K.L.N. COLLEGE OF ENGINEERING

Pottapalayam-630612, Sivagangai District

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Estd: 1994

FINAL YEAR
CURRICULUM AND SYLLABUS

REGULATIONS 2020

For Under Graduate Program

B.E. – MECHANICAL ENGINEERING

CHOICE BASED CREDIT SYSTEM

(For the students admitted from the academic year 2021-2022 onwards)

K.L.N. COLLEGE OF ENGINEERING, POTTAPALAYAM

(An Autonomous Institution, Affiliated to Anna University, Chennai)

VISION OF THE INSTITUTION

To become a Centre of Excellence in Technical Education and Research in producing Competent and Ethical professionals to the society.

MISSION OF THE INSTITUTION

To impart Value and Need based curriculum to the students with enriched skill development in the field of Engineering, Technology, Management and Entrepreneurship and to nurture their character with social concern and to pursue their career in the areas of Research and Industry**.**

VISION OF THE DEPARTMENT

To become a centre of excellence for Education and Research in Mechanical Engineering.

MISSION OF THE DEPARTMENT

- Attaining academic excellence through effective teaching learning process and state of the art infrastructure.
- Providing research culture through academic and applied research.
- Inculcating social consciousness and ethical values through co-curricular and extra-curricular activities.

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PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1 Graduates will have successful career in Mechanical Engineering and serviceindustries.

PEO 2 Graduates will contribute towards technological development through academic research and industrial practices.

PEO 3 Graduates will practice their profession with good communication, leadership, ethics and social responsibility.

PEO 4 Graduates will adapt to evolving technologies through life-long learning.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1 Derive technical knowledge and skills in the design, develop, analyze and manufacture of mechanical systems with sustainable energy, by the use of modern tools andtechniques and applying research based knowledge.

PSO 2 Acquire technical competency to face continuous technological changes in the field of mechanical engineering and provide creative, innovative and sustainable solutions to complex engineering problems.

PSO 3 Attain academic and professional skills for successful career and to serve the societyneeds in local and global environment.

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PO1: Engineering knowledge

Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis

Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions

Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems

Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage

Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society

Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability

Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics

Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work

Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication

Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance

Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning

Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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REGULATIONS 2020

For Under Graduate Program

B.E. – MECHANICAL ENGINEERING

CHOICE BASED CREDIT SYSTEM

CATEGORY OF COURSES

i. **Humanities and Social Sciences (HS) Courses** include Technical English, Environmental Science and Engineering, Engineering Ethics and human values, Communication Skills and Management courses.

ii. **Basic Sciences (BS) Courses** include Mathematics, Physics, and Chemistry.

iii. **Engineering Sciences (ES) Courses** include Engineering Practices, Engineering Graphics, Basics of Electrical / Electronics / Mechanical / Computer Engineering / Instrumentation etc.

iv. **Professional Core (PC) Courses** include the core courses relevant to the chosen programme of study.

v. **Professional Elective (PE) Courses** include the elective courses relevant to the chosen programme of study.

vi. **Open Elective (OE) Courses** include courses from other departments which a student can choose from the list specified in the curriculum of the students B.E. / B.Tech. Programmes.

vii. **Employability Enhancement Courses (EEC)** include Project Work and/or Internship, Seminar, Professional Practices, Case Study and Industrial/Practical Training.

viii. **Mandatory (MC) Courses** include Personality and Character development and the courses recommended by the regulatory bodies such as AICTE, UGC, e

SEMESTER VII

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	20ME701	Mechatronics	PC	3	3	0	0	3
2		Open Elective – II	OE	3	3	0	0	3
3		Professional Elective – IV	PE	3	3	0	0	3
4		Professional Elective – V	PE	3	3	0	0	3
5		Professional Elective – VI	PE	3	3	0	0	3
PRACTICAL								
6	20ME7L1	Mechatronics Laboratory	PC	4	0	0	4	2
7	20ME7L3	Technical Seminar	EEC	4	0	0	4	2
TOTAL				**23**	**15**	**0**	**8**	**19**

SEMESTER VIII

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICAL								
1	20ME8L1	Project Work	EEC	20	0	0	20	10
TOTAL				**20**	**0**	**0**	**20**	**10**

SEMESTER VII

OPEN ELECTIVE II

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	20OE205	Industrial Energy Auditing and Management	OE	3	3	0	0	3
2	20OE305	Fundamentals of Image Processing	OE	3	3	0	0	3
3	20OE405	Fundamentals of Machine Learning	OE	3	3	0	0	3
4	20OE407	Computer Graphics	OE	3	3	0	0	3
5	20OE408	Essentials of Data Analytics	OE	3	3	0	0	3
6	20OE507	Concepts of Ethical Hacking	OE	3	3	0	0	3
7	20OE606	Modern Technologies for Vehicles	OE	3	3	0	0	3
8	20OE607	New Generation Hybrid vehicles	OE	3	3	0	0	3
9	20OE608	Automotive Electrical and Electronic Systems	OE	3	3	0	0	3
10	20OE708	Instrumentation for Agro food industry	OE	3	3	0	0	3

OPEN ELECTIVE – II (VII SEMESTER) offered to other Department

SEMESTER VII ELECTIVE II

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	20OE105	Solar Photovoltaic Fundamentals and Applications	OE	3	3	0	0	3
2	20OE106	Fundamentals of Product Design	OE	3	3	0	0	3
3	20OE107	Autonomous and Electric Vehicles	OE	3	3	0	0	3
4	20OE108	Industrial Safety Practices	OE	3	3	0	0	3

Professional Elective Courses – Verticals

Vertical 1	Vertical 2	Vertical 3	Vertical 4	Vertical 5	Vertical 6
Design and Development	**Modern Manufacturing**	**Clean Energy Technologies**	**Robotics and Automation**	**Industrial Engineering**	**Modern Mobility Systems**
Product Design and Development	Unconventional Machining Processes	Compressible Flow and Turbomachinery	Applied Hydraulics and Pneumatics	Statistical Quality and Control	Automobile Engineering
Product Life Cycle Management	Computer Integrated Manufacturing Systems	Power Plant Engineering	Industrial Robotics	Process Planning and Cost Estimation	Advanced Internal Combustion Engines
Design of Jigs, Fixtures and Press Tools	Composite Material and Mechanics	Engine Pollution and Control	Sensors and Actuators	Production Planning and Control	Two wheeler and Four wheeler Overhauling
Piping Design Engineering	Additive Manufacturing	Energy Conservation and Management	Automation in Manufacturing	Supply chain and Logistic management	Battery Technology
Computational Fluid Dynamics	Testing of Materials	Renewable energy sources	Virtual Instrumentation	Engineering Economics and Cost Analysis	Alternative fuels for IC engines
Innovation in design	Digital Manufacturing	Fundamentals of HVAC Systems	Data Analytics for Mechanical Engineering	Maintenance Engineering	Intelligent Transportation systems
		Energy efficient Buildings	Micro Electro Mechanical Systems	Operations Research	

Registration of Professional Elective Courses from Verticals:

Professional Elective Courses will be registered in Semesters V to VII. These courses are listed in groups called verticals that represent a particular area of specialisation / diversified group. Students are permitted to choose all the Professional Electives from a particular vertical or from different verticals.

Enrolment for B.E. / B. Tech. Minor degree (Optional)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E./B.Tech (Honors) or B.E./B.Tech Minor degree. For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes. For more details on B.E./B.Tech (Honours) or Minor degree refer to the Regulations 2020 (Amendments), Clause 4 & Clause 16.

SEMESTER VII

20ME701	MECHATRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the functional key elements of mechatronics system.
- To study the characteristics and applications of various types of sensors and transducers.
- To impart knowledge in basic structure and programming of microprocessor.
- To learn about real-time interfacing system.
- To study the architecture, ladder logic program and applications of PLC.

PREREQUISITE:

Course code:20GE203

Course Name: Basic Electrical, Electronics and Instrumentation Engineering

UNIT - I INTRODUCTION TO MECHATRONICS - SENSORS AND TRANSDUCERS 9

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

UNIT – II MICROPROCESSOR AND MICROCONTROLLER 9

Introduction – Architecture of 8085 – Pin Configuration – Addressing Modes –Instruction set, Timing diagram of 8085- Assembly language programming – Examples. Concepts of 8051 microcontroller – Block diagram– Memory map - Addressing modes, I/O Ports.

UNIT – III PROGRAMMABLE PERIPHERAL INTERFACE 9

Introduction – Architecture of 8255, Keyboard interfacing, LED display –interfacing, ADC and DAC interface, Temperature Control – Stepper Motor Control – Traffic Control interface.

UNIT – IV PROGRAMMABLE LOGIC CONTROLLER AND VIRTUAL INSTRUMENTATION 9

Introduction – Basic structure and Specifications – Input and output processing – PLC hardware components Analog & digital I/O modules, Programming – Mnemonics – Timers, counters and internal relays – Data handling – Selection of PLC- Applications.

Virtual Instrumentation: Block diagram and architecture of a virtual instrument, data -flow techniques, graphical programming in data flows.

UNIT - V ACTUATORS AND MECHATRONIC SYSTEM DESIGN 9

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

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Bolton, W “Mechatronics”, Pearson Higher Education, 2017.
2. Ramesh S Gaonkar, “Microprocessor Architecture, Programming, and Applications with the 8085”, Prentice Hall, 6th Edition, 2013.
3. Michael B.Histand and Davis G. Alciatore, “Introduction to Mechatronics and Measurement systems”, McGraw Hill International edition, 2007.

REFERENCES:

1. Bradley D.A, Dawson D, Buru N.C and Loader A.J, “Mechatronics”, Chapman and Hall, 1993.
2. Clarence W, de Silva, "Mechatronics" CRC Press, First Indian Re-print, 2015.
3. Devadas Shetty and Richard A. Kolk, “Mechatronics Systems Design”, PWS publishing company, 2007.
4. Krishna Kant, “Microprocessors & Microcontrollers”, Prentice Hall of India, 2016.
5. Jovitha Jerome, “Virtual Instrumentation Using LabVIEW”, Kindle Edition, PHI Publishers, 2010.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: MECHATRONICS													**Course Code: 20ME701**		
CO	**Course Outcomes**												**Unit**	**K –CO**	**POs**	**PSO**
C401.1	Describe the interdisciplinary applications of Electronics, Electrical, Mechanical and Computer Systems for the Control of Mechanical, Electronic Systems and sensor technology.												I	K2	1,2,3	1,2,3
C401.2	Explain the architecture of Microprocessor and Microcontroller, Pin Diagram, Addressing Modes and Programming of Microprocessor and Microcontroller.												II	K2	1,2,3,4	1,2,3
C401.3	Discuss the Programmable Peripheral Interface, Architecture of 8255 PPI, and various device interfacing.												III	K2	1,2,3,4,5	1,2,3
C401.4	Describe the architecture, Programming and applications of Programmable Logic Controllers in industries.												IV	K2	1,2,3,4,5	1,2,3
C401.5	Explain the architecture, data flow techniques and graphical programming of Virtual Instruments.												IV	K2	1,2,3,4,5	1,2,3
C401.6	Discuss about the various actuators used in mechatronics system using the knowledge and skills acquired through the course.												V	K2	1,2,3,4,5	1,2,3
CO-PO Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	
C401.1	2	2	1	-	-	-	-	-	-	-	-	-	2	2	1	
C401.2	2	2	1	1	-	-	-	-	-	-	-	-	2	2	1	
C401.3	2	2	2	1	1	-	-	-	-	-	-	-	2	2	1	
C401.4	2	2	2	1	2	-	-	-	-	-	-	-	2	2	1	
C401.5	2	2	2	1	2	-	-	-	-	-	-	-	2	2	1	
C401.6	2	2	2	1	1	-	-	-	-	-	-	-	2	2	1	

20ME7L1	MECHATRONICS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To know the assembly language programming in microprocessor and microcontroller.
- To impart knowledge in the design, modeling & analysis of basic electrical, hydraulic, pneumatic system.
- To understand the working of interfacing circuits for stepper motor, servo motor and traffic light controller.
- To know the programming of LabVIEW and Fluidsim software.
- To understand the circuit connection for PLC based Electro Pneumatic system.

PREREQUISITE:

Course Code: 20GE203

Course name: Basic Electrical, Electronics and Instrumentation Engineering

LIST OF EXPERIMENTS

1. Assembly language programming of 8085 – Addition – Subtraction – Multiplication – Division – Sorting – Code Conversion.
2. Stepper motor interface.
3. Traffic light interface.
4. Speed control of DC motor.
5. Study of various types of optical transducers.
6. Study of hydraulic, pneumatic and electro-pneumatic circuits.
7. Modelling and analysis of basic hydraulic, pneumatic and electrical circuits using software.
8. Study of PLC based Electro Pneumatic circuit with multiple cylinder sequences.
9. Study of Image processing technique.
10. Real-time temperature data logging system with LabVIEW software and DAQ cards.
11. Study of Process control trainer for controlling pressure and flow rate of the liquid.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No.	Name of The Equipment	Quantity
1.	Basic Pneumatic Trainer Kit with manual and electrical Controls / PLC Control each	1
2.	Basic Hydraulic Trainer Kit	1
3.	Hydraulics and Pneumatics Systems Simulation Software	10
4.	8051 - Microcontroller kit with stepper motor and drive circuit sets	2
5.	8051 – Microcontroller kit with traffic light control and Dc motor control	1
6.	8085 microprocessor with interfacing kit	2
7.	Optical transducer trainer kit (LDR, Photo diode, Photo Transistor)	1
8.	Image processing system with hardware & software	1
9.	LabVIEW software with DAQ cards	2
10.	Process Control trainer kit	1

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: MECHATRONICS LABORATORY		Course Code: 20ME7L1			
CO	**Course Outcomes**	**Experiments**	**K –CO**	**POs**	**PSO**
C406.1	Develop the program for arithmetic functions and the program for sorting, code conversion functions.	1	K3	1,2,3,4,5,9	1,2,3
C406.2	Develop the program codes to interface with traffic light controller, stepper motor and DC motor.	2,3,4	K3	1,2,3,4,5,9	1,2,3
C406.3	Determine the performance characteristics of LDR, Photo diode and Photo transistors.	5	K3	1,2,3,4,5,9	1,2,3
C406.4	Construct the hydraulic, pneumatic and electro pneumatic circuits by using simulation software and also interface with PLC.	6,7,8	K3	1,2,3,4,5,9	1,2,3
C406.5	Develop graphical programming language codes for image analysis and temperature data logging system.	9,10	K3	1,2,3,4,5,9	1,2,3
C406.6	Construct the circuit to control the temperature, pressure and flow rate of the liquid in process control trainer kit by using DAQ cards with LabVIEW software.	11	K3	1,2,3,4,5,9	1,2,3

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C406.1	3	2	2	1	1	-	-	-	3	-	-	-	3	2	1
C406.2	3	2	2	1	1	-	-	-	3	-	-	-	3	2	1
C406.3	3	2	2	2	1	-	-	-	3	-	-	-	3	2	1
C406.4	3	2	2	1	1	-	-	-	3	-	-	-	3	2	1
C406.5	3	2	2	1	2	-	-	-	3	-	-	-	3	2	1
C406.6	3	2	2	1	1	-	-	-	3	-	-	-	3	2	1

20ME7L3 **TECHNICAL SEMINAR**

L	T	P	C
0	0	4	2

A student has to present three Technical papers or recent advances in engineering/technology that will be evaluated by a Committee constituted by the Head of the Department.

TOTAL: 60 PERIODS

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : TECHNICAL SEMINAR		**Course Code : 20ME7L3**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C407.1	Function effectively as an individual and Make effective presentation on Engineering/ technology.	-	K4	1-12	1,2
C407.2	Review, prepare and present technological developments in the field of mechanical engineering.	-	K4	1-12	1,2
C407.3	Design documentation and write effective reports on seminar topics	-	K4	1-12	1,2

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C407.1	3	3	2	1	1	1	1	1	1	1	1	1	2	2
C407.2	3	3	2	1	1	1	1	1	1	1	1	1	2	2
C407.3	3	3	2	1	1	1	1	1	1	1	1	1	2	2

Professional Elective Courses

		L	T	P	C
20MEV11	**PRODUCT DESIGN AND DEVELOPEMENT**	3	0	0	3

OBJECTIVES

- To understand various global trends and identify the scope of a new product development.
- To translate conceptual idea into detailed design.
- To understand the concept of product development.
- To impart knowledge on various industrial design process.
- To create prototype to demonstrate the product.

PREREQUISITE: NIL

UNIT - I INTRODUCTION 9

Strategic importance of Product development – Modern Product development process – Examples of Product development process - Understanding customer needs – Types of Customer needs - Gathering Customer needs – Benchmarking and Establishing Engineering Specifications – A benchmarking Approach - Examples.

UNIT – II CONCEPT GENERATION AND SELECTION 9

Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology –benefits.

UNIT - III PRODUCT ARCHITECTURE 9

Implications – Product change – variety – component standardization – product performance – manufacturability – product development management – establishing the architecture – creation – clustering – geometric layout development – fundamental and incidental interactions – related system level design issues.

UNIT – IV DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT 9

Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs– Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes

UNIT - V INDUSTRIAL DESIGN 9

Integrated process design – Managing costs – Robust design – Need for industrial design – impact – design process – investigation of for industrial design – impact – design process–conceptualization – refinement – management of the industrial design process – technology driven products – user – driven products – assessing the quality of industrial design.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Anita Goyal, Karl T Ulrich, Steven D Eppinger, “Product Design and Development”, Tata McGraw Hill Education, 4th Edition, 2009.
2. Kevin Otto, Kristin Wood, “Product Design”, Indian Reprint 2004, Pearson Education.
3. George E Dieter, Linda C Schmidt, “Engineering Design”, Mc-Graw Hill International Edition, 5th Edition, 2012

REFERENCES:

1.Kemnneth Crow, Concurrent Engg./Integrated Product Development, DRM Associates, 26/3,Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book.
2.Stephen Rosenthal, Effective Product Design and Development, Business One Orwin, Homewood, 1992.
3.Staurt Pugh, Tool Design -Integrated Methods for Successful Product Engineering, Addison Wesley Publishing, New york.
4.Reddy G B, “Intellectual Property Rights and the Law”, Gogia Law Agency, 7thEdition Reprint, 2009
5. Chiu-Shui Chan, “Style and creativity in design” Springer, 2015.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : PRODUCT DESIGN AND DEVELOPEMENT													Course Code : 20MEV11		
CO	**Course Outcomes**								**Unit**	**K-CO**			**POs**		**PSOs**
CO1	Explain the basic concepts of product design and development								I	K2			1,2,3,6,9,10		1,2,3
CO2	Describe the basic concepts of concurrent Engineering								I	K2			1,2,3,6,9,10		1,2,3
CO3	Generate various concepts for a product design and to select the best concept								II	K3			1,2,3,4,6,9,10		1,2,3
CO4	Discuss the concepts and importance of product architecture								III	K2			1,2,3,6,9,10		1,2,3
CO5	Illustrate the importance of industrial design in view of aesthetics factors and ergonomic factors								IV	K2			1,2,3,6,9,10		1,2,3
CO6	Apply design for manufacture guidelines for reducing manufacturing cost without compromising quality								V	K3			1,2,3,4,6,9,10		1,2,3
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	1	-	-	1	-	-	1	1	-	-	2	1	1
CO2	3	2	1	-	-	1	-	-	1	1	-	-	2	1	1
CO3	3	2	1	1	-	1	-	-	1	1	-	-	2	1	1
CO4	3	2	1	-	-	1	-	-	1	1	-	-	2	1	1
CO5	3	2	1	-	-	1	-	-	1	1	-	-	2	1	1
CO6	3	2	1	1	-	1	-	-	1	1	-	-	2	1	1

20MEV22	COMPUTER INTEGRATED MANUFACTURING SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the application of computers in manufacturing systems.
- To know the concept of cellular manufacturing systems.
- To familiarize about FMS and its applications.
- To comprehend the application of automation and AGVS in industry.
- To know the application of computer for generating process planning of the product.

PREREQUISITE: NIL

UNIT - I INTRODUCTION TO CIM AND AUTOMATION 9

Automation in Production Systems, automated manufacturing systems- types of automation, reasons for automating, Computer Integrated manufacturing, computerized elements of a CIM system, CAD/CAM and CIM.

Mathematical models and matrices: production rate, production capacity, utilization and availability, manufacturing lead time, work-in process, numerical problems.

UNIT – II CELLULAR MANUFACTURING SYSTEMS 9

Group technology-Part Families, Features and Optiz of Parts Classification and Coding Systems, Machine Cell Design, Applications Of Group Technology.

Quantitative analysis of Cellular Manufacturing, Grouping of parts and Machines by Rank Order Clustering method - Hollier Method – Simple Problems.

UNIT – III FLEXIBLE MANUFACTURING SYSTEMS 9

FMS- Flexibility – Types of FMS- Components - work stations –FMS layout configurations- Computer control and functions – Applications.

Analysis of flexible manufacturing systems – Bottleneck model – sizing the FMS –simple numerical problems.

UNIT – IV AUTOMATED ASSEMBLY SYSTEMS AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS) 9

Automation – Basic elements- power - program of instructions – control system – levels of automation. Fundamentals of automated assembly systems – system configurations - parts delivery – applications.

Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety.

UNIT - V COMPUTER AIDED PROCESS PLANNING SYSTEMS 9

Computer aided Process Planning – Variant process planning – Generative process planning– Forward and backward planning, input format.

Totally Integrated process planning systems – Expert process planning-Commercial systems: CAM-I, CAPP, MIPLAN, APPAS, CPPP.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Mikell.P.Groover “Automation, Production Systems and Computer Integrated Manufacturing”, Pearson Education Limited, 5th Edition, 2019.
2. Radhakrishnan P, SubramanyanS.andRaju V., “CAD/CAM/CIM”, New Age, International (P) Ltd, 4th Edition, 2016.
3. James A. Rehg, and Henry W Kraebber, ‘Computer-Integrated Manufacturing’, Pearson Education Limited, 2nd Edition, 2000.

REFERENCES:

1. Kant Vajpayee S, “Principles of Computer Integrated Manufacturing”, Prentice Hall India, 2003.
2. Gideon Halevi and Roland Weill, “Principles of Process Planning – A Logical Approach”, Chapman & Hall, 1995.
3. Rao. P, N Tewari&T.K. Kundra, “Computer Aided Manufacturing”, Tata McGraw Hill, Publishing Company, 2000.
4. Vollmann, T.E. and Bery, W.E., “Manufacturing Planning and Control Systems, Galgotia Publications, 5th Edition, 2004.
5. YoramKoren, ‘Computer Control of Manufacturing Systems’, McGraw Hill Education, Indian Edition, 2017.

REFERENCES

1. Kant Vajpayee S, “Principles of Computer Integrated Manufacturing”, Prentice Hall India, 2003.
2. Gideon Halevi and Roland Weill, “Principles of Process Planning – A Logical Approach”, Chapman & Hall, 1995.
3. Rao. P, N Tewari &T.K. Kundra, “Computer Aided Manufacturing”, Tata McGraw Hill, Publishing Company, 2000.
4. Vollmann, T.E. and Bery, W.E., “Manufacturing Planning and Control Systems, Galgotia Publications, 5th Edition, 2004.
5. Yoram Koren, ‘Computer Control of Manufacturing Systems’, McGraw Hill Education, Indian Edition, 2017.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : COMPUTER INTEGRATED MANUFACTURING SYSTEMS													**Course Code : 20MEV22**		
CO	**Course Outcomes**												**Unit**	**K –CO**	**POs**	**PSO**
CO1	Explain the knowledge about role of computer and automation in manufacturing.												I	K2	1,2,8,10	1,2,3
CO2	Explain the concept of group technology and formation of parts – machine cell.												II	K3	1,2,3,8,10	1,2,3
CO3	Explain the concept of FMS, and sizing of FMS systems.												III	K2	1,2,8,10	1,2,3
CO4	Describe the automation, types of automation and automation strategies.												IV	K2	1,2,8,10	1,2,3
CO5	Describe Automated Guided Vehicle System and its application.												IV	K2	1,2,8,10	1,2,3
CO6	Describe the application of computer in CAPP, and explore to integrated planning software.												V	K2	1,2,8,10	1,2,3
CO-PO Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	
CO1	2	1	-	-	-	-	-	1	-	1	-	-	2	1	1	
CO2	3	2	1	-	-	-	-	1	**2**	1	-	-	2	1	1	
CO3	2	1	-	-	-	-	-	1	-	1	-	-	2	1	1	
CO4	2	1	-	-	-	-	-	1	-	1	-	-	2	1	1	
CO5	2	1	-	-	-	-	-	1	-	1	-	-	2	1	1	
CO6	2	1	-	-	-	-	-	1	-	1	-	-	2	1	1	

20MEV35	PRODUCTION PLANNING AND CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the various components and functions of production planning and control
- To gain knowledge about method study, motion study and work study,
- To understand the product planning, process planning, production scheduling, Inventory Control.
- To know the recent trends like manufacturing requirement Planning (MRP II)
- To gain knowledge in Enterprise Resource Planning (ERP).

PREREQUISITE: NIL

UNIT - I INTRODUCTION 9

Production planning and control – Objectives, benefits, Functions. Types of production, Product development and design - Marketing, Functional, Operational, Durability and dependability, aesthetic aspect. Profit consideration- Standardization, Simplification & specialization

UNIT – II WORK STUDY 9

Method study, basic procedure, Selection, Recording of process, Micro motion and memo motion study, work measurement techniques, Time study, Work sampling, Synthesis from standard data, Predetermined motion time standards.

UNIT – III PRODUCT PLANNING AND PROCESS PLANNING 9

Value analysis, Problems in lack of product planning, Process planning and routing-Prerequisites, Steps in process planning, Quantity determination in batch production-Machine capacity, balancing, Analysis of process capabilities in a multi-product system.

UNIT – IV PRODUCTION SCHEDULING 9

Master Scheduling, Scheduling rules, Gantt charts, Basic scheduling problems, Line of balance, Flow and batch production scheduling, Product sequencing, Production Control systems-Periodic batch control, Material requirement planning, kanban. Manufacturing lead time, Techniques for aligning completion times and due dates.

UNIT - V RECENT TRENDS IN PPC 9

Introduction to computer integrated production planning systems, elements of JUST IN TIME SYSTEMS, Fundamentals of MRP II and ERP.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. MartandTelsang, “Industrial Engineering and Production Management”, S. Chand and Company, Reprint, 2006.
2. James.B.Dilworth, “Operations management – Design, Planning and Control for manufacturing and services” McGraw Hill International edition, 1992.
3. Samson Eilon, “Elements of Production Planning and Control”, Universal Book Corporation,2015

REFERENCES:

1. Elwood S.Buffa, and RakeshK.Sarin, “Modern Production / Operations Management”, John Wiley and Sons, 8th Edition, 2000.
2. KanishkaBedi, “Production and Operations management”, Oxford university press, 3rd Edition, 2013.
3. Melynk, Denzler, “Operations management – A value driven approach” Irwin Mcgraw hill, 1995.
4. Norman Gaither, G. Frazier, “Operations Management”, Thomson learning IE, 9th edition, 2007
5. Jain. K.C & L.N. Aggarwal, “Production Planning Control and Industrial Management”, Khanna Publishers, 8th Edition, 1999.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : PRODUCTION PLANNING AND CONTROL		**Course Code : 20MEV35**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Explain various aspects of product development.	I	K3	1,2,3,11	1, 2,3
CO2	Describe work sampling techniques.	II	K3	1,2,3,8,11	1, 2,3
CO3	Determine the quantity in batch production system.	III	K3	1,2,3,4,5,11,12	1, 2,3
CO4	Explain scheduling rules	IV	K3	1,2,3,4,5,7,11	1, 2,3
CO5	Determine manufacturing lead time for the given production system.	IV	K3	1,2,3,5,11,12	1, 2,3
CO6	Explain MRP and ERP.	V	K3	1,2,3,5,11,12	1, 2,3

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	1	-	-	-	-	-	-	-	2	-	3	2	1
CO2	3	2	1	-	-	-	-	1	-	-	2	-	3	2	1
CO3	3	2	1	1	2	-	-	-	-	-	2	1	3	2	1
CO4	3	2	1	2	2	-	1	-	-	-	2	-	3	2	1
CO5	3	2	1	-	1	-	-	-	-	-	2	1	2	2	1
CO6	3	2	1	-	1	-	-	-	-	-	2	1	2	2	1

Electives for Honors Degree

20MEV46	BATTERY TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the working principle of automotive batteries.
- To gain knowledge in energy storage systems.
- To understand about the battery performance
- To understand the battery management system
- To understand the requirement of batteries for automotive applications

PREREQUISITE:NIL

UNIT - I INTRODUCTION TO BATTERIES 9

Classification of batteries, Automotive Batteries - Principle, construction and working of lead acid battery, advanced lead-acid batteries horizontal plate Pb-acid batteries for transportation, cylindrical Pb-acid battery vs. flat plate system, maintenance free batteries.

UNIT – II ENERGY STORAGE SYSTEMS 9

Advanced Li-ion batteries - principle of operation, battery components and design, electrode, cell and battery fabrications, Li-polymer batteries and applications, Li-S battery, Li-Air battery, Sodium battery, Magnesium battery, Aluminum battery, Advanced Ni-MH batteries for transportation, future prospects of Ni-MH batteries, super capacitors

UNIT – III BATTERY TESTING AND EVALUATION 9

Battery performance evaluation- Primary battery - Service time- Voltage data- Service life – ohmic load curve- Effect of operating temperature on service life. Secondary batteries- Discharge curves-Terminal voltages- Plateau voltage, Maintenance of batteries.

UNIT – IV BATTERY PACK AND BATTERY MANAGEMENT SYSTEM 9

Selection of battery for EVs & HEVs, Traction Battery Pack design, Requirement of Battery Monitoring, Battery State of Charge Estimation methods, Battery Cell equalization problem, thermal control, protection interface, SOC Estimation, Energy & Power estimation, Battery thermal management system, Battery Management System: Definition, Parts: Power Module, Battery, DC/DC Converter, load, communication channel, Battery Pack Safety, Battery Standards & Tests.

UNIT - V BATTERIES FOR AUTOMOTIVES – FUTURE PROSPECTS 9

Degrees of vehicle electrification – Battery size vs. application -USABC and DOE targets for vehicular energy storage systems – Analysis and Simulation of batteries - Equivalent circuit and life modeling – Environmental concerns in battery production – Disposal and recycling of batteries

TOTAL : 45 PERIODS

TEXT BOOKS:

1. David Linden, Thomas Reddy, Hand book of batteries, MC Graw Hill Professional, Third Edition 2002
2. T.Minami, M.Tatsumisago,M.Wakihara,C. Iwakura,S. Kohijiya, Solid state ionics for batteries, Springer Publication, 2009
3. SandeepDhameja, Electric Vehicle Battery Systems, Newnes publication, 2001.

REFERENCES:

1. MasatakaWakihara and Osamu Yamamoto, Lithium ion Batteries Fundamental and Performance,Wiley–VCH, Verlag GmbH, 2008.
2. Robert A.Huggins, Advanced Batteries – Materials science aspects,Springer, 2009.
3. Ibrahim Dinçer, Halil S. Hamut and Nader Javani, “Thermal Management of Electric Vehicle Battery Systems”, JohnWiley& Sons Ltd., 2016.
4. Albert N. Link, Alan C. O’ Connor and Troy J. Scot, Battery technology for Electric vehicles, Routledge,2015
5. G.Pistoia, J.P. Wiaux, S.P. Wolksy, Used Battery Collection and Recycling, Elsevier, 2001

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : BATTERY TECHNOLOGY		Course Code : 20MEV46			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Describe the construction and working of lead acid batteries.	I	K2	1, 2, 3, 4, 6, 7	1, 2, 3
CO2	Explain the construction and working of lithium ion batteries.	II	K2	1, 2, 3, 4, 6, 7	1, 2, 3
CO3	Discuss about the testing of batteries.	III	K2	1, 2, 3, 4, 6, 7	1, 2, 3
CO4	Explain the battery pack system.	IV	K2	1, 2, 3, 4, 6, 7	1, 2, 3
CO5	Discuss about the battery management system.	IV	K2	1, 2, 3, 4, 6, 7	1, 2, 3
CO6	Discuss the environmental aspects, energy consumption, reuse and recycling of batteries.	V	K2	1, 2, 3, 4, 6, 7, 12	1, 2, 3

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	-	1	2	-	-	-	-	-	2	1	1
CO2	2	1	1	1	-	1	2	-	-	-	-	-	2	1	1
CO3	2	1	1	1	-	1	2	-	-	-	-	-	2	1	1
CO4	2	1	1	1	-	1	2	-	-	-	-	-	2	1	1
CO5	2	1	1	1	-	1	2	-	-	-	-	-	2	1	1
CO6	2	1	1	1	-	1	2	-	-	-	-	1	2	1	1

20MEV56	ALTERNATE FUELS FOR IC ENGINES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To expose potential alternate fuels and their characteristics
- To use appropriate synthetic fuels and fuel additives for better combustion characteristics
- To utilize alcohol fuels effectively for lower emissions
- To elaborate on the utilization of Bio-Diesel and its types as a suitable fuel in CI engines
- To utilize different gaseous fuels and predict their performance and combustion characteristics

PREREQUISITE: NIL

UNIT - I INTRODUCTION 9

Availability, Suitability, Properties, Merits and Demerits of Potential Alternative Fuels – Alcohols, Bio-Diesel, Hydrogen, Liquefied Petroleum Gas, Natural Gas, Biogas, Fuel standards – ASTM & EN.

UNIT – II SPECIAL AND SYNTHETIC FUELS 9

Different synthetic fuels, Merits and demerits, Dual, Bi-fuel and Pilot injected fuel systems, Fuel additives – types and their effect on performance and emission characteristics of engines, Flexi fuel systems, Ethers - as fuel and fuel additives, properties and characteristics.

UNIT - III ALCOHOL FUELS 9

Alcohols – Properties, Production methods and usage in engines. Blending, dual fuel operation, surface ignition, spark ignition and oxygenated additives. Performance, combustion and emission Characteristics in engines. Issues & limitation in alcohols

UNIT – IV BIO-DIESEL FUELS 9

Vegetable oils and their important properties. Fuel properties characterization. Methods of using vegetable oils – Blending, preheating, Transesterification and emulsification – Performance, combustion and emission Characteristics in diesel engines. Third generation biofuels, Ternary and Quaternary fuels, Issues & limitation of using vegetable oils in IC engines

UNIT - V GASEOUS FUELS 9

Biogas, Natural gas, LPG, Hydrogen – Properties, problems, storage and safety aspects. Methods of utilization in engines. Performance, combustion and emission Characteristics in engines. Issues & limitation in Gaseous fuels

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Ramachandran S., Rapid Thermodynamic Simulation Model of an Internal Combustion Engine on Alternate Fuels,2014

2. Singh A.P. ,Alternative Fuels And Advanced Combustion Techniques As Sustainable Solutions For Internal Combustion Engines, Springer,2021

3. Biernat K, Alternative Fuels Technical and Environmental Conditions, INTECH, 2017

REFERENCES:

1.Keith Owen and Trevor Eoley, Automotive Fuels Reference Book , SAE Publications, 2014

2. PundirB.P , I.C. Engines Combustion and Emission, Narosa Publishing House. 2010

3. Pundir B.P , Engine Combustion and Emission, , Narosa Publishing House 2011

4. Richard L. Bechtold, Automotive Fuels Guide Book, SAE Publications, 2014.

5. S M AshrafurRahman, Alternative Fuels and Their Application to Combustion Engines, MDPI, 2021

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : ALTERNATE FUELS FOR IC ENGINES													**Course Code : 20MEV56**			
CO	**Course Outcomes**												**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Explain various properties of Alternative Fuels and their merits demerits												I	K2	1,2,3	1,2
CO2	Describe various properties of Different Synthetic fuels and their merits demerits												II	K2	1,2,3	1,2
CO3	Discuss the performance and emission characteristics of engines using additives.												II	K2	1,2,3	1,2
CO4	Explain Properties, Production methods and usage of Alcohol fuels in I.C Engines.												III	K2	1,2,3	1,2
CO5	Describe various properties and production methods of BIO-Diesel fuels.												IV	K2	1,2,3	1,2
CO6	Discuss different types utilization of Gaseous Fuels												V	K2	1,2,3	1,2
CO-PO Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	
CO1	2	1	1	1	-	-	-	-	-	-	-	-	2	1	1	
CO2	2	1	1	1	-	-	-	-	-	-	-	-	2	1	1	
CO3	2	1	1	1	-	-	-	-	-	-	-	-	2	1	1	
CO4	2	1	1	1	-	-	-	-	-	-	-	-	2	1	1	
CO5	2	1	1	1	-	-	-	-	-	-	-	-	2	1	1	
CO6	2	1	1	1	-	-	-	-	-	-	-	1	2	1	1	

20MEV66	INTELLIGENT TRANSPORTATION SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVES

- To enable the students to study about the functional areas of Intelligent Transportation System. (ITS)
- To teach students about the architecture of Intelligent Transportation System. (ITS)
- To enable the students to know the strategies and algorithms of advanced Transport Management System.
- To teach students about the concepts of Advanced Traveller and Information System (ATIS)
- To develop the skills of the students to implement ITS in developed and developing countries.

PREREQUISITE:

Course Code: 20GE203

Course Name: Basic Electrical, Electronics and Instrumentation Engineering

UNIT - I INTRODUCTION TO INTELLIGENT TRANSPORT SYSTEM 9

Introduction to Intelligent Transportation Systems (ITS) -Definition – Role and Responsibilities – Advanced Traveller Information System – Fleet Oriented ITS Services – Electronic Toll Collection – Critical issues – Security – Safety.

UNIT – II ITS ARCHITECTURE AND HARDWARE 9

Architecture –ITS Architecture Framework – Hardware Sensors –Vehicle Detection – Techniques – Dynamic Message Sign – GPRS – GPS – Toll Collection.

UNIT - III ADVANCED TRANSPORT MANAGEMENT SYSTEM 9

Video Detection – Virtual Loop - Cameras - ANPR – IR Lighting – Integrated Traffic Management – Control Centre – Junction Management Strategies- ATMS – Advanced Traveler Information Systems (ATIS)- Route Guidance – Issues -– Historical – Current – Predictive Guidance – Data Collection – Analysis – Dynamic Traffic Assignment (DTA) – Components – Algorithm.

UNIT – IV ADVANCED TRAVELLER AND INFORMATION SYSTEM 9

Travel Information – Pre Trip and Enroute Methods- Basic ATIS Concepts – Smart Route System – Data Collection – Process – Dissemination to Travelers – Evaluation of Information – Value of Information – Business Opportunities.

UNIT - V CASE STUDIES 9

Automated Highway Systems -Vehicles in Platoons–Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Choudury M A and Sadek A, “Fundamentals of Intelligent Transportation Systems Planning” Artech House, 2003.
2. Pradip Kumar Sarkar, Amit Kumar Jain, “Intelligent Transport Systems”, PHI Learning Publishers, 2018.
3. Turban E.,”Decision Support and Export Systems Management Support Systems", Maxwell Macmillan, 1998.

REFERENCES:

1. Cycle W.Halsapple and Andrew B.Winston, "Decision Support Systems – Theory and Application", Springer Verlog, New York, 1987.
2. Sitausu S. Mittra, "Decision Support Systems – Tools and Techniques", John Wiley, New York, 1986.
3. Henry F.Korth, and Abraham Siberschatz, Data Base System Concepts, 7th edition, McGraw Hill, 2019.
4. Sussman, J. M., “Perspective on ITS”, Artech House Publishers, 2005.
5. Turban. E and Aronson. J. E, “Decision Support Systems and Intelligent Systems”, Prentice Hall, 2005.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : INTELLIGENT TRANSPORTATION SYSTEM		Course Code : 20MEV66			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Describe the role and Responsibilities of Advanced Transportation System (ATS).	I	K2	1,2	1
CO2	Explain the Architecture and Hardware of ATS.	II	K2	1,2	1
CO3	Describe the strategies used in Advanced Transport Management System.	III	K2	1,2,3	1,2
CO4	Discuss about the algorithms used in Dynamic Traffic Assignment System.	III	K2	1,2,3	1,2
CO5	Describe about the data collection and evaluation process used in Advanced Traveller and Information System.	IV	K2	1,2,3	1,2
CO6	Discuss about the implementation of ITS in developed and developing countries.	V	K2	1,2,3	1,2

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	-	2	1	-
CO4	3	2	1	-	-	-	-	-	-	-	-	-	2	1	-
CO5	3	2	1	-	-	-	-	-	-	-	-	-	2	1	-
CO6	3	2	1	-	-	-	-	-	-	-	-	-	2	1	-

SEMESTER VIII

20ME8L1	PROJECT WORK	L	T	P	C
		0	0	20	10

The student individually or 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 prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 300 PERIODS

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : PROJECT WORK		**Course Code : 20ME8L1**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C410.1	Identify and apply the real world and societal importance problems in the mechanical engineering and its allied area	-	K4	1-12	1,2
C410.2	Identify, analyze, design, implement and handle prototype projects with a complete and organized solution methodologies	-	K4	1-12	1,2
C410.3	Apply modern engineering tools for solution	-	K4	1-12	1,2
C410.4	Contribute as an individual or in a team in development of technical projects	-	K4	1-12	1,2
C410.5	Develop effective communication skills for presentation of project related activities	-	K4	1-12	1,2
C410.6	Prepare reports and examination following professional ethics	-	K4	1-12	1,2

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C410.1	3	3	2	1	1	1	1	1	1	1	1	1	2	2
C410.2	3	3	2	1	1	1	1	1	1	1	1	1	2	2
C410.3	3	3	2	1	1	1	1	1	1	1	1	1	2	2
C410.4	3	3	2	1	1	1	1	1	1	1	1	1	2	2
C410.5	3	3	2	1	1	1	1	1	1	1	1	1	2	2
C410.6	3	3	2	1	1	1	1	1	1	1	1	1	2	2

OPEN ELECTIVE – II (VII SEMESTER) offered to other Department

20OE105	SOLAR PHOTOVOLTAIC FUNDAMENTALS AND APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To explain basics of solar photovoltaic.
- To explain basics of PV Systems.
- To explain basics of PV System grid connections.
- To explain basics of Hybrid systems
- To know in depth of its types and design of various PV-interconnected systems

PREREQUISITE:

20ME304 Engineering Thermodynamics
20HS401 Environmental Science and Engineering

UNIT - I PHOTOVOLTAIC BASICS 9

Structure and working of Solar Cells - Types, Electrical properties and Behavior of Solar Cells – Cell properties and design - PV Cell Interconnection and Module Fabrication – PV Modules and arrays - Basics of Load Estimation.

UNIT – II STAND ALONE PV SYSTEMS 9

Schematics, Components, Batteries, Charge Conditioners - Balance of system components for DC and/or AC Applications - Typical applications for lighting, water pumping etc.

UNIT – III GRID CONNECTED PV SYSTEMS 9

Schematics, Components, Charge Conditioners, Interface Components - Balance of system Components - PV System in Buildings.

UNIT – IV HYBRID SYSTEMS 9

Solar, Biomass, Wind, Diesel Hybrid systems - Comparison and selection criteria for a given application.

UNIT - V DESIGN OF PV SYSTEMS 9

Radiation and load data - Design of System Components for different PV Applications – Sizing and Reliability - Simple Case Studies

TOTAL : 45 PERIODS

TEXT BOOKS:

1. CS Solanki: Solar Photovotaics – Fundamentals, Technologies and Applications, PHI Learning Pvt. Ltd., 2015.
2. Martin A. Green, Solar Cells Operating Principles, Technology, and System Applications Prentice-Hall, 2008
3. Nelson, J the Physics of Solar Cells. Imperial College Press, 2017.

REFERENCES:

1. Thomas Markvart, Solar Electricit, John Wiley and Sons, 2015.
2. Stuart R. Wenham, Martin A. Green, Muriel E. Watt, Richard Corkish (Editors), Applied Photovoltaics, Earthscan, 2014.
3. Michael Boxwell, the Solar Electricity Handbook, Code Green Publishing, UK, 2015.
4. Rik DeGunther, Solar Power Your Home for Dummies, Wiley Publishing Inc, 2016.
5. Chetan Singh Solanki, Renewable Energy Technologies; A Practical Guide for Beginners, PHI School Books, 2014.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : SOLAR PHOTOVOLTAIC FUNDAMENTALS AND APPLICATIONS		Course Code : 20OE105			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Summarize the basics of Photovoltaic systems.	I	K2	1, 2, 3	1, 2, 3
CO2	Explain the component of stand- alone photovoltaic systems	II	K2	1, 2, 3	1, 2, 3
CO3	Explain the component of grid connected photovoltaic systems	III	K2	1, 2, 3	1, 2, 3
CO4	Summarize the basics of Hybrid systems.	IV	K2	1, 2, 3	1, 2, 3
CO5	Explain the selection criteria for a given Photovoltaic application.	V	K2	1, 2, 3	1, 2, 3
CO6	Design of various components of solar PV systems.	V	K3	1, 2, 3	1, 2, 3

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
CO2	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
CO3	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
CO4	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
CO5	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
CO6	3	2	1	-	-	-	-	-	-	-	-	-	3	2	1

20OE106 FUNDAMENTALS OF PRODUCT DESIGN

L	T	P	C
3	0	0	3

OBJECTIVES:

- To Understand various global trends and identify the scope of a new product design
- To translate conceptual idea into detailed design
- To understand the concept of new product design.
- To understand various Quality Concepts in product design
- To impart knowledge on various industrial design process

PREREQUISITE: NIL

UNIT - I PRODUCT PLANNING 9

Product Planning Process - Identify Opportunities - Evaluating and Prioritizing Projects - Allocating Resources and Timing - Identifying Customer Needs - Raw Data from Customers - Interpreting Raw Data in Terms of Customer Needs - Organizing the Needs into a Hierarchy - Establishing the Relative Importance of the Needs - Case study for motor driven nailer - Reflecting on the Results and the Process

UNIT – II CONCEPT GENERATION AND SELECTION 9

Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology –benefits.

UNIT – III PRODUCT ARCHITECTURE 9

Implications – Product change – variety – component standardization – product performance – manufacturability – product development management – establishing the architecture – creation – clustering – geometric layout development – fundamental and incidental interactions – related system level design issues.

UNIT – IV QUALITY CONCEPTS 9

Design For Quality - Quality Function Deployment - Design Of Experiments - Failure Modes & Effect Analysis - TQM - Design For Six Sigma - Brain Storming Techniques - Design For Manufacturing - Design Ethics - Safety and Environmental Considerations in Product Design

UNIT - V INDUSTRIAL DESIGN 9

Integrate process design – Managing costs – Robust design – Need for industrial design – impact – design process – investigation of for industrial design – impact – design process–conceptualization – refinement – management of the industrial design process – technology driven products – user – driven products – assessing the quality of industrial design.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Anita Goyal, Karl T Ulrich, Steven D Eppinger, “Product Design and Development”, Tata McGraw Hill Education, 4th Edition, 2009.
2. Kevin Otto, Kristin Wood, “Product Design”, Indian Reprint 2004, Pearson Education
3. George E Dieter, Linda C Schmidt, “Engineering Design”, Mc-Graw Hill International Edition, 5th Edition, 2012

REFERENCES:

1. David G.Ullman, “The Mechanical Design Process”, Tata McGraw Hill , 2011
2. Stephen Rosenthal, Effective Product Design and Development, Business One Orwin, 1992,
3. Staurt Pugh, Tool Design -Integrated Methods for Successful Product Engineering, Addison Wesley Publishing, 1991.
4. Chitale A K and Gupta R C, “Product Design and Manufacturing”, PHI 2007.
5. Yousef Haik, T. M. M. Shahin, “Engineering Design Process”, Cengage Learning, 2nd Edition Reprint, 2010.

Course Name : FUNDAMENTALS OF PRODUCT DESIGN		Course Code : 20OE106			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Explain the basic concepts of product design	I	K3	1,2,3,6,9,10	1,2,3
CO2	Describe the basic concepts of concurrent Engineering	I	K3	1,2,3,6,9,10	1,2,3
CO3	Generate various concepts for a product design and to select the best concept	II	K3	1,2,3,4,6,9,10	1,2,3
CO4	Discuss the concepts and importance of product architecture	III	K3	1,2,3,6,9,10	1,2,3
CO5	Apply the quality concepts to develop robust product	IV	K3	1,2,3,6,9,10	1,2,3
CO6	Illustrate the importance of industrial design in view of aesthetics factors and ergonomic factors	V	K3	1,2,3,4,6,9,10	1,2,3

CO-PO Mapping

CO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO 3
CO1	3	2	1	-	-	1	-	-	1	1	-	-	2	1	1
CO2	3	2	1	-	-	1	-	-	1	1	-	-	2	1	1
CO3	3	2	1	1	-	1	-	-	1	1	-	-	2	1	1
CO4	3	2	1	-	-	1	-	-	1	1	-	-	2	1	1
CO5	3	2	1	-	-	1	-	-	1	1	-	-	2	1	1
CO6	3	2	1	1	-	1	-	-	1	1	-	-	2	1	1

20OE107	AUTONOMOUS AND ELECTRIC VEHICLES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To Understand the technologies used in autonomous system
- To understand the perception, prediction and routing of autonomous driving
- To understand the planning and control of autonomous driving
- To understand the architecture of electric vehicle and energy storage device
- To understand the architecture of hybrid electric vehicle

PREREQUISITE: NIL

UNIT - I AUTONOMOUS DRIVING TECHNOLOGIES 9

Autonomous driving Technologies overview- Autonomous driving algorithms-Autonomous driving client system- Autonomous driving cloud platform

UNIT – II PERCEPTION, PREDICTION AND ROUTING 9

Perception in Autonomous Driving – Detection – Segmentation – Stereo, optical flow and scene flow – Tracking. Prediction and Routing – Planning and control – Traffic Prediction- Lane level Routing.

UNIT – III DECISION AND PLANNING 9

Decision, planning and control – Behavioral Decisions – Motion Planning – Feedback control.

UNIT – IV ELECTRIC VEHICLE AND ENERGY STORAGE 9

Basics of Vehicle mechanisms, history of Electric vehicles (EV), Electric vehicle Architecture: Major components of electric vehicle. Energy storage-Battery, fuel cell and ultra capacitor.

UNIT - V HYBRID ELECTRIC VEHICLE 9

Introduction to hybrid electric vehicle, Types- series, parallel and complex configuration- Architecture of hybrid electric vehicle-drive train-sizing of components.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Shaoshan Liu; Liyun Li; Jie Tang; Shuang Wu; Jean-Luc Gaudiot, “Creating Autonomous Vehicle Systems”, Morgan & Claypool, 2018.
2. A. Perallos, U. Hernandez-jayo, E. Onieva and I. Garcia-Zuazola (Eds.), Intelligent Transport Systems: Technologies and Applications, Wiley publications, 2015.
3. Iqbal Hussain, Electric & Hybrid Vehicles – Design Fundamentals, CRC Press, New York, 2003.

REFERENCES:

1. Danil Prokhorov, “Computational Intelligence in Automotive Applications”, Studies in Computational Intelligence book series, Springer, 2008.
2. H. Cheng, Autonomous Intelligent Vehicles: Theory, Algorithms, and Implementation, Berlin:Springer, 2011.
3. Andreas Herrmann, Walter Brenner, Rupert Stadler, Autonomous Driving: How the Driverless Revolution will Change the World Emerald Publishing, 2018
4. Michael E. McGrath, Autonomous Vehicles: Opportunities, Strategies, and Disruptions, Amazon, 2018.
5. Tom Denton, Electric and Hybrid Vehicles,1st edition, Routledge Publishers,2017

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : AUTONOMOUS AND ELECTRIC VEHICLE		**Course Code : 20OE107**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Discuss the latest technologies in the design of autonomous systems.	I	K2	1, 2, 3, 4, 5, 6, 7	1, 2, 3
CO2	Explain the perception of autonomous system.	II	K2	1, 2, 3, 4, 6, 7	1, 2, 3
CO3	Explain the prediction and routing of autonomous system.	II	K2	1., 2, 3, 4, 6, 7	1, 2, 3
CO4	Explain the planning and control of autonomous driving.	III	K2	1, 2, 3, 4, 6, 7	1, 2, 3
CO5	Explain the importance of electric vehicle and energy storage system.	IV	K2	1, 2, 3, 4, 6, 7	1, 2, 3
CO6	Discuss about the hybrid electric vehicles.	V	K2	1, 2, 3, 4, 6, 7	1, 2, 3

CO-PO Mapping

CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	2	1	1	1	1	1	2	-	-	-	-	-	2	1	1
CO2	2	1	1	1	-	1	2	-	-	-	-	-	2	1	1
CO3	2	1	1	1	-	1	2	-	-	-	-	-	2	1	1
CO4	2	1	1	1	-	1	2	-	-	-	-	-	2	1	1
CO5	2	1	1	1	-	1	2	-	-	-	-	-	2	1	1
CO6	2	1	1	1	-	1	2	-	-	-	-	-	2	1	1

20OE108	INDUSTRIAL SAFETY PRACTICES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To impart knowledge on safety engineering fundamentals.
- To gain knowledge on safety management practices.
- To understand about the chemical, fire, mechanical hazards.
- To understand about noise and vibration control.
- To gain knowledge in Factories Act.

PREREQUISITE: NIL

UNIT - I INTRODUCTION 9

Evolution of modern safety concepts – Fire prevention – Mechanical hazards – Boilers, Pressure vessels, Electrical Exposure.

UNIT – II CHEMICAL HAZARDS 9

Chemical exposure – Toxic materials – Radiation Ionizing and Non-ionizing Radiation - Industrial Hygiene – Industrial Toxicology.

UNIT - III ENVIRONMENTAL CONTROL 9

Industrial Health Hazards – Environmental Control – Industrial Noise - Noise measuring instruments, Control of Noise, Vibration, - Personal Protection.

UNIT – IV HAZARD ANALYSIS 9

System Safety Analysis –Techniques – Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), HAZOP analysis and Risk Assessment.

UNIT - V SAFETY REGULATIONS 9

Explosions – Disaster management – catastrophe control, hazard control, Factories Act, Safety regulations, Product safety – case studies.

TEXT BOOKS:

1. John V.Grimaldi, “Safety Management”, AITB S Publishers, 2003.
2. David L. Goetsch, “Occupational Safety and Health for Technologists”, Engineers and Managers, Pearson Education Ltd. 5th Edition, 2005.
3. Deshmukh L M, “Industrial Safety Management”, Tata McGraw-Hill Publishing Company Ltd.,2005

REFERENCES:

1. Safety Manual, “EDEL Engineering Consultancy”, 2000.
2. Charles D. Reese, “Occupational Health and Safety Management”, CRC Press, 2003.
3. Philip E. Hagan, John Franklin Montgomery, James T. O'Reilly, “Accident Prevention Manual – NSC”, Chicago, 2009.
4. John Davies, Alastair Ross, Brendan Wallace, “Safety Management: A Qualitative Systems Approach”, CRC Press, 2003.
5. Anil Mital, “Advances in Industrial Ergonomics and Safety”, Taylor and Francis Ltd, London, 1989

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : INDUSTRIAL SAFETY PRACTICES		Course Code : 20OE108			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Illustrate the importance of safety in Boilers and Pressure vessels.	I	K3	1,2,3,4,6,10,12	1,2
CO2	Identify and prevent chemical, environmental mechanical, fire hazard.	II	K3	1,2,3,4,6,10,12	1,2
CO3	Collect, analyze and interpret the accidents data based on various safety techniques.	III	K3	1,2,3,4,5,6,10,12	1,2
CO4	Apply proper safety techniques on safety engineering and management.	IV	K3	1,2,3,4,5,6,10,12	1,2
CO5	Perform hazard analysis.	V	K3	1,2,3,4,5,6,10,12	1,2
CO6	Design the system with environmental consciousness by implementing safety regulation.	V	K3	1,2,3,4,6,10,12	1,2

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	-	2	-	-	-	1	-	1	2	1	-
CO2	3	3	1	1	-	2	-	-	-	1	-	1	2	1	-
CO3	3	3	1	1	-	2	-	-	-	1	-	1	2	1	-
CO4	3	3	1	1	1	2	-	-	-	1	-	1	2	1	-
CO5	3	3	1	1	1	2	-	-	-	1	-	1	2	1	-
CO6	3	3	1	1	-	2	-	-	-	1	-	1	2	1	-