SCHEME OF INSTRUCTION & EXAMINATION
AICTE Model Curriculum
B. E. VII – Semester (MECHANICAL ENGINEERING)
(Proposed for the Academic year 2020-2021)

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	HS104ME	Operations Research	3	-	-	3	30	70	3	3
2	PC416ME	Automation in Manufacturing	3	-	-	3	30	70	3	3
3	PE54ME	Professional Elective-IV	3	-	-	3	30	70	3	3
4	PE55ME	Professional Elective-V	3	-	-	3	30	70	3	3
5	OE62	Open Elective-II	3	-	-	3	30	70	3	3
Practical / Laboratory Course										
6	PW702ME	Project –I	-	-	6	6	50			3
Total										**18**

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	Refrigeration & Air Conditioning	3	PE553ME	Total Quality Management
4	PE544ME	Tool Design			

Open Elective-II		
S. No.	**Course Code**	**Course Title**
1	OE621ME	Entrepreneurship (Not for Mech. Engg. 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:

1. Each contact hour is a clock hour
2. The duration of the practical class is two hours, however it can be extended wherever necessary, to enable the student to complete the experiment.

OPERATION RESEARCH

HS104ME

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 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 time scenario.
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 a conflict.
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 in LPP, Unbounded and, Infeasible solutions.
Unit-II:
Duality: Definition, Relationship between primal and 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.

AUTOMATION IN MANUFACTURING

PC416ME

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 based manufacturing.
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 various elements 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 of AM 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-Integrated Manufacturing, Prentice Hall.
2. Serope Kalpakjian and Steven R. Schmid, Manufacturing- Engineering and Technology, 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, World Scientific press, 2017.
5. Ibrahim Zeid, CAD/CAM, Theory and Practice, Mc Graw Hill, 1998.

3D PRINTING TECHNOLOGY

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 Additive Manufacturing

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/

ROBOTIC ENGINEERING

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 and find 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 robots.
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, Dynamic analysis using Lagrangian and Newton-Euler formulations of RR and RP type planar robots.

Unit-IV
Trajectory Planning: Joint interpolation,task space interpolation, executing user specified tasks, 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.

For the academic years 2020-2024

REFRIGERATION & AIR CONDITIONING

PE543ME

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. Low temperature 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 of Psychrometric processes on the chart. Introduction to Air Conditioning: Requirements of comfort air conditioning, Thermodynamics of human body, Body temperature, Metabolism, Body defense and Human tolerance, Effect of heat on 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.

TOOL DESIGN

PE544ME

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 appropriate tool 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, New Delhi.

NON-DESTRUCTIVE TESTING

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 of radiation received by personnel.
3. Technology of acoustic emission (AE), the associated instrumentation and applications
4. Technologies like neutron radiography; laser induced ultrasonics, surface analysis and thermography
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, phase analysis, 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 and applications. ***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

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, Force Transmitted, 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

For the academic years 2020-2024

TOTAL QUALITY MANAGEMENT

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 best practices 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, cost of 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 for quality 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

OE621ME

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 and performance 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 and Economic growth, Small and 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 oftime management, their strengths and weakness. The urgency addiction and time management matrix.

Unit-I
Indian Industrial Environment-competence, Opportunities and Challenges. Entrepreneurship and 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 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. Assessment of 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 Hill Publishing Company Ltd., 5^{lh} Ed., 2005.

PROJECT-I

PW703ME

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 and finalize 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 also be 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 seminars each 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 week to 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 for the 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.

Open Elective – II		
1	OE603 EE	Non-Conventional Energy Sources (Not for EEE & EIE Students)
2	OE604 EE	Transducers and Sensors (Not for EEE & EIE Students)
3	OE621 AE	Automotive Safety and Ergonomics (Not for Mech./Prod./Automobile Engg. students)
4	OE621 ME	Entrepreneurship (Not for Mech./Prod./Automobile Engg. students)
5	OE602 CE	Green Building Technologies (Not for Civil Engg. Students)
6	OE602 CS	Data Science Using R (Not for CSE Students)
7	OE 603 IT	Cyber Security (Not for IT Students)

NON-CONVENTIONAL ENERGY SOURCES

OE 603 EE

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

Objectives:

1. Toimparttheknowledge ofbasicsofdifferentnon-conventionaltypesofpowergeneration&powerplants
2. To helptheminunderstandingtheneedandroleofNon-Conventional Energysources particularlywhentheconventionalsourcesarescarcein nature

Outcomes:

Student will be able to
1. Understandthedifferentnonconventionalsourcesandthepowergenerationtechniquesto generate electricalpower.
2. UnderstandtheSolarenergypowerdevelopmentanddifferentapplications.
3. Understanddifferentwindenergypowergenerationtechniquesandapplications.
4. Designa prescribedengineeringsub-system.
5. Recognizetheneedandabilityto engagein lifelonglearningforfurtherdevelopmentsin thisfield.

UNIT – I
ReviewofConventionalandNon-Conventionalenergysources -Needfornon-conventionalenergysources. Typesof Non-conventionalenergysources-Fuel Cells-Principleof operationwithspecial referenceto H_2O_2Cell-ClassificationandBlockdiagram offuelcellsystems -Ionexchangemembranecell-Molten carbonatecells-

Solidoxideelectrolytecells-Regenerativesystem-Regenerative FuelCell-Advantages anddisadvantagesofFuelCells-Polarization-ConversionefficiencyandApplicationsofFuelCells.
UNIT – II
Solarenergy-Solarradiationand itsmeasurements-SolarEnergycollectors-SolarEnergystoragesystems-SolarPond-ApplicationofSolarPond-Applicationsofsolarenergy.
UNIT – III
Windenergy-Principlesofwindenergyconversion systems-Natureofwind-PowerintheWind-Basic components ofWECS-ClassificationofWECS-Siteselectionconsiderations -Advantagesand disadvantages ofWECS-Windenergycollectors-Windelectricgeneratingandcontrolsystems-ApplicationsofWindenergy-Environmentalaspects.
UNIT – IV
EnergyfromtheOceans-OceanThermalElectricConversion (OTEC)methods-Principlesoftidalpower generation-Advantages andlimitationsoftidalpowergeneration-Oceanwaves-Waveenergyconversion devices-Advantagesanddisadvantages ofwaveenergy-Geo-ThermalEnergy-TypesofGeo-Thermal EnergySystems-ApplicationsofGeo-ThermalEnergy.
UNIT – V
EnergyfromBiomass-Biomassconversiontechnologies/processes-Photosynthesis -Photosynthetic efficiency-Biogas generation-SelectionofsiteforBiogasplant-Classification ofBiogas plants-Details ofcommonlyusedBiogasplantsinIndia-Advantagesanddisadvantages ofBiogasgeneration-Thermal gasificationofbiomass-Biomassgasifiers.

Suggested Readings:

1. RaiG.D,*Non-ConventionalSourcesofEnergy*,KhandalaPublishers,NewDelhi,1999.
2. M.M.El-Wakil,Power*PlantTechnology*.McGrawHill,1984.

TRANSDUCERS AND SENSORS

OE 604 EE

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

Objectives:

1. To expose the students to various sensors and transducers for measuring mechanical quantities.
2. To understand the specifications of sensors and transducers.
3. To learn the basic conditioning circuits for various sensors and transducers.
4. To introduce advances in sensor technology.

Outcomes:

Student will be able to
1. Familiar with the basics of measurement system and its input, output configuration of measurement system.
2. Familiar with both static and dynamic characteristics of measurement system.
3. Familiar with the principle and working of various sensors and transducers.

UNIT – I
Introduction to measurement system (MS) static characteristics of MS:linearity,

Hysteresis, Threshold, Repeatability, Reliability and maintainability, Span, Calibration. ***Sensor Fundamentals***: Basic sensor technology and sensor system Sensor characteristics, system characteristics, instrument selection, data acquisition and readout, and installation.
UNIT – II
Resistive Transducer: Classification of transducers, Basic requirements of transducers, Variable resistance transducers; Potentiometers, Strain gauge (SG), types of Strain Guage.
UNIT – III
Variable capacitive transducers:Capacitance, Principles, Capacitance displacement transducers, Capacitive hygrometer, and capacitive proximity transducers. ***Variable inductive transducers****:* Linear variable differential transformer, Rotary variable differential transformer.
UNIT – IV
Measurement of temperature*:* Standards for calibration of temp. Temperature measuring devices, types of filled in system thermometers — liquid in glass, vapour pressure, bimetallic on solid rod thermometer Resistance temperature detectors, thermostat thermocouple.
UNIT – V
Advance Sensors:Piezoelectric transducers and their signal conditioning, Seismic transducer and its dynamic response, photoelectric transducers, Hall effect sensors, Digital displacement sensors, Fibre optic sensor, Semiconductor sensor and Smart sensors.

Suggested Readings:

1. C.S.Rangan, G R Sarma& V S N Mani, *Instrumentation Devices and Systems*-TMH, 2nd Edition2004.
2. B.Nakra&Chowdhari, *Instrumentation Measurement and Analysis*, TMH, 2nd Edition 2003.
3. D.V.S.Murthy, *Transducers and Instrumentation*, PHI, 1995 4. John P. Bentley, Principles of Measurement Systems, 3rd Edition, Pearson Education,2000.
4. Doebelin E.O, *Measurement Systems - Application and Design*, 4th Edition, McGraw-Hill, New Delhi.
5. PatranabisD, *Principles of Industrial Instrumentation*, 2nd Edition, Tata McGraw Hill, New Delhi,1997.
6. Jon Wilson *Sensor Technology Handbook*, Newness PublicationElsevier.

AUTOMOTIVE SAFETY AND ERGONOMICS

OE 621AE

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

Objectives:

1. To impart knowledge of automotive safety and ergonomics
2. To understand the basics of vehicle collision and its effects.
3. To understand the various safety concepts used in passenger cars
4. To Gain knowledge about various safeties and its equipment.
5. To understand the concepts of vehicle ergonomics.

Outcomes:

Student will be able to
1. Explain the types and importance of vehicle safety.

2. Describe the various safety equipments used in automobiles.
3. Demonstrate the modern tools used for vehicle safety.
4. Explain the role of automotive ergonomics in automobiles.
5. Demonstrate the best comfort and convenience system in vehicle.

UNIT – I

Introduction:Design of the Body for safety, Energy equations, Engine location, Effects of Deceleration inside passenger compartment, Deceleration on impact with stationary and movable obstacle, Concept of Crumble zone and Safety sandwich construction, Active and passive safety, Characteristics of vehicle structures, Optimization of vehicle structures for crash worthiness, Types of crash / roll over tests, Regulatory requirements for crash testing, instrumentation, High speed photography, image analysis.

UNIT – II

Safety Concepts:Active safety- driving safety, Conditional safety, Perceptibility safety and Operating safety, Passive safety: Exterior safety, Interior safety, Deformation behaviour of vehicle body, Speed and acceleration characteristics of passenger compartment on impact, pedestrian safety, human impact tolerance, determination of injury thresholds, severity index, study of comparative tolerance, Study of crash dummies.

UNIT – III

Safety equipments:Seat belt, automatic seat belt fastening system, Collapsible steering column, tilt-able steering wheel, Air bags, electronic systems for activating air bags, Frontal design for safety, collision warning system, Causes of rear end collision, frontal object detection, rear vehicle object detection system, Object detection system with braking system interactions. Anti-lock braking system ESP and EBD systems

UNIT – IV

Vehicle Ergonomics:Introduction to human body - anthropometrics and its application to vehicle ergonomics, Cockpit design, Driver comfort – seating, visibility, Man-machine system- psychological factors – stress, attention, Passenger comfort - ingress and egress, spaciousness, Ventilation, temperature control, Dust and fume prevention and vibration, Interior features and conveniences, Use of modern technology for the same

UNIT – V

Comfort and Convenience System: Cabin comfort - in-car air conditioning – overall energy efficiency, Air management, central and Unitary systems, air flow circuits, air cleaning, ventilation, air space diffusion, Compact heat exchanger design, controls and instrumentation, Steering and mirror adjustment, central locking system, Garage door opening system, tire pressure control system, rain sensor system, environment information system, Automotive lamps, types, design, construction, performance, Light signalling devices- stop lamp, Rear position lamp, Direction indicator, Reverse lamp, reflex reflector, position lamp, gas discharge lamp, LED, Adoptive front lighting system (AFLS) and Daylight running lamps(DRL).

Suggested Readings:

1. Prasad, Priya and BelwafaJamel, "*Vehicles Crashworthiness and Occupant Protection*", American Iron and Steel Institute,USA.
2. JullianHappian-Smith "*An Introduction to Modern Vehicle Design"* SAE,2002
3. Bosch - "*Automotive Handbook*" - 5th edition - SAE publication -2000.
4. *"Recent development in Automotive Safety Technology*", SAE International Publication. Editor: Daniel J Helt,2013.
5. Keitz H.A.E. "*Light Calculations and Measurements*", Macmillan1971.

ENTREPRENEURSHIP

OE621ME

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 infuture
2. To learn nuances of starting an enterprise & projectmanagement
3. To understand the design principles of solar energy systems, their utilization and performance evaluation
4. To understand the behavioural aspects of entrepreneurs and timemanagement

Outcomes:

At the end of the course, the students will be able to
1. Understand Indian Industrial Environment, Entrepreneurship and Economic growth, Small and Large Scale Industries, Types and forms ofenterprises.
2. Identify the characteristics of entrepreneurs, Emergence of first generation entrepreneurs, Conception and evaluation of ideas and theirsources.
3. Practice the principles of project formulation, Analysis of market demand, Financial and profitability analysis and Technicalanalysis.
4. Apply the concepts of Project Management during construction phase, project organization, project planning and control using CPM, PERTtechniques
5. UnderstandtheBehaviouralaspectsofentrepreneurs,TimeManagement,Variousapproachesofti me management, their strengths and weakness. The urgency addiction and time management matrix.

Unit-I
Indian Industrial Environment-competence, Opportunities and Challenges. Entrepreneurship and 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 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. Assessment of 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 managementmatrix.

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., 5^{lh} Ed.,2005.

GREEN BUILDING TECHNOLOGIES

OE 602 CE

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

Objectives:

1. To impart knowledge of the principles behind the green building technologies

2. To know the importance of sustainable use of natural resources and energy.
3. To understand the principles of effective energy and resources management in buildings
4. To bring awareness of the basic criteria in the green building rating systems
5. To understand the methodologies to reduce, recycle and reuse towards sustainability.

Outcomes:

Student will be able to
1. Define a green building, along with its features, benefits and rating systems.
2. Describe the criteria used for site selection and water efficiency methods.
3. Explain the energy efficiency terms and methods used in green building practices.
4. Select materials for sustainable built environment & adopt waste management methods.
5. Describe the methods used to maintain indoor environmental quality.

UNIT – I
***Introduction to Green Buildings*:** Definition of green buildings and sustainable development, typical features of green buildings, benefits of green buildings towards sustainable development. Green building rating systems – GRIHA, IGBC and LEED, overview of the criteria as per these rating systems.
UNIT – II
***Site selection and planning*:** Criteria for site selection, preservation of landscape, soil erosion control, minimizing urban heat island effect, maximize comfort by proper orientation of building facades, day lighting, ventilation, etc.
UNIT – III
Water conservation and efficiency:Rainwater harvesting methods for roof & non-roof, reducing landscape water demand by proper irrigation systems, water efficient plumbing systems, water metering, waste water treatment, recycle and reuse systems. ***Energy Efficiency:*** Environmental impact of building constructions, Concepts of embodied energy, operational energy and life cycle energy. ***Methods to reduce operational energy:*** Energy efficient building envelopes, efficient lighting technologies, energy efficient appliances for heating and air-conditioning systems in buildings, zero ozone depleting potential (ODP) materials, wind and solar energy harvesting, energy metering and monitoring, concept of net zero buildings.
UNIT – IV
Building materials: Methods to reduce embodied energy in building materials: (a) Use of local building materials (b) Use of natural and renewable materials like bamboo, timber, rammed earth, stabilized mud blocks, (c) use of materials with recycled content such as blended cements, pozzolona cements, fly ash bricks, vitrified tiles, materials from agro and industrial waste. (d) reuse of waste and salvaged materials
UNIT – V
Indoor Environmental Quality for Occupant Comfort and Wellbeing: Daylighting, air ventilation, exhaust systems, low VOC paints, materials & adhesives, building

acoustics. Codes related to green buildings: NBC, ECBC, ASHRAE, UPC etc.

Suggested Readings:

1. *IGBC Green Homes Rating System, Version 2.0.*, Abridged reference guide, 2013, Indian Green Building Council Publishers
2. GRIHA version 2015, GRIHA rating system, *Green Rating for Integrated Habitat Assessment*
3. '*Alternative building materials and technologies*' by K.S. Jagadish, B.V. Venkatarama Reddy and K.S. Nanjunda Rao.
4. '*Non-Conventional Energy Resources*' by G. D. Rai, Khanna Publishers.
5. *Sustainable Building Design Manual, Vol.1 and 2*, TERI, New Delhi 2004

DATA SCIENCE USING R

OE 602CS

For the academic years 2020-2024

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

Objectives:

1. To learn basics of R Programming environment: R language, R- studio and R packages.
2. To learn various statistical concepts like linear and logistic regression, cluster analysis, time series forecasting.
3. To learn Decision tree induction, association rule mining and text mining.

Outcomes:

Student will be able to
6. Use various data structures and packages in R for data visualization and summarization.
7. Use linear, non-linear regression models, and classification techniques for data analysis.
8. Use clustering methods including K-means and CURE algorithm

UNIT – I
Introduction To R: Introduction, Downloading and Installing R, IDE and Text Editors, Handling Packages in R. **Getting Started With R:** Introduction, Working with Directory, Data Types In R, Few Commands for Data Exploration. **Loading and Handling Data In R:** Introduction, Challenges of Analytical Data Processing, Expression, Variables, Functions, Missing Values Treatment In R, Using _As' Operator To Change The Structure Of The Data, Victors, Matrices, Factors, List, Few Common Analytical Tasks, Aggregation And Group Processing Of A Variable, Simple Analysis Using R, Methods For Reading Data, Comparison Of R GUI's For Data Input, Using R With Databases And Business Intelligence Systems.
UNIT – II
Exploring Data In R: Introduction, Data Frames, R Functions for Understanding Data in Data Frames, Load Data Frames, Exploring Data, Data Summary, Finding the Missing Values, Invalid Values And Outliers, Descriptive Statistics, Spotting Problems In Data with Visualization.
UNIT – III
Linear Regression Using R: Introduction, Model Fitting, Linear Regression, Assumptions of Linear Regression, Validating Linear Assumption. **Logistic Regression:** Introduction, What Is Regression?, Introduction To Generalized Linear Model, Logistic Regression, Binary Logistic Regression, Diagnosing Logistic Regression, Multinomial Logistic Regression Model.
UNIT – IV
Decision Tree: Introduction, What Is A Decision Tree?, Decision Tree Representation In R, Appropriate Problems For Decision Tree Learning, Basic Decision Tree Learning Algorithm, Measuring Features, Hypothesis Space Search In Decision Tree Learning,

Inductive Bias In Decision Tree Learning, Why Prefer Short Hypotheses, Issues In Decision Tree Learning.

Time Series In R: Introduction, What Is Time Series Data, Reading Time Series Data, Decomposing Time Series Data, Forecasts Using Exponential Smoothing, ARIMA Models.

UNIT – V

Clustering: Introduction, What Is Clustering, Basic Concepts in Clustering, Hierarchical Clustering, K-Means Algorithm, CURE Algorithm, Clustering in Non-Euclidean Space, Clustering for Streams and Parallelism.

Association Rules: Introduction, Frequent Itemset, Data Structure Overview, Mining Algorithm Interfaces, Auxiliary Functions, Sampling from Transaction, Generating Synthetic Transaction Data, Additional Measures of Interestingness, Distance Based Clustering Transaction and Association.

Text Mining: Introduction, Definition of Text Mining, A Few Challenges in Text Mining, Text Mining Verses Data Mining, Text Mining In R, General Architectures of Text Mining Systems, Pre-Processing of Documents In R, Core Text Mining Operations, Using Background Knowledge for Text Mining, Text Mining Query Languages.

Mining Frequent Patterns, Associations and Correlations: Basic Concepts and Methods.

Frequent Itemset, Closed Itemset And Association Rules.

Frequent Itemset: Mining Methods, Pattern Evaluation Methods, Sentiment Analysis**.**

Suggested Readings:

1. Data Analytics using R by Seema Acharya. McGraw Hill education.
2. Practical Data Science with R, Nina Zumel and John Mount, Manning Shelter Island.
3. 'The R book, Crawley, Michael J. John Wiley & Sons, Ltd

CYBER SECURITY

OE 603 IT

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

Objectives:

1. To familiarize various types of cyber-attacks and cyber-crimes
2. To give an overview of the cyber laws
3. To study the defensive techniques against these attacks

Outcomes:

Student will be able to
4. Understand different types of cyber-attacks
5. Understand the types of cybercrimes and cyber laws
6. To protect them self and ultimately the entire Internet community from such attacks

UNIT – I
Introduction to Cyber Security: Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance –Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Spectrum of attacks, Taxonomy of various attacks, IP spoofing, Methods of defense, Security Models, risk management, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy.
UNIT – II
Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Data linking and profiling, privacy policies and their specifications, privacy policy languages, privacy in different domains-medical, financial.
UNIT – III
Logical Design: Blue print for security. Security Policy, standards and Practices, Design of Security Architecture.

Physical Design: Security Technology, Physical Design of Security SDLC Firewalls, Dialup Protection, Intrusion Detection Systems, Scanning and analysis tools, and Content filters.
UNIT – IV
Cryptography: The basic elements of cryptography: symmetric (Symmetric Key-DES, IDEA, and AES), and public key cryptography (Public Key Encryptions-RSA).
UNIT – V
Message digest (MD-5, SHA), and digital signatures. ***SSL and SET:*** SSL and SET protocols, Internet transactions using both SSL and SET.

Suggested Readings:

1. Michael E. Whitman and Herbert J. Mattord, "*Principles of Information Security*", Thomson, 2003.
2. William Stallings, "*Cryptography and Network Security*", Pearson Education, 2000.
3. Nina Godbole, "*Information System Security*", John Wiley & Sons, 2008.