FACULTY OF ENGINEERING

Scheme of Instruction & Examination
(AICTE Model Curriculum for the Academic Year 2020-2024)

and

Syllabus

B.E. VII & VIII Semestersof

Four Year Degree Programmein

B.E. (Mechanical Engineering)

Issued by

Dean, Faculty of Engineering Osmania University, Hyderabad

SCHEME OF INSTRUCTION & EXAMINATION
AICTE Model Curriculum

B. E. I – Semester (MECHANICAL ENGINEERING)

S. No.	Course Code	Course Title	Scheme of Instructions				Scheme of Examination			Credits
			L	T	P/D	Contact Hours/Week	CIE	SEE	Duration in Hours	
Three Week Induction Programme										
Theory Course										
1	MC801PO	Indian Constitution	2	-	-	2	30	70	3	-
2	BS201MT	Mathematics-I	3	1	-	4	30	70	3	4
3	BS202PH	Engineering Physics	3	1	-	4	30	70	3	4
4	ES301EE	Basic Electrical Engineering	3	1	-	4	30	70	3	4
Practical / Laboratory Course										
5	BS251PH	Physics Lab	-	-	3	3	25	50	3	1.5
6	ES354EE	Basic Electrical Engineering Lab	-	-	2	2	25	50	3	1
7	ES353CE	Engineering Graphics	-	-	6	6	50	50	3	3
Total										**17.5**

MC: Mandatory Course **BS**: Basic Science **ES:** Engineering Science
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CIE: Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

Note:

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SCHEME OF INSTRUCTION & EXAMINATION
AICTE Model Curriculum

B. E. II – Semester (MECHANICAL ENGINEERING)

S. No.	Course Code	Course Title	Scheme of Instructions				Scheme of Examination			Credits
			L	T	P/D	Contact Hours/Week	CIE	SEE	Duration in Hours	
Theory Course										
1	MC802CE	Environmental Science	2	-	-	2	30	70	3	-
2	MC803PY	Essence of Indian Traditional Knowledge	2	-	-	2	30	70	3	-
3	HS101EG	English	2	-	-	2	30	70	3	2
4	BS203MT	Mathematics-II	3	1	-	4	30	70	3	4
5	BS204CH	Engineering Chemistry	3	1	-	4	30	70	3	4
6	ES302CS	Programming for Problem Solving	3	-	-	3	30	70	3	3
Practical / Laboratory Course										
7	HS151EG	English Lab			2	2	25	50	3	1
8	BS252CH	Chemistry Lab			3	3	25	50	3	1.5
9	ES351CS	Programming for Problem Solving Lab			2	2	25	50	3	1
10	ES352ME	Workshop Practice	-	-	6	6	50	50	3	3
Total										**19.5**

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SCHEME OF INSTRUCTION & EXAMINATION
AICTE Model Curriculum

B. E. III – Semester (MECHANICAL ENGINEERING)

S. No.	Course Code	Course Title	Scheme of Instructions				Scheme of Examination			Credits
			L	T	P/D	Contact Hours/Week	CIE	SEE	Duration in Hours	
Theory Course										
1	HS102EG	Effective Technical Communication in English	2	-	-	2	30	70	3	2
2	HS103CM	Finance and Accounting	3	-	-	3	30	70	3	3
3	BS205MT	Mathematics-III	3	-	-	3	30	70	3	3
4	ES303ME	Engineering Mechanic-I	3	-	-	3	30	70	3	3
5	ES304EC	Basic Electronics	3	-	-	3	30	70	3	3
6	PC401ME	Metallurgy and Material Science	3	-	-	3	30	70	3	3
7	PC402ME	Thermodynamics	3	-	-	3	30	70	3	3
Practical / Laboratory Course										
8	PC451ME	Metallurgy and Material Testing Lab	-	-	2	2	25	50	3	1
9	PC452ME	Machine Drawing and Modeling Lab	-	-	2	2	25	50	3	1
Total										**22**

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SCHEME OF INSTRUCTION & EXAMINATION
AICTE Model Curriculum

B. E. IV – Semester (MECHANICAL ENGINEERING)

S. No.	Course Code	Course Title	Scheme of Instructions				Scheme of Examination			Credits
			L	T	P/D	Contact Hours/Week	CIE	SEE	Duration in Hours	
Theory Course										
1	ES304ME	Engineering Mechanic-II	3	-	-	3	30	70	3	3
2	PC403ME	Fluid Mechanics	3	-	-	3	30	70	3	3
3	ES305ME	Energy Sciences and Engineering	2	-	-	2	30	70	3	2
4	PC404ME	Mechanics of Materials	3	-	-	3	30	70	3	3
5	PC405ME	Applied Thermodynamics	3	-	-	3	30	70	3	3
6	PC406ME	Kinematics of Machinery	3	-	-	3	30	70	3	3
7	PC407ME	Manufacturing Processes	3	-	-	3	30	70	3	3
Practical / Laboratory Course										
7	PC453ME	Thermal Engineering Lab -I	-	-	2	2	25	50	3	1
8	PC454ME	Manufacturing Processes Lab	-	-	2	2	25	50	3	1
Total										**22**

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SCHEME OF INSTRUCTION & EXAMINATION
AICTE Model Curriculum

B. E. V – Semester (MECHANICAL ENGINEERING)

S. No.	Course Code	Course Title	Scheme of Instructions				Scheme of Examination			Credits
			L	T	P/D	Contact Hours/Week	CIE	SEE	Duration in Hours	
Theory Course										
1	PC408ME	Hydraulic Machines	3	-	-	3	30	70	3	3
2	PC409ME	Design of Machine Elements	3	-	-	3	30	70	3	3
3	PC410ME	Dynamics of Machines	3	-	-	3	30	70	3	3
4	PC411ME	Metrology and Instrumentation	3	-	-	3	30	70	3	3
5	PC412ME	Heat Transfer	3	-	-	3	30	70	3	3
6	PE51ME	Professional Elective-I	3	-	-	3	30	70	3	3
Practical / Laboratory Course										
7	PC455ME	Thermal Engineering Lab-2	-	-	2	2	25	50	3	1
8	PC456ME	Dynamics of Machines Lab	-	-	2	2	25	50	3	1
9	PC457ME	Fluid Mechanics and Hydraulics Machinery Lab	-	-	2	2	25	50	3	1
Total										**21**

Professional Elective-I		
S. No.	**Course Code**	**Course Title**
1	PE511ME	CAD/CAM
2	PE512ME	Automobile Engineering
3	PE513ME	Industrial Engineering

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SCHEME OF INSTRUCTION & EXAMINATION
AICTE Model Curriculum

B. E. VI – Semester (MECHANICAL ENGINEERING)

S. No.	Course Code	Course Title	Scheme of Instructions				Scheme of Examination			Credits
			L	T	P/D	Contact Hours/Week	CIE	SEE	Duration in Hours	
Theory Course										
1	PC413ME	Machine Design	3	-	-	3	30	70	3	3
2	PC414ME	Metal Cutting and Machine Tools	3	-	-	3	30	70	3	3
3	PC415ME	Finite Element Analysis	3	-	-	3	30	70	3	3
4	PE52ME	Professional Elective-II	3	-	-	3	30	70	3	3
5	PE53ME	Professional Elective-III	3	-	-	3	30	70	3	3
6	OE61	Open Elective-I	3	-	-	3	30	70	3	3
Practical / Laboratory Course										
7	PC458ME	Metrology and Machine Tools Lab	-	-	2	2	25	50	3	1
8	PC459ME	Computer Aided Engineering Lab	-	-	2	2	25	50	3	1
9	PW701ME	Summer Internship*						50		2
Total										**22**

Professional Elective-II			**Professional Elective-III**		
S. No.	**Course Code**	**Course Title**	**S. No.**	**Course Code**	**Course Title**
1.	PE521ME	Thermal Turbo Machines	1.	PE531ME	Composite Materials
2.	PE522ME	Production and Operations management	2.	PE532ME	Product Design And Process Planning
3.	PE523ME	Design For Manufacture	3.	PE533ME	Power Plant Engineering

Open Elective-I		
S. No.	**Course Code**	**Course Title**
1	OE611ME	Industrial Robotics (Not for Mech. Engg. students)

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* ***At the end of VI semester students should undergo Summer Internship. Credits forSummer Internship will be awarded in VII semester.***

SCHEME OF INSTRUCTION & EXAMINATION
AICTE Model Curriculum

B. E. VII – Semester (MECHANICAL ENGINEERING)

S. No.	CourseCode	Course Title	Scheme of Instructions				Scheme of Examination			Credits
			L	T	P/D	Contact Hours/Week	CIE	SEE	Duration in Hours	
Theory Course										
1	HS104ME	Operations Research	3	-	-	3	30	70	3	3
2	PC416ME	Automation in Manufacturing	3	-	-	3	30	70	3	3
3	PC417ME	Refrigeration & Air Conditioning	3	-	-	3	30	70	3	3
4	PE54ME	Professional Elective-IV	3	-	-	3	30	70	3	3
5	PE55ME	Professional Elective-V	3	-	-	3	30	70	3	3
6	OE704ME	Open Elective-II	3	-	-	3	30	70	3	3
Practical / Laboratory Course										
7	PC460ME	CAM and Automation Lab	-	-	2	2	25	50	3	1
8	PW702ME	Project –I	-	-	6	6	50			3
Total										**22**

Professional Elective-IV			**Professional Elective-V**		
S.No.	**Course Code**	**Course Title**	**S. No.**	**Course Code**	**Course Title**
1	PE541ME	3D Printing Technology	1	PE551ME	Non- Destructive Testing
2	PE542ME	Robotics Engineering	2	PE552ME	Mechanical Vibrations
3	PE543ME	Tool Design	3	PE553ME	Total Quality Management

Open Elective-II		
S.No.	**Course Code**	**Course Title**
1	OE704ME	Entrepreneurship (Not for Mech./Prod./Automobile Engg. students)

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SCHEME OF INSTRUCTION & EXAMINATION
AICTE Model Curriculum
B. E. VIII – Semester (MECHANICAL ENGINEERING)

S. No	Course Code	Course Title	Scheme of Instructions				Scheme of Examination			Credits
			L	T	P/D	Contact Hours/Week	CIE	SEE	Duration in Hours	
Theory Course										
1	PE56ME	Professional Elective-VI	3	-	-	3	30	70	3	3
2	OE804ME	Open Elective-III	3	-	-	3	30	70	3	3
Practical / Laboratory Course										
3	PW703ME	Project-II	-	-	16	16	50	150		8
Total										14

Professional Elective-VI		
S.No.	**Course Code**	**Course Title**
1	PE561ME	Energy Conversation & Management
2	PE562ME	Entrepreneurship Development
3	PE563ME	Control Systems Theory
4	PE564ME	Cryogenics

Open Elective-III		
S. No.	**Course Code**	**Course Title**
1.	OE804ME	Mechatronics (Not for Mech./Prod./Automobile Engg. students)

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SCHEME OF INSTRUCTION & EXAMINATION
AICTE Model Curriculum

B. E. VII – Semester (MECHANICAL ENGINEERING)

S. No.	CourseCode	Course Title	Scheme of Instructions				Scheme of Examination			Credits
			L	T	P/D	Contact Hours/Week	CIE	SEE	Duration in Hours	
Theory Course										
1	HS104ME	Operations Research	3	-	-	3	30	70	3	3
2	PC416ME	Automation in Manufacturing	3	-	-	3	30	70	3	3
3	PC417ME	Refrigeration & Air Conditioning	3	-	-	3	30	70	3	3
4	PE54ME	Professional Elective-IV	3	-	-	3	30	70	3	3
5	PE55ME	Professional Elective-V	3	-	-	3	30	70	3	3
6	OE704ME	Open Elective-II	3	-	-	3	30	70	3	3
Practical / Laboratory Course										
7	PC460ME	CAM and Automation Lab	-	-	2	2	25	50	3	1
8	PW702ME	Project –I	-	-	6	6	50			3
Total										**22**

Professional Elective-IV			**Professional Elective-V**		
S.No.	**Course Code**	**Course Title**	**S. No.**	**Course Code**	**Course Title**
1	PE541ME	3D Printing Technology	1	PE551ME	Non- Destructive Testing
2	PE542ME	Robotics Engineering	2	PE552ME	Mechanical Vibrations
3	PE543ME	Tool Design	3	PE553ME	Total Quality Management

Open Elective-II		
S.No.	**Course Code**	**Course Title**
1	OE704ME	Entrepreneurship (Not for Mech./Prod./Automobile Engg. students)

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HS104ME

OPERATION RESEARCH

Instruction: 3 periods per week *Duration of SEE: 3 hoursCIE:*
30 marks *SEE: 70 marks*
Credits: 3

Objectives:

1. To use variables for formulating complex mathematical models in management science, industrial engineering and transportation models.
2. To use the basic methodology for the solution of linear programming problems.
3. To understand the mathematical tools that are needed to solve optimization problems like Transportation models and Assignment models.
4. To understand the replacement models with change in money value considering with time and without time.
5. To Model a system as a queuing model and compute important performance measures.

Outcomes:

After completing this course, the student will be able to:
1. To prepare the students to have the knowledge of Linear Programming Problem in Operations Research at the end students would be able to understand the concept and develop the models for different applications.
2. To make students understand the concept Replacement models at the end students would able to explain various features and applications of replacement models in real timescenario.
3. To prepare the students to understand theory of Game in operations research at the end students would able to explain application of Game theory in decision making for aconflict.
4. To prepare the students to have the knowledge of Sequencing model at the end student would able to develop optimum model for job scheduling.
5. To prepare students to understand Queuing theory concepts and various optimization techniques at the end students would able to develop models for waiting line cases.

Unit-I
Introduction: Definition and Scope of Operations Research. *Linear Programming:* Introduction, Formulation of linear programming problems, graphical method of solving LP problem, simplex method, maximization and minimization, Degeneracy inLPP, Unbounded and, Infeasible solutions.
Unit-II
Duality: Definition, Relationship between primal & dual solutions, Economic Interpretation, Post optimal of sensitivity analysis, Dual Simplex Method.
Unit-III
Transportation Models: Finding an initial feasible solution - North West corner method, least cost method, Vogel‘s Approximation method, Finding the optimal solution, optimal solution by stepping stone and MODI methods, Special cases in Transportation problems - Unbalanced Transportation problem. *Assignment Problems:* Hungarian method of Assignment problem, Maximization in Assignment problem, unbalanced problem, problems with restrictions, travelling salesman problems.
Unit-IV
Replacement Models: Introduction, replacement of items that deteriorate ignoring change in money value, replacement of items that deteriorate considering change in money value with time,replacement of items that fail suddenly - Individual replacement policy, Group replacement policy. ***Game Theory:*** Introduction, 2 person zero sum games, Maximin - Minimax principle, Principle of Dominance, Solution for mixed strategy problems, Graphical method for 2 x n and m x 2 games.
Unit-V
Sequencing Models: Introduction, General assumptions, processing n jobs through 2 machines, processing _n‘ jobs through m machines, Processing 2 jobs through m machines ***Queuing Theory:*** Introduction, single channel - Poisson arrivals - exponential service times with infinite population & finite population, Multi channel - poison arrivals - Exponential service times with infinite population. ***Introduction to Optimization Techniques:*** Single objective & Multi objective optimization Techniques like G.A, NSGA, P.Q.O & MPSO Techniques.

Suggested Reading:

1. Hamdy, A. Taha, -*Operations Research-An Introduction*‖, Sixth Edition, Prentice Hall of India Pvt. Ltd., 1997.
2. S.D. Sharma, -*Operations Research*‖, Kedarnath, Ramnath & Co., Meerut, 2009.
3. Hrvey M. Wagner, -*Principles of Operations Research*‖, Second Edition, Prentice Hall of India Ltd., 1980.
4. V.K. Kapoor, -*Operations Research*‖, S. Chand Publishers, New Delhi, 2004.
5. R. Paneer Selvam, -*Operations Research*‖, Second Edition, PHI Learning Pvt. Ltd., New Delhi, 2008.
6. Data Reconciliation by Prof. Shanker Narasimha.

PC416ME **AUTOMATION IN MANUFACTURING**

Instruction: 3 periods per week *Duration of SEE: 3 hours CIE: 30 marks* *SEE: 70 marks*
Credits : 3

Objectives:

1. To understand the importance of Automation in the field of machine tool basedmanufacturing.
2. To get the knowledge of various elements of manufacturing automation- like CAD,CAM,NC,CNC AM, hydraulic & pneumatic controls & FMS.
3. To understand the concepts of product design and role of manufacturing automation.

Outcomes:

1. Understand the importance of automation in the field of machine tool based manufacturing.
2. Understand the various concepts of CAD and Numerical control machines.
3. Understand the concepts of CAM and CNC machining.
4. Understand the concepts of Additive Manufacturing Technologies.
5. To study the concepts of pneumatics & hydraulics systems and controls, and variouselements of Flexible Manufacturing System.

Unit-I
Introduction to Automation: Why automation, Current trends, Rigid automation: Part handling, Machine tools, CAD, CAM, CIM: Basic Concepts of CIM: Elements of CIM, Benefits of CIM. Automation principles and strategies. Basic elements of an automated system, levels of automation. Hardware components for automation and process control, PLC: Programmable logic Controllers.
Unit-II
Computer Aided Design: Fundamentals of CAD - Geometric modeling for downstream applications and analysis methods. Solid Modeling Techniques: Boundary Representation (B-rep) & Constructive Solid Geometry (CSG). Numerical Control of Machine tools, Features and elements of NC, NC Part Programming. Manual and Computer Aided Part Programming for simple components.
Unit-III
Computer Aided Manufacturing: Flexible automation - Computer control of Machine Tools and Machining Centers, CNC technology, Micro-controllers, CNC-Adaptive Control, Direct Numerical Control, Feedback devices and control system.Automated material handling, assembly and Flexible fixturing.
Unit-IV
Introduction to Additive Manufacturing: Need for time compression in product development, Fundamentals of additive manufacturing, AM process chain, Classification ofAM processes, advantages, limitations and applications. Distinction between Additive Manufacturing and Conventional Machining processes.
Unit-V
Low cost automation & FMS: Mechanical & Electro mechanical systems, Pneumatics and Hydraulics, Illustrative Examples and case studies. Cellular Manufacturing, Flexible Manufacturing Systems: What is an FMS, FMS Components, FMS Applications & Benefits, and FMS Planning &Implementation issues.

Suggested Reading:

1. Mikell P. Groover, Automation, Production Systems and Computer-IntegratedManufacturing, Prentice Hall.
2. Serope Kalpakjian and Steven R. Schmid, Manufacturing- Engineering andTechnology, 7th Edition, Pearson.
3. CAD CAM principles, practice and Manufacturing Management / Chris Mc Mohan,Jimmie Browne / Pearson edu. (LPE).
4. Chee Kai Chua and Kah Fai Leong , 3D Printing and Additive Manufacturing Principles and Applications, Fifth Edition of Rapid Prototyping, 5th Edition, WorldScientific press, 2017
5. Ibrahim Zeid, CAD/CAM, Theory and Practice, Mc Graw Hill, 1998.

REFRIGERATION & AIR CONDITIONING

PC417ME

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits : 3

Objectives:

1. To understand the basic concepts of refrigeration and air conditioning systems.
2. To study the methods of refrigeration for commercial and industrial applications.
3. To study the lower temperature applications: cryogenics by using cascade systems.
4. Solving the problems related to cooling and heating system (HVAC).

Outcomes:

1. Identify various natural and artificial methods of refrigeration. State the importance of refrigerant selection and the environmental issues related to the use of CFCs
2. Formulate equations for different types of refrigerants used in vapour compression refrigeration system. Justify the selection of single or multi stage system based on operating temperature range
3. Explain the working principles of vapour absorption, thermoelectric and steam-jet refrigeration systems. Select a suitable refrigerant absorbent mixture for Vapour absorption refrigeration system
4. Define Psychrometry and its properties. Analyze various problems on psychrometric processes, know the construction and application of Psychrometric chart
5. Able to design an air condoning system based on given inside and outside conditions. Evaluate cooling and heating loads in an air-conditioning system
6. List typical conditions required for various food product processes and List applications of refrigeration and air conditioning

Unit-I

Introduction to Refrigeration: Definition of Refrigeration and Air-conditioning, Necessity of Refrigeration, Methods of Refrigeration, Unit of Refrigeration and C.O.P. Reversed Carnot cycle. Properties of Refrigerants: Survey, Designation, Desirable properties of refrigerants, Thermodynamic, Chemical and Physical properties, Classification of Refrigerants, Ozone depletion& Global warming, Green House Effect and Future of Refrigerants.

Air Refrigeration Systems: Analysis of Bell-Coleman Cycle, Open and Dense air system, Application to aircraft refrigeration, Simple cooling system and Bootstrap refrigeration system, Regenerative cooling system and Reduced ambient cooling system.

Unit-II:

Vapour compression system: Working principle and essential components of Simple vapor compression Refrigeration cycle, Compressor, condenser, evaporator, and expansion devices, Analysis of cycle, C.O.P, Representation of the cycle on T-S, P-H and H-S charts. Performance improvement of simple vapour compression refrigeration cycle by means of flash chamber and accumulator Dry and wet compression, Effect of operating conditions like evaporating pressure, condenser pressure, Liquid sub-cooling and Vapor super heating, Performance of the system. Lowtemperature refrigeration system (with single load system), Compound compression with water
inter cooler and Flash intercooler, Cascade refrigeration system-Analysis and advantages

Unit-III

Vapour Absorption Refrigeration System: Simple absorption systems, COP, Practical ammonia absorption refrigeration system, Lithium bromide absorption system, Electrolux refrigerator, Common refrigerants and absorbents properties, Comparison with vapor compression refrigeration system Steam Jet Refrigeration: Principle of working, Analysis of the system, Advantages, limitations and applications.

Non-Conventional Refrigeration Systems: Principle and operation of Thermoelectric Refrigeration Systems, Seebeck effect - Peltier effect - Thomson effect, Analysis, Pulse tube refrigeration system.

Unit-IV

Psychrometry: Psychrometric properties, Psychrometric chart, construction, Representation ofPsychrometric processes on the chart.

Introduction to Air Conditioning: Requirements of comfort air conditioning, Thermodynamics ofhuman body, Body temperature, Metabolism, Body defense and Human tolerance, Effect of heaton performance, ASHRE comfort chart and Effective temperature.

Unit-V

Cooling Load Calculations in Air Conditioning: Concept of bypass factor, Sensible heat factor, Apparatus Dew Point, Room Sensible Heat Factor (RSHF), Gross Sensible Heat Factor (GSHF),Different heating and cooling loads, Problems. Design of air conditioning systems: All fresh air, Re-circulated air with bypassed air, Design of Summer, winter and Year round air conditioning systems, Energy conservation in air conditioned building, Case study of one building with all load calculations.

Air Conditioning Systems: Types, Components of air conditioner equipments, Humidifier, Dehumidifier, Filter, Grills, Fans and Blowers, Duct material, Function of Dampers, Diffusers. Applications of Refrigeration and Air conditioning Food Preservation, Transport air conditioning, and Industrial applications.

Suggested Reading:

1. Arora C.P., -Refrigeration and Air conditioning‖, Tata McGraw Hill, New Delhi, 2009.
2. Arora, S.C. and Domkundwar, S., -A Course in Refrigeration and Air conditioning‖, Dhanpat Rai & Sons, New Delhi, 2010.
3. Jain, V.K., -Refrigeration and Air Conditioning‖, S Chand & Company, New Delhi, 2010.
4. Stocker, W.S., -Refrigeration and Air conditioning -, McGraw Hill, New Delhi, 2009.
5. RK Rajput.,‖Refrigeration & Air conditioning‖, SK Kataria & Sons New Delhi, Third Edition 2015.

3D PRINTING TECHNOLOGY (PE-IV)

PE541ME

Instruction: 3 periods per week *Duration of SEE: 3 hours* *CIE: 30 marks* *SEE: 70 marks*

Credits: 3

Objectives:

1. To understand the fundamental concepts of 3D Printing, its advantages and limitations.
2. To know the working principle, advantages, disadvantages and applications of liquid, solid and Powder based 3D Printing Technologies.
3. To know the various types of STL file errors and other data formats used in 3D Printing Technology.
4. To know the features of various 3D printing software's.
5. To know diversified applications of 3D Printing Technologies.

Outcomes:

On successful completion of this course, the student will be able to
1. Interpret the features of 3D Printing and compare it with conventional methods.
2. Illustrate the working principle of liquid, solid and powder based 3D Printing Technologies.
3. Identify various types of errors in STL file and other data formats used in 3D Printing Technology.
4. Select suitable software used in 3D Printing Technology.
5. Apply the knowledge of various 3D Printing technologies for developing Innovative applications.

Unit-I

Introduction: Prototyping fundamentals: Need for time compression in product development, Historical development, Fundamentals of 3D Printing, 3D Printing Process Chain, Advantages and Limitations of 3D Printing, 3D Printing wheel, Commonly used Terms, Classification of 3D printing processes, Fundamental Automated Processes: Distinction between 3D Printing and Conventional Machining Processes.

Unit-II:

Liquid-based Systems: Stereo Lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Polyjet: Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies

Solid-based System: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

Unit-III

Powder Based Systems: Working principle, Specifications, Materials used, Process, Applications, Advantages and Disadvantages, Case studies of the following 3D Printing Technologies like Selective laser sintering (SLS), Selective Laser Melting (SLM) and Direct Metal Laser Sintering (DMLS), Laser Engineered Net Shaping (LENS), Electron Beam Melting (EBM).

Unit-IV

Data Formats & Software: STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs, Newly Proposed Formats.

Software's Features: Magics, Mimics, Solid View, View Expert, 3 D Rhino, 3 D doctor, Flash Print, Object Studio, Cura, ITK Snap, 3-matic, Simplant, 3-matic, Simplant, MeshLab, Ansys for AdditiveManufacturing

Unit-V

Applications of 3D Printing : Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Electronic Industry, Jewellery Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules. Biopolymers, Packaging, Disaster Management, Entertainment and Sports industry.

Suggested Reading:

1. Chee Kai Chua and Kah Fai Leong, -*3D Printing and Additive Manufacturing Principles and Applications*‖ Fifth Edition, World scientific
2. Ian Gibson, David W Rosen, Brent Stucker, -*Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing*‖ Springer, Second Edition,2010.
3. -*Rapid Prototyping & Engineering Applications*‖- Frank W.Liou, CRC Press, Taylor & Francis Group, 2011.
4. RafiqNoorani, -*Rapid Prototyping: Principles and Applications in Manufacturing*‖, John Wiley & Sons, 2006.
5. NPTEL Course on Rapid Manufacturing. https://nptel.ac.in/courses/112/104/112104265/

ROBOTICS ENGINEERING (PE-IV)

PE542ME

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits : 3

Objectives:

Students will understand
1. The configuration, work envelop and motion controls and applications
2. Familiarities with the kinematics of robots.
3. Robot end effectors and their design.
4. Familiarities with the dynamics of robots.
5. Robot Programming methods & Languages of robot.
6. Various Sensors and drives and their applications in robots

Outcomes:

At the end of the course, the students will be able to
1. Identify and classify various robot configurations with their workspaces, recognize andfind suitable robot for a particular Industrial application considering their Degrees of freedom, type of end effector and other Specifications.
2. Able to use rotation matrices and perform forward kinematic operations. Find Jacobean in velocity domain.
3. Able to perform inverse kinematics and convert a world space problem to joint space problem. Develop dynamical equations for control of robot
4. Perform trajectory planning and implement independent joint control. Identify suitability of various control methods.
5. Interface various hardware and software components to develop robotic systems for industry& Evaluate their performance

Unit-I
Brief History, Types of robots, Overview of robot subsystems, Robot Joints and its Links, Degrees of freedom of robots, Work space of Robots, accuracy, precision, resolution and repeatability, Robot classification: Based on kinematic configurations, control methods, workspace. Different types of Wrists used in industrial robots. Different types of Robot Drives. End effectors and Grippers, Mechanical, Electrical, vacuum and other methods of gripping. Robots used in various Industrial operations like Material handling, Assembly, Inspection, Welding and Painting. Description and Specifications in each case.
Unit-II
Rotation matrices, Representation of location and orientation. Euler angle and RPY representation, Homogeneous transformation matrices Denavit-Hartenberg notation, representation of Translation and rotation in terms of joint parameters, Forward kinematics. Velocity Kinematics and Jacobian in Velocity domain.
Unit-III
Inverse Kinematis, inverse location, inverse orientation, inverse velocity, Singular Configuration of robots , Static force analysis of RP type and RR type planar robots, Dynamicanalysis using Lagrangian and Newton-Euler formulations of RR and RP type planar robots.
Unit-IV
Trajectory Planning: Joint interpolation,task space interpolation, executing user specifiedtasks, Independent joint control, PD and PID feedback, actuator models, nonlinearity of manipulator models, Computed torque control, force control, hybrid control, neural network based control of manipulator, fuzzy control of manipulator, CNN based control of manipulator.
Unit-V
Sensors: types of sensors, tactile & non tactile sensors, sensors to measure Position, velocity& acceleration , Optical encoders. Range and Proximity sensing, acoustic, pneumatic, Hall effect sensor, Eddy current sensors, Force and Torque sensors. Vision: Image acquisition, types & components of vision system, Image representation, digitisation, binary, gray scale, RGB representation, Image processing, Image segementation, image smoothening, object descriptors, object recognition.

Suggested Reading:

1. Spong and Vidyasagar, "Robot Dynamics & Control", John Wiley and Sons, Ed.,1990
2. Mittal and Nagrath, "Industrial Robotics", Tata McGraw Hill Publications, 2004
3. Saha&Subirkumar saha, _Robotics', TMH, India.
4. Asada and Sllotine , _Robot analysis and intelligence' BS Publications , India.
5. Fu. K.S., GonZalez R.C., Lee C.S.G. "Robotics, Control-sensing vision and Intelligence", McGraw Hill, Int. Ed., 1987
6. Groover M.P.,"Industrial Robotics", McGraw Hill Publications, 1999.
7. Robotics toolbox in MAT LAB.

TOOL DESIGN (PE-IV)

PE543ME

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits : 3

Objectives:

Students will understand
1. Various forces involved in the machining operations
2. Heat generation in machining & coolant operation
3. Tools, jigs and fixture, suitable for a particular machining operation

Outcomes:

At the end of the course, the students will be able to
1. Calculate the values of various forces involved in the machining operations
2. Design various single and multipoint cutting tools
3. Analyse heat generation in machining & coolant operation
4. Illustrate the properties of various cutting tool materials and hence select an appropriatetool material for particular machining application
5. Identify appropriate combination of tools, jigs and fixture, suitable for a particular machining operation
6. Design assembly of jigs and fixtures on simple work-piece

Unit-I
Metal Cutting : Classification of metal cutting operations, mechanics of metal cutting, tool signature, built up edge formation, mechanism of chip formation, types of chips, oblique and orthogonal cutting - Merchant's force diagram, two component tool dynamometer, Merchant's theory of metal cutting, Lee and Schaffler's theory of metal cutting.
Unit-II
Tool Wear and Tool Life : Sources of heat in metal cutting, heat dissipation and distribution to chip, tool and work piece, methods of evaluating temperature at tool-chip interface. Machinability, factors affecting machinability, Taylor's tool life equation, crater wear and flank wear, mechanics of tool wear and various types of tool failure. Effects of tool geometry, feed, depth of cut, cutting speed on tool wear.
Unit-III
Cutting Tool Materials: Essential requirements of a tool material, tool materials - HCS, HSS, Cast alloys, Carbides, Ceramic tools, Diamond tool bits. Essential requirements of a good cutting fluid, types of cutting fluids and their relative applications. Economics of machining - introduction, economic tool life, optimal cutting speed to maximum production and maximum profit
Unit-IV
Press Tools : Press tool design - press operations, press working terminology, working of cutting die press operations - strip layout, punching, blanking-center of pressure, drawing and deep drawing, bending dies and forging - forging die design.
Unit-V
Jigs and Fixtures: Design of jigs and fixtures. Locating devices, clamping devices,principles of design of jigs and fixtures, some examples Design of Cutting Tools: Broach design, elements of twist drill, HSS twist drill design, design of rotary milling cutter. Design of single point cutting tool.

Suggested Reading:

1. Donaldson [2001], Tool Design, TMH Publishers, New Delhi.
2. Roy A. Lindberg [2002], Processes and Materials of Manufacture, PHI Publishers,New Delhi.
3. G. R. Nagpal [2004], Tool Engineering & Design, Khanna Publishers, New Delhi.
4. ASTME [1987], Fundamentals of Tool Design, PHI Publishers, New Delhi.
5. Amitha Ghose and Mallik [2004], Manufacturing Science, EWP Publishers, NewDelhi.

NON-DESTRUCTIVE TESTING (PE-V)

PE551ME

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits : 3

Objectives:

Student has to understand the
1. Need, basic concepts and technologies of Non-Destructive Testing (NDT)
2. Security precautions from Radiography, protection from radiation and measurement ofradiation received by personnel.
3. Technology of acoustic emission (AE), the associated instrumentation and applications
4. Technologies like neutron radiography; laser induced ultrasonics, surface analysis andthermography
5. Merits and demerits of the different NDT Technologies
6. Latest research and developments in NDT

Outcomes:

1. The knowledge of different NDT techniques.
2. Clear understanding of liquid penetrat inspection and magnetic particle inspection.
3. The basics of Eddy Current Testing.
4. View and interpret radiographs, utilize the various principles of radiography for different components of different shapes
5. The knowledge of acoustic emission for NDT and the instrumentation used for NDT
6. The knowledge of latest research, developments and trends in NDT

Unit-I
Liquid Penetrate inspection: Principle of penetrate inspection, characteristics of a penetrate, water washable system, post emulsification system, solvent removable system, surface preparation and cleaning, penetrate application, development, advantages, limitations, and applications. *Magnetic Particle Inspection:* Principle, magnetization methods, continuous and residual methods, sensitivities, demagnetization, Advantages, Limitations, and Applications.
Unit-II
Eddy Current Testing: Principle, lift-off factor, and edge effect, skin effect, inspection frequency, coil arrangements, inspection probes, types of circuits, reference pieces, phaseanalysis, display methods and applications
Unit-III
Ultrasonic Testing: Generation of ultra sound, Characteristics of an ultrasonic beam, sound wavesat interfaces, sound attenuation, display systems, probe construction, type of display, inspection techniques, identification of defects, immersion testing, sensitivity and calibration. Reference standards, surface conditions, applications
Unit-IV
Radiography: Principle and uses of radiography, limitation principle, radiation sources, production of X-rays, X-ray spectra, attenuation of radiation, shadow formation enlargement and distortion, radiographic film and paper, inspection of simple and complex shapes, radiation hazard, protection against radiation.
Unit-V
*Acoustic Emission:*physical principles, sources of emission, instrumentation andapplications. *Other NDT Techniques:* Neuron radiography, laser induced ultrasonics, surface analysis,and thermography.

Suggested Reading:

1. Barry Hull & Vernon John, _*Non-Destructive Testing''* , 1988.
2. Non-Destructive examination and quality control, ASM International, Vol.17, 9th edition 1989
3. J. Prasad and C.G.K. Nair, Non-Destructive Test and evaluation of materials, Tata McGraw-Hill Education, 2nd edition 2011
4. B. Raj, T. Jayakumar and M. Thavasimuth, Practical Non-Destructive Testing, Alpha Science International Limited, 3rd edition 2002
5. T. Rangachari, J. Prasad and B.N.S. Murthy, Treatise on Non-Destructive Testing and Evaluation, Navbharath enterprises, Vol.3, 1983.

MECHANICAL VIBRATIONS (PE-V)

PE552ME

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits : 3

Objectives:

Student has to understand the
1. Explain the concept of vibrations, with single degree of freedom systems
2. Discuss the numerical methods involved in vibrations
3. Demonstrate the concept of Transient vibrations

Outcomes:

At the end of the course, the students will be able to
1. Find the Natural frequencies of SDoF Systems.
2. Draw the mode shapes.
3. Solve the MDoF Systems
4. Do the Model analysis.
5. Apply the numerical methods to vibration Problems.

Unit-I
Free Vibration of Single Degree of Freedom Systems: Introduction, causes and effects of vibration. Free Vibration of an Undamped Translational System, Equation of Motion using Newton's second law of motion, Equation of motion using other methods, Equation of motion of a spring, mass system in vertical position, solution, Harmonic Motion Free Vibration of an Undamped Torsional System- Equation of motion. Free Vibration with Viscous Damping- Equation of motion.
Unit-II
Forced Vibration of Single Degree of Freedom Systems: Introduction, Beating Phenomenon. Response of a Damped system under the Harmonic Motion of the base, ForceTransmitted, Relative Motion.
Unit-III
Two Degree of Freedom Systems: Introduction, Equations of Motion for forced Vibration, Free Vibration Analysis of and undamped system, Torsional system, Coordinate Coupling and Principal Coordinates, forced Vibration Analysis, Semi definite Systems.
Unit-IV
Multi-degree of Freedom Systems: Introduction Modeling of Continuous systems as Multi- degree of Freedom systems. Equations of motion, Influence Coefficients. Potential and kinetic energy expressions in matrix form, Generalized coordinates and generalized forces, Using Lagrange's equations to derive equations of motion, Equations of motion of undamped systems in matrix form, Eigen value problem, solution of the Eigen value problems – solution of the characteristic equation, orthogonality of normal modes.
Unit-V
Determination of Natural Frequencies and Mode Shapes: Introduction, Dunkerley's formula, Rayleigh's Method- Properties of Rayleigh's Quotient, Computation of the Fundamental Natural Frequency, Fundamental Frequency of Beams and Shafts. Holzer's Method-Torsional systems, Spring Mass Systems. Jacobi method, Standard Eigen value Problems.

Suggested Reading:

1. W T Thomson., -Theory of Vibrations with Applications‖, CBS Publishers
2. S S Rao, -Mechanical Vibrations‖, Addison-Wesley Publishing Co.
3. Leonard Meirovitch, -Fundamentals of Vibration‖, McGraw Hill International Edison.
4. J P Den Hartog, -Mechanical Vibrations‖, McGraw Hill.
5. Srinivasan, -Mechanical Vibration Analysis‖, McGraw Hill.
6. Nuno Manuel Mendes Maia et al,‖ Theoretical and Experimental Modal Analysis‖, Wiley John & sons, 1999

TOTAL QUALITY MANAGEMENT (PE-V)

PE553ME

Instruction: 3 periods per week *Duration of SEE: 3 hours* *CIE: 30 marks* *SEE: 70 marks*

Credits : 3

Objectives:

1. The essence of total quality management in design and manufacturing a product
2. The a variety of principles and concepts of total quality management
3. Over view of total quality management
4. The various technical tools of quality like control charts ,QFD POKA ,YOKA etc---
5. To be aware of international/national Quality awards and Quality systems organizing.

Outcomes:

1. Student gain the knowledge and importance of TQM, types leaderships theories and bestpractices in TQM and know the Quality environment of the organization , Apply TQM techniques in engineering applications
2. An over view of Implementation of different types of quality management philosophies and quality circle concept, impact of Taguchi methods in TQM.
3. Use statistical techniques in TQM.
4. Application of tools and methods for quality management in TQM.
5. Concept s of TQM Systems implementation and IS/ISO 90004:2000 discussed .

Unit-I
Introduction to quality management: Definition and framework of TQM, benefits,awareness and obstacles. Quality statements – vision, mission and policy statements. Customer perception of quality, Translating needs into requirements, Customer retention, costof quality.
Unit-II
Quality management philosophies: Overview of the contributions of Deming, Juran Crosby,Masaaki Imai, Feigenbaum, Ishikawa, Taguchi techniques – introduction, loss function, parameter and tolerance design, signal to noise ratio. Concepts of Quality circle.
Unit-III
Statistical process control, capability and Reliability: Meaning and significance of statistical process control (SPC) – construction of control charts for variables and attributes. Process capability – meaning, significance. Reliability– definitions, reliability in series and parallel systems, product life characteristics curve.
Unit-IV
Tools and methods for quality management: Quality functions development (QFD) –House of quality (HOQ), building a HOQ, QFD process. POKA YOKE, Management tools forquality improvement, Juran's improvement programme, Tools for process improvement.
Unit-V
Quality systems organizing and implementation: Introduction to IS/ISO 9004:2000 – quality management systems – guidelines for performance improvements. Quality Audits. TQM culture, Leadership – quality council, employee involvement, motivation, empowerment, recognition and reward.

Suggested Reading:

1. Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, First Edition 2002
2. Dale H.Besterfield et al, Total Quality Management, Third edition, Pearson Education (First Indian Reprints 2004)
3. L.Suganthi etal, Total Quality Management, PHI Learning Pvt. Ltd., New Delhi,2012
4. P.N.Mukharjee, Total Quality Management, PHI Learning Pvt. Ltd., New Delhi,2010
5. Sunil Sharma, Total Engineering Quality Management, MacMillan India Ltd, New Delhi, 2003

ENTREPRENEURSHIP (OE-II)

OE704ME

Instruction: 3 periods per week *Duration of SEE: 3 hoursCIE:30*
SEE: 70 marks

Credits : 3

Objectives:

1. To motivate students to take up entrepreneurship in future
2. To learn nuances of starting an enterprise & project management
3. To understand the design principles of solar energy systems, their utilization andperformance evaluation
4. To understand the behavioural aspects of entrepreneurs and time management

Outcomes:

Course Outcomes
At the end of the course, the students will be able to
1. Understand Indian Industrial Environment, Entrepreneurship & Economic growth, Smalland Large Scale Industries, Types and forms of enterprise
2. Identify the characteristics of entrepreneurs, Emergence of first generation entrepreneurs, Conception and evaluation of ideas and their sources.
3. Practice the principles of project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis.
4. Apply the concepts of Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques
5. Understand the Behavioural aspects of entrepreneurs, Time Management, Various approaches oftime management, their strengths and weakness. The urgency addiction andtime management matrix.

Unit-I
Indian Industrial Environment-competence, Opportunities & Challenges. Entrepreneurship & Economic growth. Small Scale Industry in India, Objectives, Linkage among small, medium and heavy industries. Types of enterprises.
Unit-II:
Identification and characteristics of entrepreneurs. Emergence of First generationentrepreneurs, environmental influence and women entrepreneurs. Conception and evaluation of ideas and their sources. Choice of Technology - Collaborative interaction for Technology development.
Unit-III
Project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis, project financing in India.
Unit-IV
Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques. Human aspects of project management. Assessmentof tax burden.
Unit-V
Behavioural aspects of entrepreneurs: Personality - determinants, attributes and models. Leadership concepts and models. Values and attitudes. Motivation aspects. Change behaviour. Time Management: Various approaches of time management, their strengths and weaknesses. The urgency addiction and time management matrix.

Suggested Reading:

1. Vasant Desai, *"Dynamics of Entrepreneurial Development and Management",* Himalaya Publishing House, 1997
2. Prasanna Chandra, *"Project-Planning, Analysis, Selection, Implementation and Review",* Tata McGraw-Hill Publishing Company Ltd. 1995.
3. Stephen R. Covey and A. Roger Merrill, *"First Things First",* Simon and Schuster Publication, 1994.
4. G.S. Sudha, *"Organizational Behaviour",* 1996.
5. Robert D. Hisrich, Michael P. Peters, *"Entrepreneurship",* Tata Me Graw HillPublishing Company Ltd., 5lh Ed., 2005.

OpenElective–II		
Sl.No	**CourseCode**	**CourseTitle**
1.	OE701EE	Non-ConventionalEnergySources (NotforEEE&EIE)
2.	OE702 EE	TransducersandSensors(NotforEEE&EIE)
3.	OE703 AE	AutomotiveSafetyandErgonomics(NotforMech./Prod./Automobile Engg. Students)
4.	**OE704 ME**	**Entrepreneurship (Not for Mech./Prod./Automobile Engg. Students)**
5.	OE705 CE	PrinciplesofGreenBuildings(NotforCivilEngg. Students)
6	OE706 AS	DataMining (Notfor CSE,IT ,AI&ML,IOT,AI &DS Students)
7	OE707 CS	WebApplicationDevelopment(NotforCSE,IT,AI&ML,IOT,AI & DS Students)
8	OE 708 CS	Principles of Python (Not for CSE, IT , AI&ML,IOT,AI & DSStudents)
9	OE 709 AL	IntroductiontoDeepLearning(NotforCSE,IT,AI&ML,IOT,AI & DS Students)
10	OE 710 DS	DatabaseManagementSystem(NotforCSE,IT,AI&ML,IOT,AI & DS Students)
11	OE 711 CB	Privacy & Security in IOT (Not for CSE, IT , AI&ML,IOT,AI & DS Students)
12	OE 712 IT	Introduction to Cyber security(Not for CSE, IT , AI&ML,IOT,AI & DS Students)
13	OE713 EC	FundamentalsofIOT (NotforECE, CSE,IT ,AI&ML,IOT,AI &DS Students)
14	OE714 EC	FundamentalsofNeuralNetworks (NotforECE, CSE,IT ,AI&ML,IOT,AI &DS Students)

CAM AND AUTOMATION LAB

PC460ME

Instruction: 2 periods per week *Duration of SEE: 3 hours*
CIE: 25 marks *SEE: 50 marks*
Credits : 1

Objectives:

1. To write CNC part programs and simulate using CAM Simulation Software's like CADEM/MASTER CAM or any equivalent **OPEN SOURCE** software's.
2. To write and execute robot programming using simulation tools for performing pick and place and stacking of objects etc.
3. To conduct basic experiments on Pneumatics, Hydraulics and Electro-Pneumatic systems

Outcomes:

On successful completion of this course, students will be able to:
1. Gain working knowledge in writing CNC part Program, simulate using CAM software's and understand the manufacture components on CNC machines
2. Develop robot programs for simulating various tasks like pick and place, stacking etc., using standard robot simulation software's like Robot studio, Microsoft Robotics Developer Studio or any equivalent **OPEN SOURCE** software's.
3. Gain working knowledge in simulation of Pneumatic, Hydraulic and PLC simulator.

List of Experiments:
1. Generate tool path simulation for basic Step turning/Face turning operation.
2. Generate tool path simulation for basic taper turning operation.
3. Generate tool path simulation for thread cutting operation.
4. Generate tool path simulation for combined drilling and grooving operations
5. Generate tool path simulation for Multiple operations
6. Generate tool path simulation for Milling operations
7. Robot Program simulation for stacking the objects in a palletizer
8. Robot programming for a pick & place.
9. Robot Program for perform a spray painting or any other similar operation using any programming method.
10. Hydraulic equipment simulation using H-Simulator
11. Pneumatic equipment simulation using P-Simulator
12. PLC simulator

Note: At least 09 experiments have to be completed with minimum two experiments from CAM, Robotics, Pneumatic, hydraulic and PLC simulator

PW702ME **PROJECT-I**

Instruction: 6 periods per week *Duration of SEE: -*
CIE: 50 marks *SEE: -*
Credits : 3

Objectives:

1. To enhance practical and professional skills.
2. To familiarize tools and techniques of systematic literature survey and documentation
3. To expose the students to industry practices and team work.
4. To encourage students to work with innovative and entrepreneurial ideas

Outcomes:

1. Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to the real-world problems.
2. Evaluate different solutions based on economic and technical feasibility
3. Effectively plan a project and confidently perform all aspects of project management
4. Demonstrate effective written and oral communication skills

The department can initiate the project allotment procedure at the end of VI semester andfinalize it in the first two weeks of VII semester.
The department will appoint a project coordinator who will coordinate the following:

- Collection of project topics/ descriptions from faculty members (Problems can alsobe invited from the industries)
- Grouping of students (max 3 in a group)
- Allotment of project guides

The aim of project work is to develop solutions to realistic problems applying the knowledge and skills obtained in different courses, new technologies and current industry practices. This requires students to understand current problems in their domain and methodologies to solve these problems. To get awareness on current problems and solution techniques, the first 4 weeks of VII semester will be spent on special lectures by faculty members, research scholars, post graduate students of the department and invited lectures by engineers from industries and R&D institutions. After completion of these seminarseach group has to formalize the project proposal based on their own ideas or as suggested by the project guide.

Seminar schedule will be prepared by the coordinator for all the students from the 5th weekto the last week of the semester which should be strictly adhered to.

Each group will be required to:

1. Submit a one-page synopsis before the seminar for display on notice board.
2. Give a 30 minutes' presentation followed by 10 minutes' discussion.
3. Submit a technical write-up on the talk.

At least two teachers will be associated with the Project Seminar to evaluate students forthe award of sessional marks which will be on the basis of performance in all the 3 items stated above.

The seminar presentation should include the following components of the project:

- Problem definition and specification
- Literature survey
- Broad knowledge of available techniques to solve a particular problem.
- Planning of the work, preparation of bar (activity) charts
- Presentation- oral and written.

SCHEME OF INSTRUCTION & EXAMINATION
AICTE Model Curriculum
B. E. VIII – Semester (MECHANICAL ENGINEERING)

S. No	Course Code	Course Title	Scheme of Instructions				Scheme of Examination			Credits
			L	T	P/D	Contact Hours/Week	CIE	SEE	Duration in Hours	
Theory Course										
1	PE56ME	Professional Elective-VI	3	-	-	3	30	70	3	3
2	OE804 ME	Open Elective-III	3	-	-	3	30	70	3	3
Practical / Laboratory Course										
3	PW703ME	Project-II	-	-	16	16	50	150		8
Total										14

Professional Elective-VI		
S.No.	**Course Code**	**Course Title**
1	PE561ME	Energy Conversation & Management
2	PE562ME	Entrepreneurship Development
3	PE563ME	Control Systems Theory
4	PE564ME	Cryogenics

Open Elective-III		
S. No.	**Course Code**	**Course Title**
1.	OE804 ME	Mechatronics (Not for Mech./Prod./AutomobileEngg.Students)

MC: Mandatory Course **BS**: Basic Science **ES:** Engineering Science
L: Lecture **T**: Tutorial **P**: Practical **D**: Drawing
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

Note:

3. Each contact hour is a clock hour
4. The duration of the practical class is two hours, however it can be extended wherevernecessary, to enable the student to complete the experiment.

ENERGY CONSERVATION AND MANAGEMENT (PE-VI)

PE561ME

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Objectives:

1. To learn about energy conservation.
2. To understand sources of loss of power in energy conversion.
3. To understand Procedure for Comprehensive Energy Conservation Planning.
4. To understand Industrial energy conservation methods.

Outcomes:

On successful completion of this course, the student will be able to
1. Understand different forms of energy.
2. Calculate the amount of heat energy available.
3. Understand the industry energy conservation modeling.
4. Understand methodology for forecasting industrial energy supply and demand.

Unit-I
Definition, Principles of Energy Conservation - Maximum Thermodynamic efficiency. Maximum Cost - effectiveness in energy use. Various forms of energy - Heat Mechanical. Electrical energy and Chemical energy. Identification of potential sources of energy losses - Transportation, operation and conversion from one from to another.
Unit-II
Heat energy and storage - Media of transport of heat energy - steam, oil and flue gases. Calculation of steam quality. Calculation of amount of heat energy available. Recuperators. Constructional details, Selection of materials to store heat energy. Concept of power. Modes of mechanical energy transport - Gears, pulleys, belts, shafts etc., Calculation of power. Sources of loss of power in energy conversion into electricity, potential energy (i.e., pumps).
Unit-III
Chemical energy - combustion of fuels - petrol, diesel and coal. Loss due to quality of fuel, conversion into other form of energy - boilers, I.C. engines. Calculation related to losses. Electrical energy - Working principle of motors and generators. Calculation of efficiency of generators. Losses during transmission and energy conversion - into mechanical energy, thermal energy. Calculation of effecting parameters.
Unit-IV
Procedure for Comprehensive Energy Conservation Planning (CECP) -Specifying targets, identifying energy in-efficient facilities. Synthesize evaluation and optimization of alternative conservation measures in view of organization costs. Flow chart of organization's functions. Collection of accountable data. Application of CECP method. An example.
Unit-V
Industrial energy conservation modeling - Methodology - Definition of production system - A primary copper production system, Model construction - Mathematical Programming. Market penetration, Structure of energy conservation model. Data preparation - coefficients needed in a model, Unit production cost and unit energy requirements. Model exercise, verification and validation. Methodology for forecasting Industrial Energy Supply and Demand.

Suggested Reading:

1. Gottschalk C.M., "*Industrial Energy Conservation*", John Wiley & Sons, 1996.
2. Chaturvedi P., and Joshi S., "*Strategy for Energy Conservation in India*", ConceptPublishingCo., New Delhi, 1997.
3. Sharna and Venkata Sebhaiah, -Energy *management and conservation*‖.
4. Dr. Sanjeevsingh, Umesh Rathore, -*Energy management*‖, Edition 2019.
5. Mrs. P Nagaveni, Dr. A Amudha, Dr. M.Sivaramkumar and Mr. N. Prasanna, -*Energy management and Energy conservation*‖.

ENTREPRENEURSHIP DEVELOPMENT (PE-VI)

PE562ME

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Objectives:

1. To motivate students to take up entrepreneurship in future.
2. To learn nuances of starting an enterprise & project management.
3. To understand the design principles of solar energy systems, their utilization andperformance evaluation.
4. To understand the behavioral aspects of entrepreneurs and time management.

Outcomes:

1. Understand Indian Industrial Environment, Entrepreneurship and Economic growth, Smalland Large Scale Industries, Types and forms of enterprises.
2. Identify the characteristics of entrepreneurs, Emergence of first generation entrepreneurs, Conception and evaluation of ideas and their sources.
3. Practice the principles of project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis.
4. Apply the concepts of Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques.
5. Understand the Behavioural aspects of entrepreneurs, Time Management, Various approaches of time management, their strengths and weakness. The urgency addiction andtimemanagement matrix.

Unit-I
Indian Industrial Environment-competence, Opportunities and Challenges. Entrepreneurshipand Economic growth. Small Scale Industry in India, Objectives, Linkage among small, medium and heavy industries. Types of enterprises.
Unit-II
Identification and characteristics of entrepreneurs. Emergence of First generation entrepreneurs, environmental influence and women entrepreneurs. Conception and evaluation of ideas and their sources. Choice of Technology - Collaborative interaction for Technology development.
Unit-III
Project formulation, Analysis of market demand, Financial and profitability analysis andTechnical analysis, project financing in India.
Unit-IV
Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques. Human aspects of project management. Assessment oftax burden.
Unit-V
Behavioural aspects of entrepreneurs: Personality - determinants, attributes and models. Leadership concepts and models. Values and attitudes. Motivation aspects. Change behaviour. Time Management: Various approaches of time management, their strengths and weaknesses. The urgency addiction and time management matrix.

Suggested Reading:

1. Vasant Desai, -Dynamics of Entrepreneurial Development and Management‖, Himalaya Publishing House, 1997.
2. Prasanna Chandra, -Project-Planning, Analysis, Selection, Implementation and Review‖, Tata McGraw-Hill Publishing Company Ltd. 1995.
3. Stephen R. Covey and A. Roger Merrill, -First Things First‖, Simon and Schuster Publication, 1994.
4. G.S. Sudha, -Organizational Behaviour‖, 1996.
5. Robert D. Hisrich, Michael P. Peters, -Entrepreneurship‖, Tata Me Graw Hill Publishing Company Ltd., 5lh Ed., 2005.

CONTROL SYSTEMS THEORY (PE-VI)

PE563ME

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits : 3

Objectives:

1. To know the development of input-output relations using block diagrams, signal flow graphsof mechanical, electromechanical systems etc and methods of obtaining time and frequency response.
2. To understand the stability and margins for stability from characteristics equation, root-locus method or frequency methods.
3. To know the development of the alternative state space models of dynamic systems, and their importance in predicting time response of multiple variables of the system.

Outcomes:

1. Derive the transfer function of mechanical, electrical, hydraulic and thermal systems.
2. Evaluate the time response of I and II order systems for various input signals.
3. Sketch the Bode, Polar and Root locus plots to check the stability of the system.
4. Sketch the Nyquist plot and design the Lead & Lag compensators to meet the requirements.
5. Develop the State space model of a system, check for its Controllability & Observability.

Unit-I
Control Systems Classification: Open Loop & Closed Loop Systems. Mathematical models and Transfer functions from governing equations of mechanical, electrical, hydraulic, pneumatic, thermal systems AC, DC servomotors & Electromechanical servo systems
Unit-II
Block Diagrams-Block diagram reduction. Signal flow graphs, Mason's gain formula. Transient response Time domain specifications of 1st and 2nd order systems Steady stateerror, Error coefficients, and sensitivity Performance indices Routh criteria
Unit-III
Routh criteria- Root Locus method Frequency Response: Bode, Polar plots. Correlation between transient and frequency response, Bandwidth, Experimental determination of transfer functions
Unit-IV
Nyquist criteria - Gain and phase margins, Lead. Lag and Lead-lag compensator design, PID controller, linearization of Non linear systems.
Unit-V
State - Space Representation of Linear Control Systems: State transition matrix. Solution ofstate equations: Zero input response and Zero state response. Concept of controllability and observability

Suggested Reading:

1. Dorf, R.C., *Modern Control Systems, Addison*-Wesley 1989.
2. M. Gopal, *Con tori Systems,* Tata McGraw Hill, 2004.
3. Ogata, K., *Modern Control Engineering,* Prentice Hall, 2004.
4. Norman S. Nise, *Control Systems Engineering,* John Wiley & Sons, Inc., 2001.

CRYOGENICS (PE-VI)

PE564ME

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Objectives:

1. Learning the mechanical properties, methods to protect the cryogenic fluids.
2. To describe liquefaction system for Neon, Hydrogen and Helium.
3. To explain the cryogenic gas separation and purification system.
4. To explain the cryogenic refrigeration systems.
5. To embark on a research career in Cryogenic Engineering.

Outcomes:

1. List the applications of cryogenic systems.
2. Understand the principles of cryogenics engineering.
3. Analyse the performance of cryogenics gas liquefaction system.
4. Analyse performance of cryogenics gas separation and purification system.
5. Evaluate material properties at cryogenic temperature.
6. Design the cryogenic storage system & cryo coolers.

Unit-I
Introduction to Cryogenic Systems: Mechanical Properties at low temperatures. Properties ofCryogenic Fluids. Gas Liquefaction: Minimum work for liquefaction. Methods to protect low temperature. Liquefaction systems for gages other than Neon. Hydrogen and Helium.
Unit-II
Liquefaction Systems for Neon, Hydrogen and Helium: Components of Liquefaction systems. Heat exchangers. Compressors and expanders. Expansion valve, Losses in realmachines.
Unit-III
Gas Separation and Purification Systems: Properties of mixtures, Principles of mixtures, Principles of gas separation, Air separation systems.
Unit-IV
Cryogenic Refrigeration Systems: Working Medium, Solids, Liquids, Gases, Cryogenic fluid storage & transfer, Cryogenic storage systems, Insulation, Fluid transfer mechanisms, Cryostat, Cryo Coolers.
Unit-V
Applications: Space technology, In-Flight air separation and collection of LOX, Gas industry,Biology, Medicine, Electronics.

Suggested Reading:

1. Cryogenic Systems/ R.F. Barren/ Oxford University Press.
2. Cryogenic Engineering- Thomas Flynn- CRC Press-2nd Edition.
3. Cryogenic Research and Applications: Marshal Sitting/ Von Nostrand/ Inc. NewJersey.
4. Cryogenic Heat Transfer/ R.F.Baron.
5. Cryogenic Engineering Edit / B.A. Hands/ Academic Press, 1986.
6. Cryogenic Engineering/ R.B. Scottm Vin Nostrand/ Inc. New Jersey, 1959

MECHATRONICS (OE-III)

OE 804 ME

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits : 3

Objectives:

Student has to understand the
1. How to identify, formulate, and solve engineering problems
2. The design a system, component, or process to meet desired needs within realisticconstraints
3. The how to use the techniques, skills, and modern engineering tools necessary forengineering practice
4. The use of drive mechanisms and fluid power systems
5. The use of industrial electronic devices
6. The demonstrate the design of modern CNC machines, and Mechatronics elements

Outcomes:

At the end of the course, the students will be able to
1. Model and analyse electrical and mechanical systems and their interconnection
2. Integrate mechanical, electronics, control and computer engineering in the design ofMechatronics systems
3. Do the complete design, building, interfacing and actuation of a Mechatronics system for a set of specifications
4. Be proficient in the use of fluid power systems in various Mechatronics applications
5. Demonstrate the use of industrial electronic devices
6. Demonstrate the design of modern CNC machines, and Mechatronics elements

Unit-I
Introduction to mechanization & automation: Need of interface of electrical & electronic devices with mechanical elements, the concept of Mechatronics, Flow chart of Mechatronics system, elements of Mechatronics system, drive mechanisms, actuators, feedback devices and control system, application in industries and systems development
Unit-II
Drive mechanisms: Feeding and indexing, orientation, escapement and sorting devices, conveyor systems Introduction to electrical actuators: A.C. servomotors, D.C.servomotors, stepper motors
Unit-III
Introduction to fluid power systems: Industrial Pneumatics and hydraulics, merits of fluid power, pneumatic & hydraulic elements symbols, study of hydraulic control valves, pumps& accessories, hydraulic circuits & mechanical servo control circuits, Electro-hydraulic and Hydro pneumatic circuits
Unit-IV
Introduction to industrial electronic devices: Diodes, Transistors, Silicon Controlled Rectifiers (SCR), Integrated Circuits (IC), Digital Circuits, Measurement systems & Data acquisition systems: sensors, digital to analog and analog-to-digital conversion, signal processing using operational amplifiers, introduction to microprocessor & micro controller, Temperature measurement interface and LVDT interface, Systems response
Unit-V
Design of modern CNC machines and Mechatronics elements: machine structures, guide ways, spindles, tool monitoring systems, adaptive control systems, Flexible manufacturing systems, Multipurpose control machines, PLC programming

Suggested Reading:

1. William Bolton, Mechatronics: Electronic control systems in mechanical and electrical engineering, 6th edition, Pearson Education
2. HMT Ltd, Mechatronics, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1998
3. Michaels Histand & David G, Alciatore, Introduction to Mechatronics andMeasurement Systems, Tata McGraw-Hill International Edition
4. Devdas Shetty, Richard A. Kolk, Mechatronics System Design, Cengage Learning
5. S.R. Majumdar, Oil Hydraulic Systems – Principles & Maintenance, McGraw-Hill Publishing Company Limited, New Delhi
6. Godfrey Onwubolu, Mechatronics: Principles and Applications, Butterworth-Heinemann

OpenElective–III		
S.No.	**CourseCode**	**CourseTitle**
1.	OE801 EE	SmartBuilding Systems(Not forEEE &EIE)
2.	OE802 EE	ProgrammableLogicControllers(Notfor EEE&EIE)
3.	OE803 AE	AutomotiveMaintenance(NotforMech./Prod./AutomobileEngg. Students)
4.	**OE804 ME**	**Mechatronics(NotforMech./Prod./AutomobileEngg.Students)**
5.	OE805 CE	EssentialsofRoadSafetyEngineering(NotforCivilEngg. Students)
6	OE806 CS	SoftwareEngineering(NotforCSE, IT,AI&ML,IOT,AI &DS Students)
7	OE 807 AS	DataVisualization(Not forCSE,IT,AI&ML,IOT,AI&DS Students)
8	OE808 AL	HumanComputerInteraction(NotforCSE,IT,AI&ML,IOT,AI&DS Students)
9	OE 809 DS	CognitiveScienceandAnalytics(NotforCSE,IT,AI&ML,IOT,AI&DS Students)
10	OE 810 CB	PrinciplesofBlockchainTechnologies(NotforCSE,IT,AI&ML,IOT,AI & DS Students)
11	OE811 IT	MobileComputing (Notfor CSE,IT ,AI&ML,IOT,AI &DS Students)
12	OE812 EC	PrinciplesofEmbeddedSystems(NotforECE,CSE,IT,AI&ML,IOT,AI & DS Students)
13	OE813 EC	FundamentalsofFuzzyLogic(NotforECE,CSE,IT,AI&ML,IOT,AI& DS Students)

PROJECT WORK-II

PW703ME

Instruction: 16 periods per week *Duration of SEE: -*
CIE: 50 marks *SEE: 150 marks*
Credits : 8

Objectives:

1. To enhance practical and professional skills.
2. To familiarize tools and techniques of systematic literature survey and documentation
3. To expose the students to industry practices and team work.
4. To encourage students to work with innovative and entrepreneurial ideas

Outcomes:

1. Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to the real-world problems.
2. Evaluate different solutions based on economic and technical feasibility
3. Effectively plan a project and confidently perform all aspects of project management
4. Demonstrate effective written and oral communication skills

The aim of Project work –II is to implement and evaluate the proposal made as part of Project Work - I. Students can also be encouraged to do full time internship as part of project work-II based on the common guidelines for all the departments. The students placed in internships need to write the new proposal in consultation with industry coordinator and project guide within two weeks from the commencement of instruction.

The department will appoint a project coordinator who will coordinate the following:

1. Re-grouping of students - deletion of internship candidates from groupsmade as part of project Work-I
2. Re-Allotment of internship students to project guides
3. Project monitoring at regular intervals

All re-grouping/re-allotment has to be completed by the 1st week of VIII semester so that students get sufficient time for completion of the project.

All projects (internship and departmental) will be monitored at least twice in a semester through student presentation for the award of sessional marks. Sessional marks are awarded by a monitoring committee comprising of faculty members as well as by the supervisor. The first review of projects for25 marks can be conducted after completion of five weeks. The second review for another 25 marks can be conducted after 12 weeks of instruction.

Common norms will be established for the final documentation of the project report by the respective departments. The students are required to submit draft copies of their project report within one week after completion of instruction.

Note: Three periods of contact load will be assigned to each project guide.