PAAVAI ENGINEERING COLLEGE, NAMAKKAL – 637 018

(AUTONOMOUS)

B.E. MECHATRONICS

REGULATONS - 2015

CURRICULUM

SEMESTER VII

S. No	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PC	MT15701	CAM and Automation	3	0	0	3
2	PC	MT15702	Mechatronics System Design	3	0	0	3
3	PC	MT15703	Robotics and Machine Vision System	3	0	0	3
4	PC	MT15704	Automobile Engineering	3	0	0	3
5	PE	*******	Programme Elective - III*	3	0	0	3
6	PE	*******	Programme Elective - IV*	3	0	0	3
Practical							
7	PC	MT15705	CAD/CAM Laboratory	0	0	2	1
8	PC	MT15706	Robotics Laboratory	0	0	2	1
9	EE	MT15707	Mini Project	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	MT15801	Automotive Electronics	3	0	0	3
2	PE	*******	Programme Elective - V*	3	0	0	3
3	PE	MT1565*	Programme Elective - VI*	3	0	0	3
Practical							
4	EE	MT15802	Project Work	0	0	12	6
			Total	**9**	**0**	**12**	**15**

PROGRAMME ELECTIVE COURSES (PE)

PROGRAMME ELECTIVE - III

S. No	Category	Course Code	Course Title	L	T	P	C
1	PE	MT15351	Engineering Economics and Cost Analysis	3	0	0	3
2	PE	MT15352	Computer Integrated Manufacturing	3	0	0	3
3	PE	MT15353	Computational Fluid Dynamics	3	0	0	3
4	PE	IT15501	Computer Networks	3	0	0	3
5	PE	MT15354	Design of Jigs, Fixtures and Press Tools	3	0	0	3

PROGRAMME ELECTIVE - IV

S. No	Category	Course Code	Course Title	L	T	P	C
1	PE	MT15451	Biomedical Instrumentation	3	0	0	3
2	PE	MT15452	MEMS and NEMS	3	0	0	3
3	PE	BA15254	Principles of Management	3	0	0	3
4	PE	MT15453	Un-Conventional Machining Processes	3	0	0	3
5	PE	MT15454	Industrial Electronics and Applications	3	0	0	3

PROGRAMME ELECTIVE - V

S. No	Category	Course Code	Course Title	L	T	P	C
1	PE	BA15253	Total Quality Management	3	0	0	3
2	PE	IT15302	Database Management Systems	3	0	0	3
3	PE	MT15551	Additive Manufacturing	3	0	0	3
4	PE	MT15552	Advanced Sensor Technology	3	0	0	3
5	PE	MT15553	Renewable Energy Sources	3	0	0	3

PROGRAMME ELECTIVE - VI

S. No	Category	Course Code	Course Title	L	T	P	C
1	PE	MT15651	Intellectual Property Rights	3	0	0	3
2	PE	MT15652	Artificial Intelligence	3	0	0	3
3	PE	MT15653	Concepts of Engineering Design	3	0	0	3
4	PE	MT15654	Internal Combustion Engines	3	0	0	3
5	PE	MT15655	Flexible Manufacturing Systems	3	0	0	3

SEMESTER VII

MT15701 CAM AND AUTOMATION 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the concept of manufacturing planning and group technology.
- impart knowledge about fundamentals of the vision system.
- understand the concept of lighting systems.
- impart knowledge about latest machine vision techniques.
- apply various automatic material handling techniques.

UNIT I COMPUTER AIDED MANUFACTURING AND GROUP TECHNOLOGY 9

Introduction - manufacturing planning - manufacturing control - Computer Integrated Manufacturing; Flexible manufacturing systems - components - types of systems - FMS layout and FMS benefits; Computer Aided Process Planning - Retrieval CAPP - Benefits of CAPP; Introduction to Group Technology - part families.

UNIT II INTRODUCTION AND FUNDAMENTALS OF VISION SYSTEM 9

Vision system - human vision - disadvantages; Machine vision - advantages - components and working principles of MVS - Fundamental of Imaging - MVS specifications - Design requirements; Human Machine Interfaces.

UNIT III LIGHTING SYSTEM 9

Importance of Illumination light and light perception - light characteristics; Light sources - Monochromatic light, White light, UV, IR, LED and Laser polarized lighting - Filtered lighting; Types of illuminator techniques.

UNIT IV IMAGE ANALYSIS AND IMAGE PROCESSING 9

Introduction to digital images - Image analysis basic - scalar - arithmetic - Image enhancement thresholding - Histogram - Line profile - Intensity measurement; Image processing lookup tables (LUT) - Morphology - spatial filters; Particle measurement - dimension measurement - edge detection - alignment - pattern matching.

UNIT V AUTOMATED MATERIAL HANDLING AND INSPECTION 9

Introduction to Automated Guided Vehicle (AGV) Systems; Automated Storage and Retrieval System (AS/RS) - basic components - types and its application; Automated inspection principles - off line and on line inspection - distributed inspection and final inspection.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- learn on application of computers in the manufacturing scenario.
- understand the basic structure & working of machine vision system.
- comprehend the working and importance of lighting system.
- develop knowledge based on image processing.
- gather knowledge about AS, RS and AGV's.

TEXT BOOKS

1. Mikell P. Groover, Automation, Production Systems, and Computer-integrated Manufacturing, Prentice Hall, 2015.
2. Harley R. Myler , Fundamentals of Machine Vision , Prentice - Hall, 2007.

REFERENCES

1. Louis J Galbiati , Image Processing Fundamentals, Prentice -Hall,2008.
2. D. Richard Klafter, Thomas A Cmielewski and Michael Negin, Robotic Engineering, An Integrated Approach, Prentice Hall of India, New Delhi, 1999.
3. M. P. Groover, Mitchell Weiss, N.Roger Nagel and G. Odrey, Industrial Robotics, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 2005.
4. Yoram Koren, Computer Control of Manufacturing Systems, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 2005.

WEB LINKS

1. nptel.ac.in/courses/112102011/
2. nptel.ac.in/courses/112102101/
3. https://www.youtube.com/watch?v=fmralr8DJFc.

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	-	-	-	2	-	-	-	2	1	-	2	-
CO2	2	1	-	-	-	3	-	1	-	2	1	-	-	-
CO3	-	3	-	2	-	-	-	3	-	-	2	-	-	-
CO4	2	3	-	-	-	2	-	1	-	3	2	-	-	-
CO5	-	2	-	2	-	-	-	3	-	-	2	-	-	-

MT15702 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 & son Ltd, 2003.

REFERENCES

1. Bishop, Robert H, "Mechatronics Hand book", CRC Press, 2002.
2. Bradley, D.Dawson, N.C. Burd and A.J. Loader, "Mechatronics: Electronics in Products and Processes”, CRC Press 1991 , First Indian print 2010.
3. De Silva, "Mechatronics: A Foundation Course", Taylor & Francis, Indian Reprint, 2013.

WEB LINKS

1. nptel.ac.in/courses/112103174/
2. nptel.ac.in/noc/individual_course.php?id=noc17-me10
3. https://www.youtube.com/watch?v=K3h9fCCwvpo

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	-	-	-	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

MT15703 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 technique - 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, "Industrial Robotics - Technology, Programming and Applications" Tata , McGraw-Hill Education Pvt Limited, 2008.
2. Sathya Ranjan Deb, "Robotics Technology & flexible Automation" Sixth edition, Tata McGraw - Hill Publication, 2003.

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: Sensing, Vision & Intelligence", Tata McGraw- Hill Publication, 1987.
3. John.J.Craig, "Introduction to Robotics: Mechanics & control", Second edition, 2002.
4. Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer, Indian Reprint, 2010.

WEB LINKS

1. nptel.ac.in/courses/112101098/25.
2. https://www.youtube.com/watch?v=dz_UKpjqsLU.

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	-	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

MT15704 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 & 2, Standard Publishers, 13th Edition, New Delhi, 2012.
2. Jain K.K. and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2017.

REFERENCES

1. Newton, Steeds and Garet, "Motor Vehicles", Butterworth Publishers,1989.
2. Joseph Heitner, "Automotive Mechanics," Second Edition, East-West Press, 1999.
3. Martin W, Stockel and Martin T Stockle, "Automotive Mechanics Fundamentals," The Good heart - Will Cox Company Inc, USA,1978.
4. Heinz Heisler, "Advanced Engine Technology," SAE International Publications USA,1998.
5. Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2007.

WEB LINK

1. https://www.wartsila.com/products/...oil.../engines.../wartsila-engines-auxiliary-systems
2. https://www.udemy.com/automobile-engineering-from-zero-to-100-for-everyone/
3. https://books.google.co.in/books?isbn=1119279321

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	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	-	-	-	-

MT15705 **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.
- gain practical experience in computer assisted part programming.
- operate and control CNC machine tools and CAM software.

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)														
	Programme Outcomes (POs)													
COs	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	-	-

MT15706 **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)														
	Programme Outcomes (POs)													
COs	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	-	-

MT15707 **MINI PROJECT** **0 0 4 2**

COURSE OBJECTIVES

To enable the students to

- formulate and plan for a technical project.
- execute the various tasks of the project and standard procedures.
- learn and use new tools, algorithms and techniques required to carry out the projects.
- perform validation of the product and the cost analysis, prepare a technical report of the project.

GUIDELINE FOR REVIEW AND EVALUATION

The students may be grouped into 2 to 4 and work under a project supervisor. The device/ system/ component(s) to be fabricated may be decided in consultation with the supervisor and if possible, with an industry. A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the department. At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the department.

TOTAL PERIODS 60

COURSE OUTCOMES

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

- describe the real-world problem, identify the requirement and develop the design solutions.
- explain the technical ideas, strategies and methodologies.
- use the new tools, algorithms, techniques that contribute to obtain the solution of the project.
- analyze and validate through conformance of the developed prototype and analysis the cost effectiveness.

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	3	-	3	-	-	-	-	-	-	1	-	3	3
CO2	1	1	-	2	-	-	3	3	-	-	-	3	2	1
CO3	2	2	-	-	-	-	2	2	-	-	2	2	-	2
CO4	2	2	-	-	-	-	2	-	-	-	3	-	2	2

SEMESTER VIII

MT15801 **AUTOMOTIVE ELECTRONICS** **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, Electronics & Computer Controls”, Delmar Publishers, 2001.

REFERENCES

1. Richard K. Dupuy “Fuel System and Emission controls”, Check Chart Publication, 2000.
2. Ronald. K. Jurgon, “Automotive Electronics Handbook”, McGraw-Hill, 1999.
3. Ribbens, "Understanding Automotive Electronics", 7th Edition, Elsevier, Indian Reprint, 2013.

WEB LINKS

1. https://www.ecnmag.com/blog/2012/05/evolution-automotive-electronics
2. http://www.mechscience.com/electronic-fuel-control-system
3. http://what-when-how.com/automobile/cruise-control-systems-automobile

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	-	-	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

MT15802 **PROJECT WORK** **0 0 12 6**

COURSE OBJECTIVES

To enable the students to

- develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- apply the new tools, algorithms and techniques required to carry out the projects.
- analyze various procedures for validation and cost effectiveness of the product.
- prepare project reports and present the project.

GUIDELINE FOR REVIEW AND EVALUATION

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

TOTAL PERIODS 180

COURSE OUTCOMES

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

- identify the real world problem, formulate the requirement and develop suitable design.
- identify the technical ideas, strategies and methodologies.
- use the new tools, algorithms, techniques to obtain the solution.
- validate the project and perform cost analysis, prepare report and present their project orally

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	-	-	-	-	-	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 - III

MT15351 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. James L Riggs- David D. Bedworth - "Engineering Economics"- Tata McGraw Hill- 1996.
2. A. Ramachandra Aryasri and V. V. Ramana Murthy - Engineering Economics and Financial Accounting - Tata McGraw-Hill Publishing Company Pvt. Ltd.- New Delhi - 2009.

REFERENCES

1. Prasanna Chandra, “Projects”, Tata McGraw Hill, 2003.
2. Patel Bhavesh . M, "Project Management, Strategic Financial Planning Evaluation and Control", Vikas Publishing House, New Delhi, 2000.
3. Varshney R Lnd Maheswari K L - "Managerial Economics"- S.Chand& Co - 1993.
4. Samuelson P A and Nordhaus W D- "Economics" - Tata McGraw Hill - 2001.

WEB LINK

1. www.investopedia.com/university/economics/economics3.asp
2. https://accountingexplained.com/managerial/capital-budgeting/
3. www.profitbooks.net/what-is-depreciation/

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	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	-	-	-

MT15352 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 TO AUTOMATION AND PROTOTYPING 9

Automation - Introduction - automation principles and strategies - basic elements of advanced functions - level modelling of manufacturing systems; RPT - definitions - evolution - CAD; Product design and Rapid product development - conceptual design - detail design; Prototyping - fundamentals of RP systems; 3D solid modeling software and their role in RPT - the creation of STL file.

UNIT II RAPID PROTOTYPING PROCESSES 9

Stereolithography; Solid Ground Curing; Fusion Deposition Modeling; Laminated Object Manufacturing - principle and applications; Selective Laser Sintering - 3D Printing.

UNIT III 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 IV 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 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; Lean manufacturing and 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", 2nd Edition, Pearson Education, 2004.
2. Radhakrishnan P, Subramanyan S, And Raju V., "CAD/CAM/CIM", 2nd Edition New Age International (P) Ltd., New Delhi, 2008.

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. et al., "Rapid Prototyping: principles and applications" Wiley, 2003.
4. Zeid I., "CAD/CAM: Theory & Practice", McGraw Hill, Singapore, 1991.

WEB LINKS

1. https://www.protosystech.com/rapid-prototyping.htm
2. http://cerasis.com/2016/01/12/manufacturing-technologies/
3. https://www.investopedia.com/terms/f/flexible-manufacturing-system.asp

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	-	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	-

MT15353 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, 2009.

REFERENCES

1. P. Ghosdastidar, Computational Fluid Flow and Heat Transfer, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi, 2003.
2. K. A. Hoffman, Computational Fluid Dynamics for Engineering, Engineering Education System, Austin, Texas 1989.
3. Muralidhar and T. Sundarajan, Computational Fluid Flow and Heat Transfer, Narosa Publishing House, New Delhi 2002.
4. S. V. Patankar, Numerical Heat Transfer and Fluid Flow, Hemisphere, New York, 1994.
5. T. J. Chung, Computational Fluid Dynamics, Cambridge University Press, Chennai 2003.

WEB LINK

1. nptel.ac.in/courses/112105045/10
2. https://www.mr;cfd.com/services/flow;regime;fluid;mechanics/heat;transfer/

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	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	-

IT15501 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 & 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	PO10	PO11	PO12	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

MT15354 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 G Hoffman, Jigs & Fixture Design, Thomson – Delmar Learning, Singapore 2004.
2. Joshi, P.H., "Jigs & Fixtures, Second Edition", Tata McGraw-Hill Publishing Company Limited, New Delhi 2004.

REFERENCES

1. Kempster, "Jigs & Fixtures Design, The English Language Book Society", 1978.
2. Donaldson, Lecain and Goold "Tool Design", 3rd Edition, Tata McGraw Hill, 2000.
3. Hiram E Grant, ' Jigs and Fixture' Tata McGraw-Hill, New Delhi, 2003.
4. Fundamentals of Tool Design, CEEE Edition, ASTME, 1983.
5. PSG College of Technology, Coimbatore - Design Data Handbook.

WEB LINKS

1. http://www.nitc.ac.in/dept/me/jagadeesha/mev303/CHAPT_INTRODUCTION_TO_JIGS_AND%20FIXTURES.pdf
2. https://en.wikipedia.org/wiki/Types_of_press_tools
3. http://www.arpnjournals.com/jeas/research_papers/rp_2014/jeas_0414_1057.pdf

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

PROGRAMME ELECTIVE - IV

MT15451 BIOMEDICAL INSTRUMENTATION 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- make the students to understand the role of instrumentation in bio medical applications.
- gain adequate knowledge on ECG, EEG and EMG.
- introduce the methods for conditioning.
- analyse parameters of medical imaging and its measurements.
- introduce the basis of signal conversion.

UNIT I INTRODUCTION 9

Cell structure - electrode - electrolyte interface - electrode potential - resting and action potential - electrodes for their measurement - ECG, EEG, EMG and EOG - machine description - methods of measurement - Stem cells.

UNIT II BIO MEDICAL SENSORS AND TRANSDUCERS 9

Basic transducer principles - types - source of bio electric potentials - resistive, inductive, capacitive, fiber-optic, photoelectric, chemical; active and passive transducers and their description and feature applicable for biomedical Instrumentation.

UNIT III SIGNAL CONDITIONING, RECORDING AND DISPLAY 9

Input isolation - DC amplifier - charge amplifier - power amplifier and differential amplifier - feedback Op-amp - electrometer amplifier - carrier amplifier - instrument power supply - oscillography - galvanometric - XY magnetic recorder - storage oscilloscopes - electron microscope - PMMC writing systems - telemetry principles.

UNIT IV MEDICAL MEASUREMENT AND MONITORING SYSTEMS 9

Blood pressure measurement - ultrasonic method - plethysmography - blood flow measurement – electromagnetic flow meter - cardiac output measurement - dilution method - phonocardiography - vector cardiography; Heart lung machine - artificial ventilator - Anesthetic machine - Basic ideas of CT scanner - MRI - ultrasonic scanner laser equipment and application - cardiac pacemaker - DC - defibrillator patient safety - electrical shock hazards.

UNIT V BIO MEDICAL DIAGNOSTIC INSTRUMENTATION 9

Introduction - computers in medicine - basis of signal conversion and digital filtering - data reduction technique - time and frequency domain technique - Biomatics.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- gain adequate knowledge on ECG, EEG and EMG.
- acquire knowledge on characteristics and applications of a variety of signal transducers.
- understand the various recording and display devices.
- distinguish between various health measurement and monitoring system.
- familiarize various medical equipment's and their technical aspects.

TEXT BOOKS

1. R. S. Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2014.
2. Cromwell, Weibell and Pfeiffer, Biomedical Instrumentation and Measurements, Prentice Hall of India. Learning. Ltd., New Delhi, 2011.

REFERENCES

1. R. Ananda Natarajan, Biomedical Instrumentation and Measurements, Prentice-Hall of India Pvt.Ltd; 2nd revised edition, 1995.
2. L. A. Geddes and Baker, L.E., Principles of Applied Bio-medical Instrumentation, John Wiley and Sons Publishing Company, New York, 1995.
3. W. J. Tompkins, Biomedical Digital Signal Processing, Prentice Hall of India Learning. Ltd., New Delhi, 2000.

WEB LINK

1. https://study.com/articles/Biomedical_Instrumentation_Courses_and_Training_Programs.html
2. http://www.tankonyvtar.hu/en/tartalom/tamop412A/2011_0079_jobbagy_biomedical/ch02.html
3. https://www.igi-global.com/article/biomedical-instrumentation/148682

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	3	1	3	-	2	1	1	3	3	1	2	3	3
CO2	1	1	3	-	1	1	2	2	2	1	1	3	-	1
CO3	2	1	-	1	-	-	-	2	3	2	1	-	3	2
CO4	-	-	2	2	2	3	2	1	-	-	3	2	-	3
CO5	1	1	-	-	1	3	-	-	1	1	-	1	2	-

MT15452 **MEMS AND NEMS** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- have a concept on the scope and recent development of the science and technology of micro and nano - systems.
- gain the physical knowledge underlying the operation principles and design of micro and Nano-systems.
- learn some typical or potentially applicable micro and nano-systems at the frontier of the development of the field.
- acquire knowledge on super conducting devices and molecular nanotechnology.
- understand the requirements and developments of nano systems.

UNIT I INTRODUCTION TO MICROSYSTEM **9**

Basics of MEMS; Microsystems and microelectronics; Working and principle of MEMS; Scaling loss in miniaturizations; Materials for MEMS - Silicon as MEMS materials; Crystal structure; Silicon compounds; Quartz; Polymers for MEMS; Properties of MEMS.

UNIT II MECHANICS FOR MICROSYSTEM AND FABRICATION TECHNIQUES **9**

Static bending of thin plates; Mechanical vibrations; Thermo mechanics - Fracture mechanics; Finite element analysis; stress analysis; Fabrication technique; Photo lithography; Diffusion; Oxidation; CVD; PVD; Etching process; Bulk micro manufacturing; Surface micro manufacturing; LIGA; SLIGA; Micro pumps.

UNIT III MICROSYSTEM PACKAGING AND APPLICATIONS **9**

Packaging techniques; Die preparation; Surface bonding; Wire bonding; Sealing; Applications of micro system; Automotive bio medical; Aerospace and telecommunications field.

UNIT IV NANO ELECTRONICS **9**

Basics of Nano-electronics; Nano electronics with tunneling devices - super conducting devices; Molecular nanotechnology - applications of MNT; Direct self-assembly - device assembly; Electrostatic self-assembly Nano tubes - Nano wire and carbon 60 - Die electrophoretic Nano assembly.

UNIT V ARCHITECTURE AND APPLICATIONS **9**

Architecture of MEMS; Requirements of Nano systems; Development of Nano electronics and structuring; Application of NEMS; Deposition of coatings; Three dimensional materials; Dewatering.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- understand the operation of micro devices; micro systems and their applications.
- design the micro devices; micro systems using the MEMS fabrication process.
- gain a knowledge of basic approaches for various sensor design.
- gain a knowledge of basic approaches for various actuator design.
- develop experience on micro/Nano systems for photonics.

TEXT BOOKS

1. Tai - Ran Hsu,"MEMS& Microsystems: Design and Manufacture ", Tata Mc Graw Hill, 2014.
2. Michael PycraftInrushes , "Nano Electro Mechanics in Engineering & biology '' ,CRC press New York, 2011.

REFERENCES

1. Marc Madou, "Fundamentals of Microfabrication", CRC Press, New York, 2009.
2. Norio Taniguchi, "Nano Technology", Oxford University Press, New York, 2010.
3. Chang Liu, "Foundation Of MEMS", Pearson education India limited, 2006.

WEB LINKS

1. http://www.st.com/en/mems;and;sensors.html
2. http://www.understandingnano.com/mems.html

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
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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	-	-

BA15254 **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 & 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 & 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 & Entrepreneurial Perspective", Tata McGraw- Hill Education, 2010.
2. James A.F. Stoner & 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.
4. L.M. Prasad, "Principles of Management", Sultan Chand & Sons, New Delhi, 9/e, 2015.

WEB LINKS

1. https://www.slideshare.net/ersmbalu/principles-of-management-lecture-notes
2. mbaexamnotes.com/principles-of-management.html
3. https://www.cliffsnotes.com/study-guides/principles-of-management

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	-	-	-	1	2	3	1	2	-	3	2	1	2
CO2	2	-	-	-	1	2	2	2	2	-	2	1	-	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	-	-	2

MT15453 UN-CONVENTIONAL MACHINING PROCESSES 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- learn about various unconventional 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 5

Unconventional machining process – need - classification - brief overview.

UNIT II MECHANICAL ENERGY BASED PROCESSES 10

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 10

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 10

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 10

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 unconventional 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. Vijay.K. Jain "Advanced Machining Processes" Allied Publishers Pvt. Ltd., New Delhi, 2007.
2. Pandey P.C. and Shan H.S. "Modern Machining Processes" Tata McGraw; Hill, New Delhi, 2007.
3. Hassan Abdel-Gawad El-Hofy, "Advanced Machining Processes: Nontraditional and Hybrid Machining Processes", McGraw-Hill Education , 1st Edition-2005.

REFERENCES

1. Benedict. G.F. "Nontraditional Manufacturing Processes", Marcel Dekker Inc., New York, 1987.
2. Mc Geough, "Advanced Methods of Machining", Chapman and Hall, London, 1998.
3. Paul De Garmo, J.T.Black, and Ronald.A.Kohser, "Material and Processes in Manufacturing" Prentice Hall of India Pvt. Ltd., 8th Edition, New Delhi , 2001.

WEB LINKS

1. http://nptel.ac.in/courses/112105127/pdf/LM;37.pdf
2. http://nptel.ac.in/courses/112105127/pdf/LM;39.pdf
3. http://www.idc;online.com/control/Laser_Beam_Machining.pdf

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	-	-

MT15454 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 & 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 & 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. Chitode .J.S " Industrial Electronics " Technical Publications ,2009.
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 Baltelt, "Industrial electronics, devices, systems and applications", Delmar publishers, 1997.
2. Stephan L.Herman, Walter N.Alerich, "Industrial Motor Control", fourth edition, Delmar publishers, 1998.
3. Biswanath Paul, "Industrial Electronics and Control" Prentice Hall India publisher;2004.
4. P.Harrott; "Process Control"; Tata McGraw Hill;1991.

WEB LINK

1. www.industrial101.com/electronics/
2. http://www.pvisys.com/solutions/process;control.html
3. http://www.hirect.com/converters;inverters.html

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	1	1	2	2	-	-	-	-	-	-	-	-	1	1
CO2	2	1	2	1	-	-	-	-	-	-	-	-	1	1
CO3	2	1	1	1	1	-	-	-	-	-	-	-	1	1
CO4	1	1	1	1	1	-	-	-	-	-	-	-	1	1
CO5	2	1	2	1	1	-	-	-	-	-	-	-	2	1

PROGRAMME ELECTIVE - V

BA15253 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 and HR practices.

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 return on investment - Personnel management: recruitment, selection and training - Technology in agricultural 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 and HR practices.

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.

WEB LINKS

1. https://onlinecourses.nptel.ac.in/noc18_mg04
2. nptel.ac.in/courses/110105039/10
3. https://www.youtube.com/watch?v=ksR4Xy6tFcM.

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	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

IT15302 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.

WEB LINKS

1. www.nptelvideos.in/2012/11/database-management-system.html
2. nptel.ac.in/courses/106106093

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

MT15551 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, FDM and LOM.
- learn the principle, process parameters, applications of SLS, 3D Printing, EBM and LENS.
- create the concepts of RP system design and CATE.

UNIT I INTRODUCTION 9

Overview - history - need - classification - additive manufacturing technology in product development - materials for additive manufacturing technology - tooling - applications.

UNIT II CAD AND REVERSE ENGINEERING 9

Basic concept - digitization techniques - model reconstruction - data processing for additive manufacturing technology; CAD model preparation - part orientation and support generation - model slicing - tool path generation - software for additive manufacturing technology; MIMICS, MAGICS.

UNIT III LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS 9

Classification - Liquid based system - Stereolithography Apparatus (SLA) - principle, process, advantages and applications - Solid based system - Fused Deposition Modeling - principle, process, advantages and applications, Laminated Object Manufacturing.

UNIT IV POWDER BASED ADDITIVE MANUFACTURING SYSTEMS 9

Selective Laser Sintering - principles of SLS process - process, advantages and applications, Three-Dimensional Printing - principle, process, advantages and applications - Laser Engineered Net Shaping (LENS), Electron Beam Melting.

UNIT V MEDICAL AND BIO-ADDITIVE MANUFACTURING 9

Customized implants and prosthesis: Design and production; Bio - Additive Manufacturing - Computer Aided Tissue Engineering (CATE) - Case studies.

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.
- develop the various printer models using RP process.
- create the model using various bio- additive manufacturing processes.

TEXT BOOKS

1. Chua Chee Kai, Leong Kah Fai and Lim Chu Sing, Rapid Prototyping: Principles and Applications, World Scientific Publishing Company, Singapore, 2010.
2. Gebhardt A., "Rapid prototyping", Hanser Gardener Publications, 2003.

REFERENCES

1. Frank W. Liou, Rapid Prototyping and Engineering Applications: A toolbox for prototype development CRC Press- Technology and Engineering, 2007.
2. Chua C.K. et al., "Rapid Prototyping: principles and applications" Wiley, 2003.
3. Paul F. Jacobs: Stereo Lithography and other RP & M Technologies, SMENY, 1996.
4. D. T. Pham and S. S. Dimov, Rapid Manufacturing, Springer-Verlag, London, 2001.

WEB LINK

1. https://www.protosystech.com/rapid-prototyping.htm
2. www.worldscientific.com › All Publications › All Books › Rapid Prototyping
3. https://uni.edu/~rao/rt/tooling.htm

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	3	2	2	2	-	2	-	1	2	1	-
CO2	2	-	2	1	2	1	-	-	2	2	-	1	1	1
CO3	1	3	-	-	1	2	2	1	-	-	1	1	-	2
CO4	-	-	1	2	1	-	1	-	3	-	1	-	2	1
CO5	1	1	3	-	-	2	2	1	3	2	1	2	-	-

MT15552 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. Sensors Hand Book Sabaree Soloman ; Sensors Hand Book, McGraw Hill,1998.
2. Smith H.M. ; Principles of Holography, John Wiley & Sons, New York, 1975.
3. J.G. Webster Medical Instrumentation Application and Design, Houghton Mifilin Co. 2004.

REFERENCES

1. Carr and Brown; Introduction to Medical Equipment Technology, Addison Wesley. 1999.
2. Culshaw B and Dakin J (Eds) Optical Fibre Sensors, Vol. 1 & 2 Artech House, Norwood.(1989).
3. P. Garnell– Guided Weapon Control Systems - Pergamon Press. 1980.

WEB LINKS

1. https://electronicsforu.com/technology;trends/must;read/biomedical;sensors;biotechnology
2. https://www.nap.edu/read/4782/chapter/4
3. http://www.i;con.com/support/troubleshooting/sensors.aspx

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	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	-	-	-

MT15553 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, 2011.
2. B.H.Khan, “Non-Convention Energy Resources”, 2nd Edition, Tata McGraw Hill, 2009.

REFERENCES

1. Garg.H. P and Prakash. J., “Solar Energy - Fundamentals and applications”, 21st revised edition, Tata McGraw Hill, 2000.
2. Freris L.L., “Wind Energy Conversion Systems”, Prentice Hall, 1990.
3. David M. Mousdale – “Introduction to Biofuels”, CRC Press, Taylor & Francis Group, USA 2010.
4. Sukhatme, S.P., “Solar Energy, Principles of Thermal Collection and Storage”, 3rd Edition, Tata MCGraw Hill, 2008.
5. Twidell, J.W. & Weir, A., “Renewable Energy Sources”, EFN Spon Ltd., UK, 2006.

WEB LINKS

1. https://www.seia.org/initiatives/about-solar-energy
2. https://www.energy.gov/eere/wind/wind-resource-assessment-and-characterization

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	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

PROGRAMME ELECTIVE - VI

MT15651 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 trademark registration - 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. Subbaram N.R., S. Viswanathan "Handbook of Indian Patent Law and Practice", Printers and Publishers Pvt. Ltd., 1998.

REFERENCES

1. Eli Whitney, “The United States Patent Number: 72X”, Cotton Gin, March 14, 1994.
2. Intellectual Property Today: Volume 8, No. 5, May 2001, [www.iptoday.com].
3. Derwent IP Matters “Using the Internet for non-patent prior art searches”, 2000.

WEB LINK

1. https://copyrightalliance.org/ca_faq_post/difference-copyright-patent-trademark/
2. www.ipmatters.net/features/000707_gibbs.html
3. https://www.wto.org/english/tratop_e/trips_e/intel4_e.htm

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	-	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	-	-	-

MT15652 **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. Elaine Rich, "Artificial Intelligence", McGraw-Hill Book Co., 2009.
2. Nils J. Nilsson, "Artificial Intelligence", Morgan Kaufman publishers, 2007.

REFERENCES

1. M. W. Richaugh, "Artificial Intelligence, A. Knowledge Based Approach", PWS Rent Publishing Boston, 1998.
2. Charniac. E and M.C.Dermott. "Introduction to Artificial Intelligence", Addison Wesley Publishing Company, 2002.
3. Robert Goodell Brown, "Materials Management Systems ; A Members Library", John Wiley Publishers, 1977.
4. Westing Fine and Zone, "Purchasing Management Principles", John Wiley Publishers, 1986.

WEB LINKS

1. https://onlinecourses.nptel.ac.in/noc18_cs18
2. https://www.youtube.com/watch?v=XCPZBD9lbVo

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	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

MT15653 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. Dieter, George E., "Engineering Design - A Materials and Processing Approach", McGraw Hill, International Editions, Singapore, 2000.

REFERENCES

1. Pahl, G, Beitz, W, Feldhusen, J, Grote, K.-H," Engineering Design- A systematic approach", Springer - Verlag, NY. 2007.
2. Ray, M.S., "Elements of Engg. Design", Prentice Hall Inc. 1985.
3. Karl T. Ulrich and Steven D. Eppinger "Product Design and Development" McGraw Hill Edition 2008.

WEB LINKS

1. https://node.nid.edu/learn/module/11-introduction
2. http://nptel.ac.in/courses/105108128/pdf/Index%20and%20bibilography/References.pdf

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

MT15654 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. R.B. and R.P. Sharma, "Internal Combustion Engines"., Dhanpat Rai & Sons 2007.
2. Duffy Smith, "Auto Fuel Systems", The Good Heart Willcox Company, Inc., 1987.
3. Eric Chowenitz, "Automobile Electronics", SAE Publications, 1995.

WEB LINK

1. https://www.wartsila.com/products/...oil.../engines.../wartsila-engines-auxiliary-systems
2. https://en.wikipedia.org/wiki/Spark-ignition_engine
3. nptel.ac.in/courses/112104033/2

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
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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	-	-	-

MT15655 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. Raouf, A. and Ben-Daya, M., Editors, "Flexible manufacturing systems: recent development", Elsevier Science, 1995.

REFERENCES

1. Radhakrishnan P. and Subramanyan S., "CAD/CAM/CIM", Wiley Eastern Ltd., New Age International Ltd., 1994.
2. Jha, N.K. "Handbook of flexible manufacturing systems", Academic Press Inc., 1991.
3. Groover M.P., "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India Pvt., New Delhi, 1996.
4. Kalpak jian, "Manufacturing Engineering and Technology", Addison-Wesley Publishing Co.,1995.
5. Taiichi Ohno, "Toyota Production System: Beyond large-scale Production", Productivity Press (India) Pvt. Ltd. 1992.

WEB LINKS

1. http://nptel.ac.in/courses/110106044/37
2. https://www.youtube.com/watch?v=BiOzGlaAE_8

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