission standards in automobiles.
- discuss the electronic fuel injection/ignition components and their function.
- choose equipment for measuring mechanical quantities, temperature and appropriate actuators.
- diagnose electronic engine control systems problems with appropriate diagnostic tools.
- illustrate the chassis and vehicle safety system.

TEXT BOOKS

1. Tom Denton, "Automobile Electrical and Electronics Systems", 5 edition, Routledge, 2017.
2. Barry Hollembeak, "Automotive Electricity and Electronics", 6th edition, Delmar Publishers, 2014.

REFERENCES

1. James D. Halderman "Automotive Fuel and Emissions Control Systems", Pearson, 4th edition, 2015.
2. A. K. Babu, "Automotive Electrical and Electronics", 1st edition, Khanna Publishing, 2018.
3. William Ribbens, " Understanding Automotive Electronics: An Engineering Perspective ", 8th Edition, Butterworth-Heinemann, 2017.

Mapping of Course Outcomes with Programme Outcomes:
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programme Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	3	-	2	-	-		3	-	-	-	3
CO2	1	-	3	2	-	1	-	3		1	-	3	-	-
CO3	2	-	2	-	-	2	-	2		-	-	2	-	2
CO4	2	-	2	-	-	-	-	-		-	-	-	-	1
CO5	-	-	2	2	-	3	-	1		1	-	1	-	2

MT16802 PROJECT WORK PHASE II 0 0 12 6

COURSE OBJECTIVES

To enable the students to

- design, analyze, realize / simulate a physical system by using the technology they learnt during the program.
- integrate various systems into one mechatronics product.
- work in a team with confined time duration.
- disseminate his work both in oral and written format.

GUIDELINE FOR REVIEW AND EVALUATION

- Students in the form of group, not exceeding 3 members in a group to carry out their main project.
- It should be a mechatronics project. However, special considerations can be given for interdisciplinary measurement and computer-based simulation projects. This exception should be recorded and approved by the department committee.
- Management related projects will not be allowed.
- The interdisciplinary projects will carry more weightage.
- It is mandatory to publish their main project in national/international level conferences to appear in the viva-voce exam.

TOTAL PERIODS 180

COURSE OUTCOMES

upon the completion of the course, the students will be able to

- identify feasible problems to solve through project works.
- collect literature through research journals and identify the gap in selected area.
- devise the methodology to find solution through gathering complete knowledge on materials/design procedure/analysis and optimization techniques/ availability of experimental setup/ company permission and other documentation procedures to execute the project.
- prepare project report as per format and confidently face viva voce with proper PPT for presentation.

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes (POs)**													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	2	-	-	-	-	-	3	3	3	2	2	2
CO2	3	-	2	-	-	-	-	-	3	3	3	2	2	2
CO3	3	-	2	-	-	-	-	-	3	3	3	2	2	2
CO4	3	-	2	-	-	-	-	-	3	3	3	2	2	2

PROGRAMME ELECTIVE - II

MT16251 ENGINEERING ECONOMICS AND COST ANALYSIS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- learn the fundamentals of demand and supply.
- understand and apply methods of cost analysis.
- know the types of banking and its functions.
- compute the depreciation methods.
- the method adopted for capital budgeting.

UNIT I DEMAND AND SUPPLY ANALYSIS 9

Definition and scope of study - importance of economic analysis - demand and supply analysis - demand determinants - Law of demand - elasticity of demand - Law of supply - elasticity of supply - demand forecasting Methods.

UNIT II COST ANALYSIS 9

Types of cost - Fixed cost- variable cost - marginal cost - pricing decisions - pricing techniques in practice - full cost - pricing - marginal cost pricing - going rate pricing - bid pricing - price fixing for a rate of return.

UNIT III MONEY AND BANKING 9

Value of money - inflation, deflation; Banking - commercial bank and its functions - central bank and its functions; New economic environment - globalization - liberalization and privatization.

UNIT IV DEPRECIATION AND COST ANALYSIS 9

Causes of depreciation - objectives - methods of computing depreciation - simple problems; Breakeven analysis - breakeven point - breakeven chart - uses of breakeven analysis; Balance sheet.

UNIT V CAPITAL BUDGETING 9

Need for capital budgeting - rate of return method - payback period method - present value comparisons method - cost benefit analysis; Preparation of feasibility report - economic and commercial feasibility - financial feasibility - technical feasibility.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- acquire knowledge to the major concepts and techniques of engineering economic analysis.
- carryout the supply of material and demand of products in their management profession.
- gain adequate knowledge on banking system.
- perform demand forecasting, cost analysis, pricing and financial accounting for an engineering

industry.

- carryout cost analysis for capital subjecting based on depreciation money available.

TEXT BOOKS

1. Panneerselvam R, "Engineering Economics", Prentice Hall India Learning Private Limited; 2nd Revised edition, 2013.
2. Anjali Bagad, “Engineering Economics and Financial Accounting”, Technical Publications, 2012.

REFERENCES

1. Donald.G. Newman, Jerome.P.Lavelle, “Engineering Economics and Analysis” Engg. Press, Texas, 2010.
2. Patel Bhavesh. M, "Project Management: Financial Evaluation with Strategic Planning, Networking and Control ", 2nd edition, Vikas Publishing House, New Delhi, 2010.
3. Michael Baye and Jeff Prince, " Managerial Economics and Business Strategy ", Tata McGraw Hill, 2013.
4. Paul Samuelson and William Nordhaus, "Economics", Tata McGraw Hill, 19th edition, 2010.

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2
CO1	2	3	1	3	2	2	3	-	2	-	3	2	1	-
CO2	-	3	2	1	2	-	-	3	2	-	2	2	-	1
CO3	3	3	2	-	1	2	2	1	-	3	2	1	-	2
CO4	3	2	1	-	2	2	1	-	3	2	1	-	2	3
CO5	2	1	-	-	-	3	2	1	3	2	1	-	-	-

MT16252 ADDITIVE MANUFACTURING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the need, history, growth and classification of RP system.
- convert CAD models in to real life engineering components.
- know the principle, process parameters, applications of SLA, SLS and EBM.
- learn the principle, process parameters, applications of FDM and LOM.
- illustrate the principle, process parameters, applications of 3D printing and LENS.

UNIT I INTRODUCTION 9

Overview - Need - Development of Additive Manufacturing Technology - Principle - AM Process Chain - Classification - Rapid Prototyping - Rapid Tooling - Rapid Manufacturing - Applications - Benefits - Case studies.

UNIT II DESIGN FOR ADDITIVE MANUFACTURING 9

Design tools: Data processing - CAD model preparation - Part orientation and support structure generation - Model slicing - Tool path generation - Design for Additive Manufacturing: Concepts and objectives - AM unique capabilities - DFAM for part quality improvement - Customised design and fabrication for medical applications.

UNIT III PHOTO POLYMERIZATION AND POWDER BED FUSION PROCESSES 9

Photo polymerization: SLA - Photo curable materials - Process - Advantages and Applications. Powder Bed Fusion: SLS - Process description - powder fusion mechanism - Process Parameters - Typical Materials and Application. Electron Beam Melting.

UNIT IV EXTRUSION BASED AND SHEET LAMINATION PROCESSES 9

Extrusion Based System: FDM-Introduction - Basic Principle - Materials - Applications and Limitations - Bio extrusion. Sheet Lamination Process: LOM - Gluing or Adhesive bonding - Thermal bonding.

UNIT V PRINTING PROCESSES AND BEAM DEPOSITION PROCESSES 9

Droplet formation technologies - Continuous mode - Drop on Demand mode - Three Dimensional Printing - Advantages - Bioplotter - Beam Deposition Process: LENS - Process description - Material delivery - Process parameters - Materials - Benefits - Applications.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- apply RP tools using additive manufacturing techniques.
- design a prototype the models of real world engineering parts.
- access the principle and effect of process parameters in RP process.

- learn about a working principle and construction of FDM and LOM process.
- develop the various printer models using RP process.

TEXT BOOKS

1. Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", 3rd edition, World Scientific Publishers, 2010.
2. Ian Gibson, David W.Rosen, Brent Stucker "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing" Springer, 2nd edition , 2015.

REFERENCES

1. Andreas Gebhardt "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing" Hanser Gardner Publication,1 st edition, 2012.
2. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.
3. Fuewen Frank Liou, "Rapid Prototyping and Engineering applications :A tool box for prototype development", CRC Press, 2nd edition, 2019.
4. Tom Page "Design for Additive Manufacturing" LAP Lambert Academic Publishing, 2012.

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2
CO1	2	-	3	3	-	-	2	-	2	-	-	-	1	-
CO2	2	-	2	1	-	-	-	-	2	2	-	-	1	1
CO3	1	-	-	-	-	-	2		-	-	-	-	-	2
CO4	-	-	1	2	-	-	1		3	-	-	-	2	1
CO5	1	-	3	-	-	-	2		3	2	-	-	-	-

MT16253 EMBEDDED SYSTEM DESIGN 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- provide the overview of embedded system design principles.
- understand the need and importance of networking in an embedded system.
- study the concepts of real time operating systems.
- define hardware and software communication and control requirements.
- get an idea of the latest trends in the embedded systems field.

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 9

Embedded systems - Processor embedded into a system - Embedded hardware units and devices in a system - Embedded software in a system - Examples of embedded systems - Complex systems design and processors - Design process in embedded system - Formalization of system design - Classification of embedded systems.

UNIT II DEVICES AND COMMUNICATION BUSES FOR DEVICES NETWORK 9

IO Types and Examples - Serial communication devices - Parallel device ports - Wireless devices - Timer and counting devices - Watchdog timer - Real time clock - Network embedded systems - Serial bus communication bus protocols - Parallel bus device protocols - Internet enabled systems - Wireless and mobile system protocols.

UNIT III REAL TIME OPERATING SYSTEM 9

Basic design using an RTOS - Tasks and Task states - Tasks and Data - Semaphore functions and shared data - Message queues functions - mailbox functions - pipe functions - Encapsulating using the semaphores and queues - interrupt routines in an RTOS environment - Introduction to RTOS Vx Works, RT Linux.

UNIT IV EMBEDDED SOFTWARE DEVELOPMENT PROCESS AND TOOLS 9

Introduction - Host and target machines - Linking and locating software - Getting embedded software into the target systems - Issues in hardware and software design and Co-design.

UNIT V PIC MICROCONTROLLER 9

Microcontrollers and embedded processors - Overview of the PIC18 family - PIC file register - Using instructions with the default access bank - Addressing modes - Standard and enhanced CCP modules - Compare mode programming - ADC characteristics - ADC programming in the PIC18.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- explain the need of embedded systems and their development procedures.
- understand interfacing of IO devices and other peripherals.
- summaries the concepts involved in real time operating systems.
- use various tools for developing embedded applications.
- explain the construction, addressing modes and instructions sets of PIC micro controller.

TEXT BOOKS

1. Rajkamal, 'Embedded System - Architecture, Programming, Design', Tata McGraw Hill, 3rd edition, 2017.
2. Muhammad Ali Mazidi, Danny Causey, Rolin McKinlay, "PIC Microcontroller and Embedded Systems: Using Assembly and C for PIC18", Microdigitaled; 2nd edition, 2016.

REFERENCES

1. Muhammad Ali Mazidi, Janice G. Mazidi, Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems", Pearson, 2nd edition, 2018.
2. Muhammad Ali Mazidi, Janice G. Mazidi, Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Pearson Education India, 2nd edition, 2008.
3. Chattopadhyan, 'Embedded System Design', Prentice Hall India Learning Private Limited, 2nd edition, 2013.

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
	Programme Outcomes (POs)												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2
CO1	1	-	2	2	-	-	2	-	2	-	-	-	1	-
CO2	1	-	-	1	-	-	-	-	2	2	-	-	1	1
CO3	1	-	-	-	-	-	2		-	-	-	-	-	1
CO4	-	-	2	2	-	-	1		3	-	-	-	1	1
CO5	1	-	2	-	-	-	2		3	2	-	-	-	-

MT16254 DESIGN OF JIGS, FIXTURES AND PRESS TOOLS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the principles, functions and design practices of jigs, fixtures and dies.
- acquire the knowledge about locating and clamping devices.
- calculate press tonnage requirements.
- gain knowledge on progressive, compound and combination dies.
- select and sketch a suitable jig/fixture/die for a given work piece.

UNIT I PURPOSE TYPES AND FUNCTIONS OF JIGS AND FIXTURES 9

Objectives of tool design - introduction to jigs and fixtures - principle in design of jigs and fixtures; Materials used in jigs and fixtures; Location and clamping - types; Analysis of clamping; Tolerance and error analysis.

UNIT II JIGS 9

Types of jigs - Template jig - plate jig - latch jigs - channel jigs - box jigs - post jigs - angle plate jigs - angular post jigs - turnover jigs - pot jigs - indexing jigs - Automatic drill jigs; Rack and pinion operated; Air operated jigs components; Design and sketching of Jigs for given work piece.

UNIT III FIXTURES 9

General principles of boring - lathe - milling and broaching fixtures; Grinding - planning and shaping fixtures - assembly - inspection and welding fixtures; Modular fixtures; Design and sketching of fixtures for given component.

UNIT IV PRESS WORKING TERMINOLOGIES AND ELEMENTS OF DIES AND STRIP LAYOUT 9

Press working terminology; Presses and press accessories; Computation of press capacities; Elements of progressive compound and combination dies; Economic strip layout; Punch-die clearance; Die block - die shoe; Bolster plate - punch plate - holder - guide pins and bushes – strippers – knockouts – stops – pilots; Selection of standard die sets.

UNIT V DESIGN OF DIES 9

Design and sketching of progressive and compound dies for Blanking and piercing operations; Bending dies - Deep drawing and wire drawing dies; Design considerations in forging and extrusion.

Note: (Use of P S G Design Data Book is permitted in the University examination)

TOTAL PERIODS 45

COURSE OUTCOMES

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

- understand the basics of Jigs and fixtures and location of clamping.
- demonstrate the working of pneumatic and hydraulic actuation.
- understand the different types of fixtures.
- understand the capacities and tonnage requirements and elements of progressive combination and compound dies.
- apply design and development of progressive and compound dies for blanking and piercing operations.

TEXT BOOKS

1. Edward Hoffman, "Jigs and Fixture Design" , Cengage India, 5th edition, 2008.
2. Joshi, P.H., "Jigs and Fixtures", McGraw Hill Education; 3rd edition, 2017.

REFERENCES

1. K. Venkataraman, "Design of Jigs, Fixtures and Press Tools", Wiley-Blackwell, 2nd edition, 2015.
2. Cyril Donaldson, George H. Lecain and VC Goold "Tool Design", McGraw Hill Education, 4th edition, 2012.
3. V.Balachandran, "Design of Jigs, Fixtures and Press Tools" Notion Press, 1st edition, 2015.
4. John Nee, "Fundamentals of Tool Design", Society of Manufacturing Engineers, 6th edition, 2010.
5. Roop Lal, "Jig and Fixtures Design", Vayu Education of India, 2015.

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1	3	2	2	2	-	2	-	3	2	1	1
CO2	1	2	2	1	2	2	-	2	2	2	2	2	2	1
CO3	2	3	2	1	-	1	2	1	-	1	2	1	-	2
CO4	3	2	2	2	1	1	1	2	3	-	1	-	2	3
CO5	2	2	1	-	1	3	2	1	3	2	2	1	-	-

IT16255 COMPUTER NETWORKS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the division of network functionalities into layers.
- explain the following terms: computer network, LAN, WAN, MAN, internet, protocol, topology, media, peer-to-peer network, and server-based network.
- familiar with the components required to build different types of networks.
- exposed to the required functionality at each layer.
- learn the flow control and congestion control algorithms.

UNIT I FUNDAMENTALS AND PHYSICAL LAYER 9

Data communication - Networks - Network models - Layer tasks - The OSI Model - Layers in the OSI model - TCP/IP protocol suit - Data and signals - Transmission media - Switching.

UNIT II DATA LINK LAYER 9

Error detection and correction - Data link control - Framing - HDLC - Multiple access - Wireless LAN's: Standard Ethernet - Fast Ethernet - Gigabit Ethernet - 802.11 - Bluetooth.

UNIT III NETWORK LAYER 9

The Logical address (IP4, IP6) - Internet protocol: Internetworking (IP4, IP6) - Transitions from IP4 to IP6 -ICMP - IGMP - Forwarding - Unicasting routing protocol (Distance Vector Routing, Link State Routing) - Multicasting routing protocol.

UNIT IV TRANSPORT LAYER 9

Duties of Transport Layer - UDP -TCP - Congestion control and Quality of Service - Techniques to Improve QoS.

UNIT V APPLICATION LAYER 9

Electronic Mail (SMTP, POP3, IMAP, MIME) - File Transfer Protocol - WWW - HTTP - DNS.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- have a good understanding of the OSI reference model.
- have experience in designing communication protocols.
- analyze the requirements for a given organizational structure and select the most appropriate networking architecture and technologies.
- expose TCP/IP protocol suite.
- design and build a network using routers.

TEXT BOOKS

1. Behrouz A. Forouzan, “Data Communication and Networking”, Fifth Edition, Tata McGraw - Hill, 2012.

REFERENCES

1. Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Fifth Edition, Morgan Kaufmann Publishers, 2011.
2. James F. Kurose, Keith W. Ross, “Computer Networking - A Top-Down Approach Featuring the Internet”, Fifth Edition, Pearson Education, 2009.
3. Nader. F. Mir, “Computer and Communication Networks”, Pearson Prentice Hall Publishers, 2010.
4. William Stallings, “Data and Computer Communication “Tenth Edition, Pearson Education, 2014.

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2
CO1	3	2	3	2	-	-	-	-	-	-	-	-	3	2
CO2	2	2	3	3	-	-	-	-	-	2	-	-	2	3
CO3	3	3	3	2	3	-	-	-	-	-	-	2	2	3
CO4	3	3	3	2	3	-	-	-	-	-	-	2	3	3
CO5	3	3	3	2	-	-	-	2	-	-	-	-	-	3

PROGRAMME ELECTIVE - III

MT16351 MECHATRONICS SYSTEM DESIGN 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- know the basic system design procedure.
- design a system with the aid of mechanical and electronic components.
- learn about mechatronics design process.
- understand the data acquisition and control methodologies.
- illustrate the application of mechatronics system.

UNIT I INTRODUCTION 9

Key elements - mechatronics design process - design parameters - traditional and mechatronics designs - advanced approaches in mechatronics - industrial design - ergonomics and safety.

UNIT II SYSTEM MODELLING 9

Introduction - model categories - fields of application - model development - model verification-model validation - model simulation - design of mixed systems - electro mechanics design - model transformation domain - independent description forms - simulator coupling.

UNIT III REAL TIME INTERFACING 9

Introduction - selection of interfacing standards; Elements of data acquisition and control systems - over view of I/O process - general purpose I/O card and its installation - data conversion process - application software - LabVIEW environment and its applications; Vim - Sim Environment and its applications; Man Machine Interface.

UNIT IV CASE STUDIES ON MECHATRONIC SYSTEM 9

Introduction - fuzzy based washing machine - PH control system - autofocus camera - exposure control - motion control using D.C. motor and solenoids - engine management systems - controlling temperature of a hot/cold reservoir using PID - control of pick and place robot - part identification and tracking using RFID - online surface measurement using image processing.

UNIT V MICRO MECHATRONIC SYSTEM 9

Introduction - system principle - component design - system design - scaling laws - micro actuation - micro robot - micro pump - applications of micro mechatronics components.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- identify various mechatronics elements.
- categorize the different system models.
- obtain knowledge about of real time interface.
- apply mechatronics design process for new product development.
- outline the importance of micro mechatronics system.

TEXT BOOKS

1. Devdas shetty, Richard A. Kolk, “Mechatronics System Design”, 2nd Edition, Cengage Learning, 2012.
2. Georg pelz, "Mechatronics Systems: Modeling and simulation" with HDL’s, John Wiley and son Ltd, 2003.

REFERENCES

1. Bishop, Robert H, "Mechatronics Hand book", 2nd Edition, CRC Press, 2018.
2. Bradley, D.Dawson, N.C. Burd and A.J. Loader, "Mechatronics: Electronics in Products and Processes”, CRC Press 1993, First Indian print 2010.
3. De Silva, "Mechatronics: A Foundation Course", Taylor and Francis, Indian Reprint, 2013.

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	Programme Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2
CO1	2	2	-	-	-	2	-	-	-	2	-	-	-	1
CO2	-	2	-	-	1	3	-	1	-	2	-	-	-	3
CO3	2	-	-	-	3	-	-	3	-	-	-	2	-	2
CO4	2	2	-	-	1	2	-	1	-	3	-	2	-	3
CO5	2	-	-	-	3	-	-	3	-	-	-	2	-	1

MT16352 FINITE ELEMENT ANALYSIS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the concepts of mathematical modeling of engineering problems.
- study the methods to assemble finite element equations, boundary conditions and post processing.
- learn about the triangular element, load vectors and applications to heat transfer.
- study about plane stress, plane strain and plate and shell elements.
- gain knowledge on iso- parametric formulation, shape functions, numerical integration and matrix solution techniques.

UNIT I INTRODUCTION 9

Historical Background - Mathematical Modeling of field problems in Engineering - Governing Equations - Discrete and continuous models - Boundary, Initial and Eigen Value problems - Weighted Residual Methods - Variational Formulation of Boundary Value Problems - Ritz Technique - Basic concepts of the Finite Element Method.

UNIT II ONE-DIMENSIONAL PROBLEMS 9

One Dimensional Second Order Equations - Discretization - Element types - Linear and Higher Order Elements - Derivation of Shape functions and Stiffness matrices and force vectors - Assembly of Matrices - Solution of problems from solid mechanics and heat transfer. Longitudinal vibration frequencies and mode shapes. Fourth Order Beam Equation - Transverse deflections and Natural frequencies of beams.

UNIT III TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS 9

Second Order 2D Equations involving Scalar Variable Functions - Variational formulation - Finite Element formulation - Triangular elements - Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems - Torsion of Non-circular shafts - Quadrilateral elements - Higher Order Elements.

UNIT IV TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS 9

Equations of elasticity - Plane stress, plane strain and axisymmetric problems - Body forces and temperature effects - Stress calculations - Plate and shell elements.

UNIT V ISOPARAMETRIC FORMULATION 9

Natural co-ordinate systems - Isoparametric elements - Shape functions for iso parametric elements - One and two dimensions - Serendipity elements - Numerical integration and application to plane stress problems - Matrix solution techniques - Solutions Techniques to Dynamic problems - Introduction to Analysis Software.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- understand different mathematical techniques used in FEM analysis.
- understand methods to assemble finite element equation of structural problems and non-structural problems.
- attain knowledge of basic idea about triangular element, plane stress, plane strain conditions and application to heat transfer problems.
- acquire knowledge on basic idea about axisymmetric element, plane stress conditions with different boundary conditions.
- understand the concept in mapping of elements from natural to local coordinate system, displacement and stress calculations with numerical integration.

TEXT BOOKS

1. Seshu, P, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi, 2013.
2. Reddy. J.N., "An Introduction to the Finite Element Method", 3rd Edition, Tata McGraw-Hill, 2017.

REFERENCES

1. Rao, S.S., "The Finite Element Method in Engineering", 5th Edition, ButterworthHeinemann, 2010.
2. Daryl L. Logan , "A First Course in the Finite Element Method", Cengage Learning Custom Publishing, 6th edition, 2016.
3. Malkus, Plesha, Witt Robert D. Cook, "Concepts and Applications of Finite Element Analysis", 4th Edition, Wiley, 2007.
4. Tirupathi R. Chandrupatla and Ashok D. Belugundu, "Introduction to Finite Elements in Engineering", Pearson Education India, 4th edition, 2015.

Mapping of Course Outcomes with Programme Outcomes:
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programme Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	3		2	-	-	-	-	3	-	2	-
CO2	-	3	-	1		-	-	3	-	-	2	-	-	-
CO3	3	3	-	-		2	-	1	-	2	2	-	-	-
CO4	3	2	-	-		2	-	-	-	2	1	-	2	-
CO5	3	3	-	-	-	3	-	2	-	2	2	-	-	-

MT16353 NON-TRADITIONAL MACHINING PROCESSES 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- learn about various non-traditional machining processes, the various process parameters and their influence on performance and their applications.
- access knowledge on various types of mechanical energy-based processes.
- identify the principles and working of electrical energy-based processes.
- gain the knowledge of chemical and electro- chemical energy-based processes.
- acquire the concept of thermal energy-based processes.

UNIT I INTRODUCTION 9

Introduction to Non-traditional machining processes, need for non-traditional machining, classification of non-traditional machining processes, their applications, advantages, limitations, Comparison of non-traditional machining processes.

UNIT II MECHANICAL ENERGY BASED PROCESSES 9

Abrasive Jet Machining - Water Jet Machining - Abrasive Water Jet Machining - Ultrasonic Machining (AJM, WJM, AWJM and USM) - working principles - equipment used - process parameters - MRR - applications.

UNIT III ELECTRICAL ENERGY BASED PROCESSES 9

Electric Discharge Machining (EDM) - Wire cut EDM tool - working principles - equipment - Surface finish - power and control Circuits - tool wear - process parameters - MRR - applications.

UNIT IV CHEMICAL AND ELECTRO - CHEMICAL ENERGY BASED PROCESSES 9

Chemical Machining and Electro Chemical Machining (CHM and ECM) - working principles - equipment used - process parameters - surface finish and MRR - Applications - ECG and ECH - applications.

UNIT V THERMAL ENERGY BASED PROCESSES 9

Laser Beam machining (LBM) - Plasma Arc Machining (PAM) - Electron Beam Machining (EBM) - Ion Beam Machining (IBM) - working principles - equipment used - types - beam control techniques - applications.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- demonstrate different non-traditional machining processes and know the influence of difference process parameters on the performance and their applications.
- understand the knowledge on various types of mechanical energy-based processes.
- identify a problem and apply the fundamental concepts and enable to solve problems arising in metal removal process.
- interpret Electro Chemical Machining process, economic aspects of ECM and problems on estimation.
- relate generation and control of Electron Beam for Machining, Laser Beam Machining and comparison.

TEXT BOOKS

1. Jagadeesha T. "Unconventional Machining Processes", I K International Publishing House Pvt. Ltd, 2016.
2. V. K. Jain, "Advanced Machining Processes", 26th Reprint, Allied Publishers Pvt. Ltd., 2016.

REFERENCES

1. Angelos P. Markopoulos and J. Paulo Davim, "Advanced Machining Processes: Innovative Modeling Techniques", CRC Press, 1st edition, 2017.
2. J.A. McGeough, "Advanced Methods of Machining", Springer, 2011.
3. Paul De Garmo, J.T.Black, and Ronald.A.Kohser, "Material and Processes in Manufacturing" John Wiley and Sons, 10th Edition, 2010.

Mapping of Course Outcomes with Programme Outcomes:
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	Programme Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	3	-	-	2	-	-	-	-	2	-	2
CO2	1	-	-	1	-	-	-	-	-	2	-	2	-	2
CO3	-	-	-	-	-	-	2	-	-	3	-	2	-	2
CO4	3	-	-	2	-	-	2	-	-	2	-	-	-	2
CO5	2	-	-	-	-	-	2	-	-	2	-	2	-	-

MT16354 INDUSTRIAL ELECTRONICS AND APPLICATIONS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the fundamentals of Industrial control.
- impart students with analysis of converters and inverters.
- introduce the method of controlling speed.
- outline the formal procedures for relays, heating and welding control.
- introduce the concept of process control.

UNIT I INTRODUCTION 9

Industrial control classification - motion and process control - feed forward control - interfacing devices - amplifier - review of thyristor - SCR - TRIAC - phototransistor.

UNIT II CONVERTERS AND INVERTERS 9

Analysis of controlled and fully controlled converters - dual converters - analysis of voltage source and current source - current source and series converters.

UNIT III INDUSTRIAL MOTOR CONTROL 9

Method of controlling speed - basic control circuit - DC motor control, AC motor control - Servo motor control - Stepper motor control - micro controller based speed control - solid state motor control - PLL control of a DC motor control

UNIT IV HEATING AND WELDING CONTROL 9

Introduction - principle of relays - electromechanical relay - solid state relays - latching relays timing relays - induction heating - dielectric heating - controls for welding.

UNIT V PROCESS AND MOTION CONTROL 9

Elements of process control - temperature control - flow control, level control - methods of motion control - feedback control - direct digital control.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- solve the fundamentals of Industrial control applications.
- design analysis of voltage source and current source.
- acquire knowledge on the basics about principle of relays.
- understand the principle of relays used in welding process.
- design the process control of elements.

TEXT BOOKS

1. Bogdan M. Wilamowski , J. David Irwin “Fundamentals of Industrial Electronics “CRC Press, 2017.
2. Kissell T.E, “Industrial Electronics: Applications for Programmable Controllers, Instrumentation and Process Control and Electrical Machines and Motor Controls”, Prentice Hall India Learning Private Limited; 3rd edition, 2003.

REFERENCES-

1. Terry L.M. Bartelt, "Industrial electronics, devices, systems and applications", Cengage Learning, 2005.
2. Stephen L. Herman, "Industrial Motor Control", 7th edition, Delmar publishers, 2013.
3. Biswanath Paul, "Industrial Electronics and Control" PHI Learning publisher;2014.
4. Jean-Pierre Corriou; "Process Control"; Springer;2017.

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	-	-	-	-	-	-	-	-	3	2
CO2	2	3	3	3	-	-	-	-	-	-	-	-	2	3
CO3	2	3	3	3	2	-	-	-	-	-	-	-	3	3
CO4	2	3	3	3	2	-	-	-	-	-	-	-	2	3
CO5	2	3	3	2	3	-	-	-	-	-	-	-	2	3

BA16254 **PRINCIPLES OF MANAGEMENT** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- understand history and development of management thought.
- know the planning activities in management.
- understand organizing, dimensions of organization structure, and choosing the right structural form.
- know how to manage human resources.
- understand various methods and techniques of control.

UNIT I INTRODUCTION TO MANAGEMENT **9**

Management: Meaning, Scope, Managerial Roles. Management: Science, Art or Profession; Universality of management, Ancient roots of management theory; Classical schools of management thought; Behavioral School, Quantitative School; Systems Approach, Contingency Approach; Contemporary Management thinkers and their contribution.

UNIT II PLANNING **9**

Characteristics of planning, Planning Process; Types of plans; Decision making, Decision making tools, Group decision making, Forecasting and MBO.

UNIT III ORGANIZING **9**

Organizational structure and design; types of organizational structures; authority, delegation, decentralization and reengineering; Organization Size, Technology, Environment, Power-control; choosing the right structural Form

UNIT IV MANAGING HUMAN RESOURCES **9**

Human resource planning, Recruitment, selection, training and development, performance appraisal, managing change, compensation and employee welfare, Leadership theory, Motivation Theory, Communication.

UNIT V CONTROLLING **9**

Nature of organizational control; control process; Methods and techniques of control; Designing control systems.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- demonstrate history and development of management thought.
- exhibit the planning activities in management.
- know organizing, dimensions of organization structure, and choosing the right structural form.

- gain knowledge how to manage human resources.
- develop various methods and techniques of control.

TEXT BOOKS

1. Heinz Weihrich, Mark V. Cannice, Management a Global and Entrepreneurial Perspective, Tata McGraw- Hill Education, 2010.
2. James A.F. Stoner and R. Edward Freeman, Management, Prentice-Hall of India Private Limited, New 5/e Delhi, 2010.

REFERENCES

1. John R. Schermerhorn, Jr., Daniel G. Bachrach, Management, Wiley India, 13/e, 2015.
2. Joseph L Massie, Essentials of Management, Prentice-Hall India, New York, 4/e, 2013.
3. S.A. Sherlekar, Management, Himalaya Publications, Mumbai, 1/e, 2012.
5. L.M. Prasad, Principles of Management, Sultan Chand and Sons, New Delhi, 9/e, 2015.

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	-	-	-	1	2	3	1	2	-	3	2	1	2
CO2	2	-	-	-	1	2	2	2	2	-	2	2	-	2
CO3	1	-	-	-	1	2	2	1	-	-	2	1	-	1
CO4	1	-	-	-	1	2	1	2	2	-	1	-	2	2
CO5	1	-	-	-	1	2	2	1	2	-	1	-	-	3

PROGRAMME ELECTIVE - IV

MT16451 COMPUTATIONAL FLUID DYNAMICS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the fundamental concepts of computational fluid dynamics.
- study the various techniques involved in the discretization of fluid elements.
- acquire knowledge about grid generation.
- impart knowledge in analysis techniques used in computational solutions of fluid mechanics and heat transfer problems.
- discuss the applications of CFD.

UNIT I INTRODUCTION 9

Impact and applications of CFD in diverse fields; governing equations of fluid dynamics; continuity; momentum and energy; generic integral form for governing equations; Initial and Boundary conditions; Classification of partial differential equations; Hyperbolic - Parabolic - Elliptic and Mixed.

UNIT II BASIC ASPECTS OF DISCRETIZATION 9

Discretization techniques; Finite difference - Finite volume and Finite element method; Comparison of Discretization by the three methods; Introduction to finite differences - difference equations; Uniform and Non -uniform grids - numerical errors - grid independence test and optimum step size.

UNIT III GRID GENERATION 9

Transformation of non-uniform grids to uniform grids - the general transformation of the equations; Form of the governing equations suitable for CFD; Compressed grids - boundary fitted coordinate systems - elliptic grid generation - adaptive grids; Modern developments in grid generation.

UNIT IV CONDUCTION AND CONVECTION 9

Steady One - dimensional conduction - two and three - dimensional conduction; Steady one - dimensional convection and Diffusion; Transient one - dimensional and two - dimensional conduction; Explicit, Implicit, Crank Nicolson.

UNIT V INCOMPRESSIBLE FLUID FLOW AND APPLICATIONS OF CFD 9

Gradient term and continuity equation - staggered grid - momentum equations - pressure and velocity corrections - pressure correction equation - numerical procedure for SIMPLE algorithm - boundary conditions for the pressure correction method - stream function - vorticity method; Discussion of case studies; Applications of CFD fluent software - drying - sterilization - mixing - refrigeration; Other applications - heat exchanger - clean room condition - future of CFD in the food industry.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- apply the fundamental concepts of computational fluid dynamics.
- evaluate the important classes of numerical discretization scheme.
- demonstrate the importance of grid generation in fluid dynamics problems
- solve numerical equations related to fluid flow and heat transfer problems.
- identify CFD software to solve fluid flow problems.

TEXT BOOKS

1. J. D. Anderson., Jr. "Computational Fluid Dynamics; The Basic with Applications", Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi, 2017.
2. John F. Wendt, "Computational Fluid Dynamics: An Introduction", Springer; 3rd edition, 2012.

REFERENCES

1. P.S. Ghoshdastidar, "Computational Fluid Dynamics and Heat Transfer", Cengage India Private Limited, 1st edition, 2017.
2. Muralidhar and T. Sundarajan, "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi 2009.
3. S. V. Patankar, "Numerical Heat Transfer and Fluid Flow", CRC Press, 2017.
4. Jiyuan Tu, Guan Heng Yeoh, Chaoqun Liu, "Computational Fluid Dynamics: A Practical Approach", Butterworth-Heinemann, 3rd edition, 2018.

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	1	3	-	2	1	1	3	3	1	2	3	3
CO2	1	1	3	-	1	1	3	3	2	1	1	3	-	1
CO3	2	1	-	1	-	-	-	2	3	2	1	-	3	2
CO4	-	-	2	2	3	3	2	1	-	-	3	2	-	3
CO5	1	1	-	-	1	3	-	-	1	1	-	1	2	-

MT16452 ADVANCED SENSOR TECHNOLOGY 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- identify the concepts of sensor technology.
- know the fundamental knowledge of biomedical sensors.
- understand the principle and operation of electrodes
- design advanced sensors.
- troubleshoot and calibrate the medical equipment.

UNIT I INTRODUCTION TO SENSORS 9

Chemical Sensors - Blood, Gas and Acid, base physiology Electrochemical sensors - Chemical Fibro sensors; Ion Selective Field Effect Transistor (ISFET); Immunologically Sensitive Field Effect Transistor (IMFET); Integrated flow sensor and Blood Glucose sensors; Optical Sensors - Fiber optic light propagation - Graded index Fibers - Fiber optic communication driver circuits; Laser classifications - driver circuits for solid state laser diodes; Radiation sensors and Optical combinations.

UNIT II BIOMEDICAL SENSORS 9

Biomedical Sensors - introduction - sensors terminology in the human body - Body fluids musculoskeletal system; Bioelectric amplifiers - bioelectric Amplifiers for Multiple input Circuits - differential amplifiers; Physiological pressure and other cardiovascular measurements and devices.

UNIT III ELECTRODES 9

Electrodes - Electrodes for Biophysical sensing - Electrode model circuits - Microelectrodes - ECG and EEG Electrodes; ECG signals - waveforms - Standard lead system - Polarization Polarizable and Non polarizable Electrodes - body surface recording electrodes; Ultrasonic Transducers for Measurement and therapy; Radiation detectors; NIR spectroscopy.

UNIT IV ADVANCED SENSOR DESIGN 9

Advanced Sensor Design - Fluoroscopic machines design - Nuclear medical systems - EMI to biomedical sensors - types and sources of EMI - fields and EMI effects; Computer systems used in X-ray and nuclear medical equipment.

UNIT V TROUBLESHOOTING AND MAINTENANCE 9

Troubleshooting - typical faults - calibration; Maintenance procedure for medical equipment; Design of 2 and 4 wire transmitters with 4-20 mA output; Aerospace Sensor - Laser Gyroscope and accelerometers; Sensors used in space and environmental applications.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- illustrate the basic concepts and principles of sensors.
- describe the fundamentals of biomedical sensors.
- define the operation and principle of electrodes.
- design advanced sensor for the required applications.
- Troubleshoot, calibrate and maintenance of medical equipment.

TEXT BOOKS

1. Jacob Fraden , "Handbook of Modern Sensors", Springer Nature, 5th edition, 2015.
2. Martin J. Richardson, John D. Wiltshire "The Hologram: Principles and Techniques", Wiley IEEE Press, 1st edition, 2017.
3. John G. Webster and Halit Eren, "Measurement, Instrumentation, and Sensors Handbook: Electromagnetic, Optical, Radiation, Chemical, and Biomedical Measurement", CRC Press, 2nd edition, 2017.

REFERENCES

1. Laurence J. Street, "Introduction to Biomedical Engineering Technology", CRC Press, 3rd edition, 2016.
2. Arthur H. Hartog, "An Introduction to Distributed Optical Fibre Sensors", CRC Press, 1st edition, 2017.
3. P. Garnell, "Guided Weapon Control Systems", Pergamon Press, 2nd edition, 1980.

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	1	3	2	2	-	-	2	3	3	2	1	3
CO2	-	-	3	1	3	1	3	3	2	2	-	2	2	1
CO3	2	3	1	-	-	2	1	2	3	-	2	2	-	2
CO4	2	2	2	3	2	-	1	-	-	-	1	3	3	2
CO5	1	1	1	-	2	3	2	1	2	2	2	-	-	-

MT16453 RENEWABLE ENERGY SOURCES 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- know the utilization of renewable energy sources.
- identify the availability of solar energy and solar cells.
- acquire knowledge of the wind energy resources and wind turbine design.
- understand the bioenergy and biomass process.
- learn other sources of energy such as tidal and geothermal energy.

UNIT I INTRODUCTION 9

World energy use - reserves of energy resources - environmental aspects of energy utilization - renewable energy scenario in Tamil Nadu, India and around the world - potentials - achievements/applications - economics of renewable energy systems.

UNIT II SOLAR ENERGY 9

Solar radiation - measurements of solar radiation - flat plate and concentrating collectors - solar direct thermal applications - solar thermal power generation - fundamentals of solar photovoltaic conversion - solar cells – solar PV power generation - solar PV applications.

UNIT III WIND ENERGY 9

Wind data and energy estimation - types of wind energy systems - performance - site selection - details of wind turbine generator - safety and environmental aspects.

UNIT IV BIOENERGY 9

Biomass direct combustion - biomass gasifiers - biogas plants - digesters - ethanol production - bio diesel - cogeneration - biomass applications.

UNIT V OTHER RENEWABLE ENERGY SOURCES 9

Tidal energy - wave energy - open and closed OTEC cycles - small hydro-geothermal energy - hydrogen and storage - fuel cell systems - hybrid systems.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- describe the availability of renewable energy sources.
- discuss the solar energy and the current solar energy cells.
- gather wind energy resources and techniques to utilize them effectively.
- categorize the availability and the conversion method of bioenergy and biofuels.
- summarize the significance of hydrogen and fuel cells principles, storage and uses.

TEXT BOOKS

1. Rai. G.D., “Non-Conventional Energy Sources”, Khanna Publishers, New Delhi, 2018.
2. N.K. Bansal, “Non-Convention Energy Resources”, Vikas, 2018.

REFERENCES

1. Garg.H. P and Prakash. J., “Solar Energy - Fundamentals and applications”, McGraw Hill Education, 2017.
2. Mohd. Hasan Ali, “Wind Energy Systems: Solutions for Power Quality and Stabilization”, CRC Press, 2017.
3. Vaughn C. Nelson, Kenneth L. Starcher, “Introduction to Bioenergy”, CRC Press, 2017.
4. Sukhatme, S.P., J. K. Nayak, “Solar Energy, Principles of Thermal Collection and Storage”, Tata MCGraw Hill, 2009.
6. John Twidell, Tony Weir, “Renewable Energy Sources”, Routledge, 2015.

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	Programme Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	-	1	-	-	-	3	-	2	-	2	3	-
CO2	3	3	-	-	-	-	3	-	-	2	-	-	3	3
CO3	2	-	-	3	-	-	2	1	-	-	-	3	3	2
CO4	-	3	-	2	-	-	2	3	-	2	-	-	-	1
CO5	2	-	-	2	-	-	-	1	-	2	-	2	3	2

BA16253 TOTAL QUALITY MANAGEMENT 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- describe the basic concepts in quality management, customer orientation and retention.
- facilitate the understanding of quality management principles and process.
- discuss the techniques in six sigma, bench marking and FMEA.
- understand the basic concepts in quality function development and TPM.
- become familiar with quality system, quality auditing in manufacturing.

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Quality statements - Customer focus - Customer orientation, customer satisfaction, customer complaints, customer retention - Costs of quality.

UNIT II TQM PRINCIPLES 9

Leadership - Strategic quality planning, Quality councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Quality circles recognition and reward, performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, supplier selection, supplier rating.

UNIT III TQM TOOLS AND TECHNIQUES I 9

The seven traditional tools of quality - New management tools - Six sigma: concepts, methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, bench marking process - FMEA - stages, types.

UNIT IV TQM TOOLS AND TECHNIQUES II 9

Control Charts - Process capability - Concepts of six sigma - Quality Function Development (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT V QUALITY SYSTEMS 9

Need for ISO 9000; ISO 9001-2008 Quality System - Elements, documentation, Quality Auditing - QS 9000 - ISO 14000 - Concepts, requirements and benefits - TQM implementation in manufacturing and service sectors.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- discuss the basic concepts in quality management, customer orientation and retention.
- describe the principles and process of quality management.
- implement the quality control techniques in six sigma, bench marking and FMEA.
- explain the basic concepts in quality function development and TPM.
- understand the elements in quality system, quality auditing in manufacturing.

TEXT BOOKS

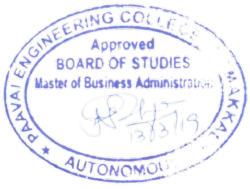
1. Dale H. Besterfiled, et at., "Total quality Management", Third Edition, Pearson Education Asia, Indian Reprint, 2006.
2. D.R Kiran, "Total quality Management", Butterworth-Heinemann, 2016.

REFERENCES

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
3. Janakiraman. B and Gopal .R.K., "Total Quality Management ;Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
4. Dennis AuBuchon, Understanding the Concept of Quality, Pronoun, 2017.
5. Donna C. S. Summers, Quality, Pearson, 5th edition, 2009.

Mapping of Course Outcomes with Programme Outcomes:
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	Programme Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	2	3	2	2	3	-	1	3	3	3	3	3
CO2	1	3	3	-	3	3	2	3	2	3	3	1	3	2
CO3	3	2	3	3	-	3	-	1	3	-	-	2	3	2
CO4	2	3	3	3	2	2	3	2	2	3	3	1	2	3
CO5	3	-	3	3	2	3	3	3	3	3	3	3	2	3



IT16456 **DATABASE MANAGEMENT SYSTEMS** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- learn the fundamentals of Database Management Systems.
- make the students understand the relational model.
- familiarize the students with ER diagrams.
- expose the students to SQL.
- familiarize the students with the different types of databases.

UNIT I INTRODUCTION **9**

Purpose of Database System -Views of data - Data Models - Database Languages - Database System Architecture - Database users and Administrator - Entity - Relationship model (E-R model) - E-R Diagrams - Introduction to relational databases.

UNIT II RELATIONAL MODEL **9**

The relational Model - The catalog - Types - Keys - Relational Algebra - Domain Relational Calculus - Tuple Relational Calculus - Fundamental operations - Additional l/O operations - SQL fundamentals - Integrity - Triggers - Security - Advanced SQL features - Embedded SQL - Dynamic SQL - Missing Information -Views - Introduction to Distributed Databases and Client/Server Databases.

UNIT III DATABASE DESIGN **9**

Functional Dependencies - Non-Loss Decomposition - Functional Dependencies - First, Second, Third Normal Forms, Dependency Preservation - Boyce/ Code Normal Form-Multi-Valued Dependencies and Fourth Normal Form - Join Dependencies and Fifth Normal Form.

UNIT IV TRANSACTIONS **9**

Transaction Concepts - Transaction Recovery - ACID Properties -System Recovery - Media Recovery - Two Phase Commit - Save Points - SQL Facilities for recovery - Concurrency - Need for Concurrency - Locking Protocols –Two -Phase Locking - Intent Locking - Deadlock- Serializability - Recovery Isolation Levels - SQL Facilities for Concurrency.

UNIT V IMPLEMENTATION TECHNIQUES **9**

Overview of Physical Storage Media - Magnetic Disks - RAID -Tertiary storage - File Organization - Organization of Records in Files - Indexing and Hashing - Ordered Indices - B+ tree Index Files -B tree Index Files - Static Hashing - Dynamic Hashing - Query Processing Overview - Catalog Information for Cost Estimation - Selection Operation -Sorting - Join Operation -Database Tuning.

TOTAL PERIODS **45**

COURSE OUTCOMES

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

- describe basic concepts of a database system.
- design a data model and schemas in RDBMS.
- analyze functional dependencies for designing a robust database.
- apply SQL for business - related problems.
- implement transactions, Concurrency control, and be able to do a database recovery

TEXT BOOKS

1. Abraham Silberschatz, Henry F. Korth and S. Sudharshan, "Database System Concepts", Sixth Edition, Tata Mc Graw Hill, 2011.
2. C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems",Eighth Edition, Pearson Education, 2006.

REFERENCES

1. Elmasri R. and Shamakant B. Navathe, "Fundamentals of Database Systems", 6th Edition, Addision Wesley, 2011.
2. Atul Kahate, "Introduction to Database Management Systems", Pearson Education, New Delhi, 2006.
3. Raghu Ramakrishnan, "Database Management Systems", Fourth Edition, Tata Mc Graw Hill, 2010.
4. G.K.Gupta, "Database Management Systems", Tata Mc Graw Hill, 2011.
5. Hector Garcia-Molina, Jeff Ullman, and Jennifer Widom, "Database Systems: The Complete Book", Pearson Education, Second Edition, 2008.

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	2	-	-	-	-	-	-	-	-	3	2
CO2	2	3	3	3	-	-	-	-	-	-	-	-	2	3
CO3	2	3	3	3	2	-	-	-	-	-	-	-	3	3
CO4	2	3	3	3	2	-	-	-	-	-	-	-	2	3
CO5	2	3	3	2	3	-	-	-	-	-	-	-	2	3

PROGRAMME ELECTIVE - V

MT16551 INTELLECTUAL PROPERTY RIGHTS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the importance of IPR.
- provide knowledge of Patents, Copyrights and Trademarks.
- understand the international convention relating to IPR.
- learn various levels of policies.
- study the different case studies related to IPR.

UNIT I INTRODUCTION 9

Introduction - invention and creativity - Intellectual Property (IP) - importance - protection of IPR - basic types of property (movable property, immovable property and intellectual property).

UNIT II PATENTS, COPYRIGHTS AND TRADEMARKS 9

IP - Patents - Copyrights and related rights - Trade Marks and rights arising from trademarkregistration - definitions - industrial designs and integrated circuits - protection of geographical indications at national and international levels - application procedures.

UNIT III INTERNATIONAL IPR CONVENTION 9

Introduction - establishment of WIPO - mission and activities - history - General Agreement on Trade and Tariff (GATT).

UNIT IV IPR STRATEGIES 9

Indian position vs WTO and strategies - Indian IPR legislations - commitments to WTO - patent ordinance and the bill - draft of a national intellectual property policy - present against unfair competition.

UNIT V CASE STUDIES 9

Case studies on - patents (basumati rice, turmeric, neem, etc.) - copyright and related rights - trade marks - industrial design and integrated circuits - geographic indications - protection against unfair competition.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- distinguish various property rights.
- acquire knowledge of patents, copyrights and trademarks.
- describe the procedures to obtain Intellectual Property Rights.
- demonstrate the Indian position with WTO.

- explain and choose on the effective usage of IPR's with some case studies.

TEXT BOOK

1. K.C. Kankanala, A.K. Narasani, V. Radhakrishnan, "Indian Patent Law and Practice", Oxford University Press, UK ed. Edition, 2012.
2. Neeraj Pandey and Khushdeep Dharni, "Intellectual Property Rights", PHI Learning, 2014.

REFERENCES

1. M. K. Bhandari, "Law Relating to Intellectual Property Rights", Central Law Publications, 4th edition, 2015.
2. Anil Kumar H S and Ramakrishna B, "Fundamentals of Intellectual Property Rights: For Students, Industrialist and Patent Lawyers", Notion Press, 1st edition, 2017.
3. Editorial Board of Professional Book Publishers, "Intellectual Property Laws", Professional Book Publishers, 1st edition, 2018.

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	1	3	2	2	2	-	2	-	1	2	1	-
CO2	-	-	1	1	2	1	-	3	3	2	-	2	2	3
CO3	3	1	2	-	-	2	1	1	-	-	3	1	-	2
CO4	1	3	2	2	2	-	1	-	1	-	1	-	1	1
CO5	3	2	1	-	1	3	2	1	2	2	2	-	-	-

MT16552 **ARTIFICIAL INTELLIGENCE** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- present the concepts of intelligent agents and searching.
- illustrate the concepts of intelligent knowledge and reasoning.
- categorize the concepts of intelligent planning and learning.
- choose the applications of AI in robot vision.
- familiarize with different AI techniques and learning the expert systems.

UNIT I INTRODUCTION TO AI AND PRODUCTION SYSTEMS 9

Introduction to AI; Criteria for success; Problem defining - production systems characteristics - specialized system characteristics; Problem solving methods - problem graphs - matching and indexing - heuristic search techniques; Generate and Test - hill climbing - first search; Problem reduction.

UNIT II KNOWLEDGE REPRESENTATION 9

Representations and mappings - approaches - issues - representing simple facts in logic - instance and ISA Relationships; Computable functions and predicates - resolution - natural deduction - procedural versus declarative knowledge - logic programming; Knowledge based agents; The Wumpus World.

UNIT III PLANNING AND LEARNING 9

Planning - components of planning system - goal stack planning - nonlinear planning - hierarchical planning - and Conditional Planning; Reactive systems; Learning - rote learning - learning by taking advice - explanation based learning - formal learning theory - genetic learning- logical formulation of learning - inductive learning.

UNIT IV AI IN ROBOT VISION 9

Introduction - steering an automobile; Two stages of robot vision; Image processing - averaging - edge enhancement - combining edge enhancement with averaging - region finding - scene analysis - interpreting lines and curves in the image - model based vision; Stereo vision and depth analysis.

UNIT V EXPERT SYSTEMS 9

Definition; Features of an expert system - organization - characteristics - representing and using domain knowledge; Expert system - architecture - typical ES- MYCIN, PIP, INTERNIST, DART, XOON - Shells; Knowledge acquisition; Perception and action; Real time search - perception and action.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- create the level of the model in design an AI system.
- interpret the knowledge about representations and mappings.
- describe about planning and components of planning.
- identify the various stages of robot vision.
- summarize the features of expert system.

TEXT BOOKS

1. Kevin Knight, Elaine Rich and B. Nair, "Artificial Intelligence", 3rd edition, McGraw Hill Education, 2017.
2. Nils J. Nilsson, "Principles of Artificial Intelligence", Springer publishers, 2014.

REFERENCES

1. Russell, "Artificial Intelligence, A Modern Approach", 3rd edition, Pearson Publisher, 2017.
2. Patterson, "Introduction to Artificial Intelligence", 1st edition, Pearson Education India, 2015.
3. Gopalkrishnan P, "Handbook of Materials Management", 2nd edition, Prentice Hall India Learning Private Limited, 2015.
4. Peter Baily, Barry Crocker, David Farmer, David Jessop and David Jones, "Procurement and Principles Management", 11th edition, Pearson Education, 2018.

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	Programme Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	1	-	2	2	1	-	3	2	1	-	2	3
CO2	2	1	-	-	-	3	2	1	3	2	1	-	-	-
CO3	-	3	2	1	2	-	-	3	2	-	2	2	-	1
CO4	2	3	2	-	1	2	2	1	-	3	2	1	-	2
CO5	-	2	2	1	2	-	-	3	2	-	2	2	-	1

MT16553 CONCEPTS OF ENGINEERING DESIGN 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- impart the importance of design in today's context of global competition, environmental awareness and customer oriented market.
- learn the basic concepts and various aspects of design using simple examples and case studies.
- acquire ideas on legal and ethical domains, codes of ethics.
- gain knowledge about rapid prototyping finite element analysis.
- understand about reliability centered maintenance.

UNIT I DESIGN FUNDAMENTALS 9

Importance of design - design process - considerations of good design - morphology of design - organization for design; Computer Aided Engineering; Designing to codes and standards; Concurrent Engineering; Product and process cycles; Technological forecasting; Market Identification; Competition bench marking.

UNIT II CUSTOMER ORIENTED DESIGN AND SOCIETAL CONSIDERATIONS 9

Identification of customer needs - customer requirements; Quality Function Deployment; Product design specifications - human factors in design - ergonomics and aesthetics; Societal consideration - contracts - Product Liability - protecting intellectual property - legal and ethical domains; Codes of ethics - ethical conflicts; Environment responsible design -future trends in interaction of engineering with society.

UNIT III DESIGN METHODS 9

Creativity and Problem Solving - creativity methods - theory of Inventive Problem Solving (TRIZ); Conceptual Decomposition; Generating design concepts - axiomatic design - evaluation methods embodiment design - product architecture - configuration design - parametric design; Role of models in design - mathematical modeling - simulation - geometric modeling; Rapid prototyping Finite Element Analysis; Optimization - search methods.

UNIT IV MATERIAL SELECTION PROCESSING AND DESIGN 9

Material selection process; Economics - cost vs performance - weighted property index - Value Analysis; Role of processing in design - classification of manufacturing process - design for manufacture; Design for assembly; Designing for castings - forging - metal forming - machining and welding; Residual stresses - Fatigue - fracture and failure.

UNIT V PROBABILITY CONCEPTS IN DESIGN FOR RELIABILITY 9

Probability; Distributions; Test of hypothesis; Design of experiments; Reliability theory; Design for reliability - reliability centered maintenance; Robust design; Failure Mode Effect Analysis.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- appreciate the aspects of need for design, design process, materials and processes used for designing various components.
- acquainted with the knowledge of designing creative components and legal, human and marketing factors during the design of products.
- equipped with tools for improving quality, reliability and performance of a product.
- self-assured of the technique to promote innovative and successful designs.
- identify the problems in which random variables and distribution concepts are used.

TEXT BOOK

1. Linda C. Schmidt and George Dieter, "Engineering Design", 4th edition, McGraw Hill Education, 2017.
2. Richard G Budynas and J Keith Nisbett, "Shigley's Mechanical Engineering Design", 1st edition, McGraw Hill Education, 2017.

REFERENCES

1. Gerhard Pahl, W. Beitz, Jörg Feldhusen and Karl-Heinrich Grote, "Engineering Design: A Systematic Approach", 3rd edition, Springer, 2014.
2. Shuchen B. Thakore and Bharat I. Bhatt, "Introduction to Process Engineering and Design", 2nd edition, McGraw Hill Education, 2017.
3. Karl T. Ulrich and Steven D. Eppinger "Product Design and Development", 5th edition, McGraw Hill Education, 2017.

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	1	3	2	2	2	-	2	-	3	2	1	1
CO2	1	2	2	1	2	2	-	3	1	2	2	3	1	1
CO3	-	3	2	-	-	2	3	1	-	-	2	1	-	3
CO4	3	2	2	2	2	1	1	2	3	-	1	-	2	3
CO5	2	2	1	-	1	3	-	1	3	2	1	1	1	2

MT16554 INTERNAL COMBUSTION ENGINES 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- gain knowledge on working of spark ignition engines.
- impart knowledge of combustion aspects of C.I engines.
- evaluate the pollution formation and control.
- understand the engineering issues and perspectives affecting fuel and engine development.
- develop the knowledge on HCCI combustion and its benefits and applications.

UNIT I SPARK IGNITION ENGINES 9

Mixture requirements - fuel injection systems - monopoint, multipoint and direct injection - stages of combustion - normal and abnormal combustion - knock - factors affecting knock - combustion chambers.

UNIT II COMPRESSION IGNITION ENGINES 9

Diesel fuel injection systems - stages of combustion - knocking - factors affecting knock - direct and indirect injection systems - combustion chambers - fuel spray behaviour - spray structure and spray penetration - air motion - introduction to turbocharging.

UNIT III POLLUTANT FORMATION AND CONTROL 9

Pollutant - sources - formation of carbon monoxide, unburnt hydrocarbon, oxides of nitrogen, smoke and particulate matter - methods of controlling emissions - catalytic converters, selective catalytic reduction and particulate traps - methods of measurement - emission norms and driving cycles.

UNIT IV ALTERNATIVE FUELS 9

Alcohol, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel - properties, suitability, merits and demerits - Engine Modifications.

UNIT V RECENT TRENDS 9

Air assisted combustion, Homogeneous charge compression ignition engines - variable geometry turbochargers - common rail direct injection systems - hybrid electric vehicles - NOx adsorbers - onboard diagnostics.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon completing the course, the student should be able to

- demonstrate the construction and working of SI engines and to identify the advantages and disadvantages of the operation and efficiency of SI engines.
- classify the various stages of combustion in C.I engines and Features and design considerations of combustion.

- identify the nature and extent of the problem of pollutant formation and control in internal combustion engines.
- examine the various alternative fuel options available for conventional fuels and their performance and emission characteristics.
- understand the concept of HCCI, its benefits and challenges.

TEXT BOOKS

1. Ramalingam. K.K, "Internal Combustion Engines", 3rd edition, Scitech Publications, 2016.
2. Ganesan. V, "Internal Combustion Engines", Tata McGraw Hill Education, 4th edition, 2017.

REFERENCES

1. Mathur. M.L and R.P. Sharma, "Internal Combustion Engines", Dhanpat Rai Publications, 2014.
2. James E Duffy, "Modern Automotive Technology for Maintenance and Light Repair", 9th edition, Goodheart-Wilcox Publisher, 2019.
3. A. K. Babu, "Automotive Electrical and Electronics", 1st edition, Khanna Publishing, 2018.

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	2	1	3	3	3	-	3	-	2	3	3	-
CO2	-	-	1	1	2	1	-	3	3	2	-	2	2	1
CO3	3	1	2	-	-	3	3	2	-	-	1	1	-	2
CO4	3	2	3	2	2	-	3	-	3	-	3	-	1	3
CO5	3	1	2	-	2	2	3	1	3	2	3	-	-	-

MT16555 FLEXIBLE MANUFACTURING SYSTEMS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- learn the modern manufacturing systems.
- understand the concepts and applications of flexible manufacturing systems.
- familiarize with planning for FMS database.
- impart knowledge on economic justification of FMS.
- gain knowledge about FMS development towards factories of the future.

UNIT I PLANNING, SCHEDULING AND CONTROL OF FLEXIBLE MANUFACTURING SYSTEMS 9

Introduction to FMS - development of manufacturing systems - benefits - major elements - types of flexibility; FMS application and flexibility - single product - single batch - n - batch scheduling problem - knowledge based scheduling system.

UNIT II COMPUTER CONTROL AND SOFTWARE FOR FLEXIBLE MANUFACTURING SYSTEMS 9

Introduction - composition of FMS - hierarchy of computer control - computer control of work center and assembly lines - FMS supervisory computer control - types of software specification and selection - trends.

UNIT III FMS SIMULATION AND DATA BASE 9

Application of simulation - model of FMS - simulation software – limitation - manufacturing data systems – data Flow - FMS database systems - planning for FMS database.

UNIT IV GROUP TECHNOLOGY AND JUSTIFICATION OF FMS 9

Introduction; Matrix formulation - mathematical programming formulation - graph formulation; Knowledge based system for group technology; Economic justification of FMS - application of possibility distributions in FMS systems justification.

UNIT V APPLICATIONS OF FMS AND FACTORY OF THE FUTURE 9

FMS application in machining - sheet metal fabrication - prismatic component production - aerospace application; FMS development towards factories of the future - artificial intelligence and expert systems in FMS; Design philosophy and characteristics for future - unmanned factories.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- perform planning, scheduling and control of flexible manufacturing systems.
- exhibits the basic hierarchy of computer control.
- acquaintance the perform simulation on software's use of group technology to product classification.
- exposure of artificial intelligence and expert systems in FMS.
- apply the possibility distributions in FMS systems justification.

TEXT BOOK

1. Ioan Constantin Dima, "Industrial Production Management in Flexible Manufacturing Systems", 1st edition, Idea Group,U.S, 2013.

REFERENCES

1. Radhakrishnan.P, Subramanyan. S and Raju.V, "CAD/CAM/CIM",4th edition, New Age International Pvt Ltd, 2018.
2. Nand K. Jha, "Handbook of Flexible Manufacturing Systems", Academic Press Inc., 2012.
3. Groover M.P., "Automation, Production Systems and Computer Integrated Manufacturing ", 5th edition, Pearson College Div, 2018.
4. Serope Kalpakjian and Steven R. Schmid, "Manufacturing Engineering and Technology", 7th edition, Pearson Education, 2018.
5. Taiichi Ohno, "Evolution of Toyota Production System", Kindle Edition, Amazon Asia-Pacific Holdings Private Limited, 2017.

Mapping of Course Outcomes with Programme Outcomes:
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	Programme Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	1	3	2	2	2	-	2	-	3	2	1	1
CO2	1	2	2	1	2	2	-	3	2	2	2	2	2	1
CO3	2	3	2	-	-	2	2	1	-	-	2	1	-	2
CO4	3	2	2	2	2	1	1	2	3	-	1	-	2	3
CO5	2	2	1	-	1	3	2	1	3	2	2	1	-	-

OPEN ELECTIVE –II (OE)

MT16906 VETRONICS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the role of vetronics in defense applications.
- gain adequate knowledge on engine control, fuel delivery systems and MPFI.
- introduce the methods for transmission control and safety systems.
- understand the components of an airplane and their functions.
- introduce the basics of marine engineering.

UNIT I FUNDAMENTALS OF VEHICLE ENGINEERING 9

Engine - Types - Modern Engines - Advanced GDI, Turbo-charged engines Transmissions, Chassis systems - Need for Avionics in Civil and Military aircraft and Space systems.

UNIT II AUTOMOTIVE ENGINE CONTROL, MONITORING AND DIAGNOSTICS SYSTEMS 9

Components of Electronic Engine Management - Engine control functions, Engine control modes, Fuel delivery systems, MPFI, Ignition Systems, Diagnostics - Compression Ignition Engines - Emission control Management - Hybrid Power Plants - BAS.

UNIT III AUTOMOTIVE TRANSMISSION AND SAFETY SYSTEMS 9

Transmission control - Autonomous cruise control - Braking control, ABS - Traction control, ESP, ASR - Suspension control - Steering control - Stability control - Parking Assist Systems - Safety Systems, SRS, Blind Spot Avoidance - Auto transmission electronic control, Telematics, Automatic Navigation, Future Challenges.

UNIT IV AIRCRAFT MECHATRONICS 9

Fundamentals - components of an airplane and their functions - motions of a plane - Inertial Navigation - Sensors – Gyroscope - Principles, Gyro equations, Rate Gyros - Rate integration and free Gyro, Vertical and Directional Gyros, Laser Gyroscopes, Accelerometers. Direct reading compass, Types of actuation systems - Linear and non-linear actuation system, modeling of actuation systems, Servo - loop analysis actuator design - testing methodologies, Performance testing equipment’s for sensors and actuation systems. Measurement and control of Pressure, temperature fuel quantity, rpm, torque, engine vibration and power. Electrical Power requirement for Military and Civil standards. Satellite navigation - GPS - system description - basic principles - position and velocity determination.

UNIT V MARINE MECHATRONIC SYSTEMS 9

Basics of Marine Engineering - Marine Propulsion Mechatronics elements in ships, submarines, Variable Buoyancy Systems.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- gather the knowledge in particularly of automotive engines.
- acquire knowledge on engine controls and fuel delivery systems.
- understand the various transmission control systems, electromagnetic interference and electronic dashboard instruments in automobiles, aircraft and marine applications.
- distinguish between various components of an airplane and their functions.
- familiarize various marine propulsion mechatronics and their technical aspects.

TEXT BOOKS

1. William B.Ribbens, "Understanding Automotive Electronics: An Engineering Perspective", - 8th Edition, Butterworth - Heinemann, 2017.
2. A. Galip Ulsoy, Huei Peng, and Melih Çakmakci, "Automotive Control Systems", Cambridge University Press, 2014.

REFERENCES

1. Tom Denton, "Automobile Electrical and Electronic Systems", 5th edition, Routledge, 2107.
2. Robert Bosch GmbH, "Bosch Automotive Electrics and Automotive Electronics", 5th edition, Springer Nature, 2014.
3. Amir Almslmany, "Recent Advancements in Airborne Radar Signal Processing: Emerging Research and Opportunities", 1st edition, IGI Global, 2018.
4. Hamid Reza Karimi, "Offshore Mechatronics Systems Engineering", 1st edition, CRC Press, 2018.

Mapping of Course Outcomes with Programme Outcomes:
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	Programme Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	-	-	-	2	-	-	-	2	-	-	-	1
CO2	-	1	-	-	1	1	-	1	-	2	-	-	-	2
CO3	2	-	-	-	2	-	-	3	-	-	-	2	-	2
CO4	2	1	-	-	2	1	-	1	-	2	-	2	-	2
CO5	2	-	-	-	2	-	-	3	-	-	-	1	-	1

MT16907 INDUSTRIAL AUTOMATION 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the basic objectives of a manufacturing industry and explain how automation and control technologies relate to control system.
- study the criteria in selecting a transducer for particular application.
- know the signal flow in a signal transmission system.
- outline the importance of PLC and SCADA in industrial automation.
- write PLC program using ladder diagram for simple applications.

UNIT I INTRODUCTION TO AUTOMATION 9

Introduction - automation principles and strategies - levels of automation - advanced automation functions - reasons for automation; industrial control system : continuous control system - discrete control systems - robot control system.

UNIT II HARDWARE COMPONENTS FOR AUTOMATION 9

Transducers - capacitive transducer - piezo electric transducer - hall effect transducer - thermo electric transducer - photo electric transducer.

UNIT III SIGNAL CONDUCTION AND DATA TRANSMISSION 9

Functions of signal conditioning equipment - amplification - types of amplifier; mechanical - fluid - optical - electrical and electronics. Signal transmission - converters.

UNIT IV PROGRAMMABLE LOGIC CONTROLLER 9

Introduction - parts of PLC - PLC hardware components - output control devices - timers; ON delay, OFF delay - counters; UP counter, DOWN counter - introduction about SCADA

UNIT V APPLICATION OF PLC 9

Simple material handling application - automatic control of ware house door - automatic lubrication of supplier conveyor belt - automatic car washing system - bottle label detection and process control application.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- describe working of various blocks of basic industrial automation system.
- learn the various types of transducers, basic principle of working and their applications.
- perform the frequency domain analysis of the signals in a signal transmission system.
- ability to apply PLC timers and counters for the control of industrial processes.
- develop PLC ladder program for a given application.

TEXT BOOKS

1. A.K. Sawhney and Puneet Sawhney, "A Course in Mechanical Measurements and Instrumentation and Control", Dhanpat Rai and Co. (P) Limited, 2017.
2. Frank D. Petruzella, "Programmable Logic Controllers", 4th edition, McGraw Hill Education India Private Limited, 2017.

REFERENCES

1. John W. Webb and Ronald A. Reis, "Programmable Logic Controllers: Principles and Applications", 5th edition, Pearson Education India, 2015.
2. Stuart A Boyer, "SCADA: Supervisory Control and Data Acquisition", International Society of Automation; 4th edition, 2016.
3. Mikell P. Groover, "Automation, Production Systems, and Computer-Integrated Manufacturing", 5th edition, Pearson College Div, 2018.

Mapping of Course Outcomes with Programme Outcomes:
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programme Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	-	2	2			3	-	1	-	2	-
CO2	2	2	-	-	-	3			3	-	1	-	1	-
CO3	1	2	-	-	2	1			3	-	3	-	-	-
CO4	3	2	-	-	2	2			-	-	2	-	3	-
CO5	2	2	-	-	2	2			3	-	2	-	2	-

MT16908 ADVANCED MANUFACTURING MANAGEMENT 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- impart knowledge on the pace of changes in the manufacturing technology.
- impart the knowledge of various principles group technology and flexible manufacturing systems.
- discuss various types of software, simulation and database of FMS.
- show how lean manufacturing principles are implemented in an organization.
- discuss the characteristics of JIT and implementation issues.

UNIT I MANUFACTURING IN A COMPETITIVE ENVIRONMENT 9

Automation of manufacturing process - Numerical control - Adaptive control – material handling and movement - Industrial robots - Sensor technology - flexible fixtures - Design for assembly, disassembly and service.

UNIT II GROUP TECHNOLOGY AND FLEXIBLE MANUFACTURING SYSTEMS 9

Part families - classification and coding - Production flow analysis - Machine cell design - Benefits. Components of FMS - Application work stations - Computer control and functions - Planning, scheduling and control of FMS - Scheduling - Knowledge based scheduling - Hierarchy of computer control - Supervisory computer

UNIT III COMPUTER SOFTWARE, SIMULATION AND DATABASE OF FMS 9

System issues - Types of software - specification and selection - Trends - Application of simulation - software - Manufacturing data systems - data flow - CAD/CAM considerations - Planning FMS database

UNIT IV LEAN MANUFACTURING 9

Objectives of lean manufacturing - key principles and implications of lean manufacturing - Traditional Vs lean manufacturing - Lean benefits - Value creation and waste elimination - Major kinds of wastes - pull production - different models of pull production - continuous flow-continuous improvement / Kaizen - Worker involvement - Implementation of Lean Concept.

UNIT V JUST IN TIME 9

Characteristics of JIT - Pull method - quality - small lot sizes - work station loads - close supplier ties - flexible work force - line flow strategy - preventive maintenance - Kanban system - strategic implications - implementation issues - Lean manufacture.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- demonstrate an understanding of competitive manufacturing environment.
- understand the principles of Group technology and FMS.
- study in detail about the software and database role FMS.
- understand the principles of Lean Manufacturing and ability to implement inorganization.
- demonstrate the concept of JIT principle in a manufacturing system.

TEXT BOOKS

1. Groover M.P., "Automation, Production Systems and Computer Integrated Manufacturing ", 5th edition, Pearson College Div, 2018.

REFERENCES

1. Serope Kalpakjian and Steven R. Schmid, “Manufacturing Engineering and Technology”, 7th edition, Pearson Education, 2018.
2. Taiichi Ohno, “Evolution of Toyota Production System”, Kindle Edition, Amazon Asia-Pacific Holdings Private Limited, 2017.
3. John Nicholas, “Lean Production for Competitive Advantage: A Comprehensive Guide to Lean Methodologies and Management Practices”, 2nd edition, Productivity Press, 2018.
4. Pascal Dennis, “Lean Production Simplified: A Plain-Language Guide to the World's Most Powerful Production System”, 3rd edition, Productivity Press, New York, 2016.

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	-	-	-	-	-	1	-	-	1	2	-	3	-
CO2	1	-	-	-	2	2	-	2	-	2	2	-	2	-
CO3	1	-	-	-	1	2	1	2	-	-	2	-	3	-
CO4	1	-	-	-	2	1	-	2	-	2	2	-	2	-
CO5	1	-	-	-	-	1	1	-	-	-	3	-	2	-

MT16909 INTELLIGENT MANUFACTURING TECHNOLOGY 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the basics of sensors in manufacturing.
- gain knowledge on different types of sensors in manufacturing.
- explain the sensors for process monitoring.
- know the concept of condition monitoring and selection of sensors.
- learn about the various automatic identification techniques.

UNIT I INTRODUCTION 9

Introduction - Role of sensors in manufacturing automation-operation principles of different sensors - electrical, optical, acoustic, pneumatic, magnetic, electro optical, photo - electric, vision, proximity, tactile, range sensors.

UNIT II SENSORS IN MANUFACTURING 9

Sensors in manufacturing - Temperature sensors in process control - Pressure sensors - Fiber optic sensors and their principles and applications - Displacement sensor for robotic application - Sensors for CNC machine tools - Linear and angular position sensors, velocity sensors. Sensors in Robotics - encoder, resolver, potentiometers, range, proximity, touch sensors.

UNIT III PROCESS MONITORING 9

Principle, Sensors for Process Monitoring - online and off line quality control, Quality parameter design Direct monitoring of fault based on process signals.

UNIT IV CONDITION MONITORING 9

Condition monitoring of manufacturing systems - principles - sensors for monitoring force, vibration and noise. Selection of sensors and monitoring techniques. Acoustics emission sensors - principles and applications - online tool wear monitoring.

UNIT V AUTOMATIC IDENTIFICATION TECHNIQUES 9

MRP - MRPII - Shop floor control - Factory data collection systems - Automatic identification methods - Bar code technology, automated data collection system - agile manufacturing - flexible manufacturing - Enterprise integration and factory information system.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- recognize role of sensors in manufacturing automation, including operation principles.
- evaluate the performance of sensors measurement and management in modern day manufacturing systems.
- analyze the process monitoring systems to improve performance of online and off line quality

control.

- illustrate principles of automatic identification techniques.
- illustrate concepts and applications of MRP, shop floor control, agile manufacturing, flexible manufacturing and factory information system.

TEXT BOOKS

1. Sabrie Salomon, “Sensors and Control Systems in Manufacturing”, 2nd edition, McGraw-Hill Education, 2010.
2. Groover M.P., "Automation, Production Systems and Computer Integrated Manufacturing ", 5th edition, Pearson College Div, 2018.

REFERENCES

1. Laurent A. Francis and Krzysztof Iniewski, “Novel Advances in Microsystems Technologies and Their Applications”, 1st edition, CRC Press, 2017.
2. Randy Frank, “Understanding Smart Sensors”, 3rd edition, Artech House, 2013.
3. Nicholas Odrey, Mitchell Weiss, Mikell Groover, Roger Nagel and Ashish Dutta, “Industrial Robotics - SIE: Technology - Programming and Applications”, 2nd edition, McGraw Hill Education, 2017.

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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CO2	1	-	-	-	1	1	-	2	-	1		-	1	-
CO3	1	-	-	-	1	1	1	1	-	-	1	-	1	-
CO4	1	-	-	-	1	1	-	1	-	2	2	-	2	-
CO5	1	-	-	-	-	1	1	-	-	-	-	-	-	-

MT16910 NANO TECHNOLOGY 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the need of nano technology and its physical scale nature.
- know characterization synthesis method of nanotechnology.
- understand the various sensor used in nano sensing.
- understand the need of molecular nano machines and nano tribology.
- understand the application of various industrial nano technology.

UNIT I INTRODUCTION TO NANO 9

Nano and nature - physical scales of nano technology - Genealogy and Philosophy of nano technology - Methods of measuring properties - structure - Microscopy - Spectroscopy.

UNIT II CHARACTERIZATION METHODS 9

Electron microscope - image collection in electron microscopes - scanning electron microscopy (SEM) - scanning transmission electron microscopy (STEM) - scanning probe microscopes - scanning tunnelling microscopy - scanning probe lithography - optical microscopes for nano science and technology - x ray diffraction.

UNIT III NANO SENSORS 9

Introduction - nano scale organization for sensors characterization - nano sensors based on optical properties - nano sensors based on quantum size effects - electrochemical sensors - sensors based on physical properties - nano biosensors - smart dust.

UNIT IV MOLECULAR NANOMACHINES AND NANOTRIBOLOGY 9

Introduction - covalent and non-covalent approaches - molecular motors and machines - molecular devices - single molecule devices - tribology at nanoscale - Nano tribology applications.

UNIT V INDUSTRIAL NANO TECHNOLOGY 9

Nano particles and microorganism - nano materials in bone substitutes and dentistry, food and cosmetic applications - textiles, paints, catalysis, drug delivery and its applications.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- demonstrate the understanding of length scales concepts, nanostructures and nanotechnology.
- discuss and evaluate state-of-the-art characterization methods for nanomaterials, and determine nanomaterial safety and handling methods required during characterization.
- demonstrate knowledge in design and structuring of nano interfaces for sensors.

- illustrate the principles involved in a nano machine and applications of studying nano tribology.
- explain the fundamental principles of nanotechnology and their application to biomedical engineering.

TEXT BOOKS

1. Pradeep. T , "NANO: The Essentials: Understanding Nanoscience and Nanotechnology" , 1st edition, McGraw Hill Education, 2017.
2. Joseph Natowitz and Christian Ngo, "Our Nanotechnology Future (Atlantis Advances in Nanotechnology, Material Science and Energy Technologies)", Amsterdam University Press, 2017.

REFERENCES

1. Wesley C. Sanders, "Basic Principles of Nanotechnology", 1st edition, CRC Press, 2018.
2. M. A. Shah and K. A. Shah, "Nanotechnology: The Science of Small", 2nd edition, Wiley, 2019.

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	Programme Outcomes (POs)													
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CO2	1	2	2	1	2	2	-	3	2	2	2	2	2	1
CO3	2	3	2	-	-	2	2	1	-	-	2	1	-	2
CO4	3	2	2	2	2	1	1	2	3	-	1	-	2	3
CO5	2	2	1	-	1	3	2	1	3	2	2	1	-	-