Counselling Code : VBIT

VIGNANA BHARATHI®
Institute of Technology

(A UGC Autonomous Institution, Approved by AICTE, Accredited by NBA & NAAC-A Grade, Affiliated to JNTUH)

DEPARTMENT

OF

MECHANICAL ENGINEERING

IV B. Tech

COURSE STRUCTURE & SYLLABUS

(R22)

IV YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1.	22ME4111	Finite Element Methods	3	0	0	3
2.	22ME4112	Refrigeration & Air Conditioning	3	0	0	3
4.	**22ME416X**	Open Elective - II	3	0	0	3
5.	**22ME417X**	Professional Elective – III	3	0	0	3
6.	**22ME417X**	Professional Elective - IV	3	0	0	3
7.	22ME4151	Computer Aided Engineering Laboratory	0	0	2	1
8.	22ME4181	Internship	0	0	4	2
9	22ME4182	Project Stage - I	**0**	**0**	**4**	**2**
		Total Credits	**15**	**0**	**10**	**20**

IV YEAR II SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits
1.	**22ME426X**	Open Elective - III	3	0	0	3
2.	**22ME427X**	Professional Elective – V	3	0	0	3
3	**22ME427X**	Professional Elective - VI	3	0	0	3
4.	22ME4281	Project Stage – II Including Seminar	0	0	22	11
		Total Credits	**9**	**0**	**22**	**20**

***MC – Satisfactory/Unsatisfactory**

PROFESSIONAL ELECTIVES OFFERED IN R22

Professional Elective – III

22ME4171	Production Planning & Control
22ME4172	Computational Fluid Dynamics
22ME4173	Composite Materials
22ME4174	Solar energy technology

Professional Elective – IV

22ME4175	Re-Engineering
22ME4176	Non-Conventional Energy Sources
22ME4177	Operations Research
22ME4178	Electric and Hybrid Vehicles

Professional Elective – V

22ME4271	Automation in Manufacturing
22ME4272	Turbo Machinery
22ME4273	Additive Manufacturing
22ME4274	Energy Conservation and Management

Professional Elective – VI

22ME4275	Industry 4.0
22ME4276	Fluid Power System
22ME4277	Fuzzy Logic and ANN
22ME4278	Total Quality Management

IV Year - I Semester

22ME4111: **FINITE ELEMENT METHODS**

B.Tech. IV Year - I Sem

L	T	P	C
3	0	0	3

Pre-requisites: Mechanics of Solids, Empirical Mathematics of Matrices, Heat Transfer, Mechanical Vibrations.

Course Objectives: To learn

- Basic principles of finite element analysis procedure.
- Concepts of Mathematical Modelling of Engineering Problems.
- Applying finite element solutions to structural, thermal& dynamic analysis problems.
- Knowledge and skills needed to effectively evaluate finite element analysis.
- Appreciate the use of FEM to a range of Engineering Problems.

Course Outcomes: At the end of the course Student will be able to

- Summarize the basics of finite element formulation.
- Apply finite element formulations to solve one dimensional Problems.
- Apply finite element formulations to solve two dimensional scalar Problems.
- Apply finite element method to solve Heat Transfer problems.
- Apply finite element method to solve problems dynamic analysis Problems.

UNIT I

Introduction to Finite Element Methods: General Procedure – Engineering Applications – Types of Analysis Performed - Stress and Equilibrium, Strain – Displacement relations. Stress – strain relations: Finite Elements: 1- Dimensional, 2 – Dimensional, 3-Dimensional & Interpolation Elements

One Dimensional Problems: 1-D Linear and 1-D Quadratic Elements - Finite element modeling, Coordinates and shape functions. Assembly of Global stiffness matrix and load vector. Finite element equations, Treatment of boundary conditions, Quadratic shape functions.

UNIT II

Analysis of Trusses: Derivation of Stiffness Matrix for Plane Truss, Displacement of Stress Calculations.

Analysis of Beams: Stiffness matrix for two noded elements, two degrees of freedom per node beam element, Load Vector, Deflection.

UNIT III

Finite element modeling of two-dimensional stress analysis with constant strain triangles and treatment of boundary conditions, Estimation of Load Vector, Stresses

Finite element modeling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements. Two dimensional four noded isoperimetric elements and numerical integration.

UNIT IV

Steady State Heat Transfer Analysis: One dimensional analysis of Slab, fin and two-dimensional analysis of thin plate.

UNIT V

Dynamic Analysis: Formulation of finite element model, element - Mass matrices, evaluation of Eigen values and Eigen vectors for a stepped bar, truss and beam.

TEXT BOOKS:

1. Tirupathi R. Chandrupatla, Ashok D.Belegundu "Introduction to Finite Elements in Engineering", 4th Edition, Pearson Publications, 2015.
2. J. N. Reddy"An Introduction to the Finite Element Method",4th Edition, Mc Graw Hill, 2020.

REFERENCES:

1. G. Ramamurty "Applied Finite Element Analysis",2nd Edition,Ik International Publications, 2010.
2. Chennakesava R. Alavala,"Finite Element Methods: Basic Concepts and applications", 1stEdition, PHI publications, 2012
3. U.S. Dixit"Finite Element Method for Engineers"1st Edition, Cengage Publications,Edition, 2009.
4. 4. S.S. Bhavikatti"Finite Element Analysis" 3rd Edition, New Age International Publishers, 2015.

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22ME4112: REFRIGERATION AND AIR CONDITIONING

B.Tech. IV Year –I Sem

L	T	P	C
3	0	0	3

Pre-requisite: Thermodynamics

Course Objective: This course will develop students 'knowledge in/on

- fundamentals of refrigeration and air conditioning, psychometry
- Types of vapour compression cycles and performance analysis of the cycles
- Refrigeration equipments - compresses, evaporators, expansion devices and properties of refrigerants
- Types of vapor absorption refrigeration systems and non-conventional refrigeration systems
- Properties of moist air, psychometric chart, cooling load calculations, comfort air-conditioning and applications air conditioning

Course Outcomes: At the end of the course, the student should be able to

- Understand the principles, applications of refrigeration systems and evaluate the performance of air refrigeration.
- Analyze performance of vapor compression refrigeration systems.
- Explain the types and working principle of refrigeration equipments and explain the desirable properties of refrigerants.
- Explain vapor absorption refrigeration system and non-conventional refrigeration systems
- Estimate the cooling load capacity for a given application and represent various processes on the psychometric chart.

UNIT – I

Introduction to Refrigeration: - Necessity and applications – Unit of refrigeration and C.O.P. – Mechanical Refrigeration – Types of Ideal cycle of refrigeration. Air Refrigeration: Bell Coleman cycle and Brayton Cycle, Open and Dense air systems – Actual air refrigeration system – Refrigeration needs of Air crafts- Air systems – Application of Air Refrigeration, Justification – Types of systems – Problems.

UNIT – II

Vapour compression refrigeration – working principle and essential components of the plant – Simple Vapour compression refrigeration cycle – COP – Representation of cycle on T-S and p-h charts – effect of sub cooling and super heating – cycle analysis – Actual cycle Influence of various parameters on system performance – Use of p-h charts – Problems.

UNIT - III

System Components: Compressors – General classification – comparison – Advantages and Disadvantages. Condensers – classification – Working Principles. Evaporators – classification – Working Principles. Expansion devices – Types – Working Principles. Refrigerants – Desirable properties – common refrigerants used – Nomenclature – Ozone Depletion – Global Warming – Azeotropes and Zeotropes.

UNIT - IV

Vapor Absorption System – Calculation of max COP – description and working of NH3 – water system – Li – Br system. Principle of operation Three Fluid absorption system, salient features. Steam Jet Refrigeration System – Working Principle and Basic Components Principle and operation of (i) Thermoelectric refrigerator (ii) Vortex tube or Hilsch tube.

UNIT – V

Introduction to Air Conditioning: Psychometric Properties & Processes – Sensible and latent heat loads – Characterization – Need for Ventilation, Consideration of Infiltration – Load concepts of RSHF, ASHF, ESHF and ADP. Concept of human comfort and effective temperature –Comfort Air conditioning – Industrial air conditioning and Requirements – Air conditioning Load Calculations. Air Conditioning systems - Classification of equipment, cooling, heating humidification and dehumidification, filters, grills and registers, deodorants, fans and blowers. Heat Pump – Heat sources – different heat pump circuits – Applications.

TEXT BOOKS

1. CP Arora "Refrigeration and Air conditioning", Mc Graw Hill 2015
2. RC Aora "Refrigeration and Air-Conditioning", PHI 2012

REFERENCES

1. Dossat"Principles of Refrigeration" Pearson
2. Anantha narayanan "Basic Refrigeration and Air-Conditioning" Mc Graw Hill
3. Manohar Prasad "Refrigeration and Air conditioning" New Age International publishers, New Delhi.
4. Stocker W.S., "Refrigeration & Air Conditioning", McGraw Hill, New Delhi, 2004.

22ME4171: PRODUCTION PLANNING AND CONTROL
(PROFESSIONAL ELECTIVE-III)

B.Tech. IV Year -I Sem **L T P C**
3 0 0 3

Pre Requisites –Management science and productivity

Course Objectives:

- Explain Production Planning & Control with reference to an Industry and Elaborate need of Forecasting.
- Explain about Inventory and Inventory managing techniques.
- Examine the factors affecting routing procedure and steps involved in Material Requirement Planning.
- Classify scheduling techniques and its implementation with different industries.
- Summarize Dispatching, following procedure.

Course Outcomes: At the end of the course, the students will develop ability to

- Execute required Forecasting method for different Forecasting problems.
- Apply suitable Analysis to be applied to maintain Economical inventory.
- Develop a route sheet for given product through line balancing problems.
- Evaluate Shortest processing time from the scheduling problems.
- Apply the knowledge of materials Dispatching, follow-up.

UNIT – I

Introduction: Definitions – Objectives of Production Planning and Control – Functions of production planning and control – Elements of production control - Types of production - Organization of production planning and control, Internal organizations department. **Forecasting**: Definition- importance of forecasting - factors affecting the forecast- types of forecasting and their uses-demand patterns - general principles of forecasting techniques quantitative techniques- qualitative techniques- measures of forecasting errors.

UNIT – II

Inventory Management: Functions of inventories – relevant inventory costs – ABC analysis – VED analysis –Basic EOQ model- Inventory control systems –continuous review systems and periodic review systems, MRP, ERP, JIT Systems-basic treatment only.

Aggregate planning: Definition – aggregate planning strategies – aggregate planning methods – transportation model.

UNIT – III

Line Balancing: Terminology, Methods of Line Balancing, RPW method-Largest Candidate ulemethod.

Routing – Definition – Routing procedure – Factors affecting routing procedure, Route Sheet.

UNIT – IV

Scheduling: Definition – Scheduling Policies – types of scheduling methods – difference with loading – flow shop scheduling **–** job shop scheduling, line of balance(LOB)-objectives-steps involved.

UNIT – V

Dispatching: Definition – activities of dispatcher – dispatching procedures – various forms used in dispatching.

Follow up: definition – types of follow up – expediting – definition – expediting procedures- Applications of computers in planning and control.

TEXT BOOKS

1. Samuel Eilon, "Elements of Production Planning and Control", ISBN-13: 9788185027098.
2. R.K.Jain, "Production Planning and Control", Khanna publishers.

REFERENCES

1. Ravi Shankar, "Industrial Engineering and management", Galgotia Publishers, 2nd Edition, ISBN Number: 978-8175156050.
2. Panner Selvam, "Production Operation Management", PHI Publishers, 2nd Edition, ISBN, 8120327675, 9788120327672.
3. Moore, "Production Control", ISBN 13: 9780070429215.
4. Joseph S. Martinich, "Production and Operations Management", John Willey & Sons, 1st Edition.

22ME4172: COMPUTATIONAL FLUID DYNAMICS
(PROFESSIONAL ELECTIVE – III)

B.Tech. IV Year –I Sem **L T P C**
3 0 0 3

Pre Requisites- Fluid Mechanics, Mathematics.

Course Objectives:

- To develop an understanding for the major theories, approaches and methodologies used in CFD
- To build up the skills in the actual implementation of CFD methods (e.g. boundary conditions, turbulence modeling etc.) in using commercial CFD codes
- To gain experience in the application of CFD analysis to real engineering designs.
- To find Finite difference applications in heat transfer
- To understand Applications of CFD

Course Outcomes: At the end of this course, the student will be able to:

- Understand and be able to numerically solve the governing equations for fluid flow
- Understand and apply finite difference, finite volume and finite element methods to fluid flow problems
- Understand how to assess stability and conduct a grid-convergence assessment
- Understand and apply compressible flow solvers
- Understand the issues surrounding two-phase flow modeling

Unit-I

Equations of fluid dynamics Basic concepts Eulerarian and Lagrangian methods of describing fluid flow motion, acceleration and deformation of fluid particle, vorticity. Laws governing fluid motion, continuity, Navier – stokes & energy equations. Boundary layer equation, Euler equations, potential flow equations, Bernoulli‟s equation and vorticity transport equation. Initial and boundary conditions. Classification of equation of motions – hyperbolic, parabolic, elliptic.

Unit-II

Mathematical Preliminaries Numerical integration. Review of linear algebra, solution of simultaneous linear algebraic equations – matrix inversion, solvers – direct methods, elimination methods, ill conditioned systems; Gauss- Sidel method, successive over relaxation method.

Unit-III

Grid Generation Transformation of coordinates. General principles of grid generation – structured girids in two and three dimensions, algebraic grid generation, differential equations based grid generation; Elliptic grid generation, algorithm, Grid clustering, Grid refinement, Adaptive grids, Moving grids. Algorithms, CAD interfaces to grid generation. Techniques for complex and large problems: Multi block methods.

Unit-IV

Finite difference discretization Elementary finite difference coefficients, basic aspects of finite difference equations, consistency, explicit and implicit methods, errors and stability analysis. Stability of elliptic and hyperbolic equations. Fundamentals of fluid flow modeling- conservative property, upwind scheme, transporting property, higher order upwinding. Finite difference applications in heat transfer – conduction, convection.

Unit-V

Finite Volume Method Introduction, Application of FVM in diffusion and convection problems, NS equations – staggered grid, collocated grid, SIMPLE algorithm. Solution of discretised equations using TDMA.Finite volume methods for unsteady problems – explicit schemes, implicit schemes. Finite Element Method: Introduction. Weighted residual and variational formulations. Interpolation in one-dimensional and two-dimensional cases. Application of FEM to ID and 2D problems in fluid flow and heat transfer

TEXT BOOKS

1. Ferziger J. H., Springer P.M, "Computational Methods for fluid Dynamics", Verlag Berlin
2. Anderson J. D. JR, "Computational fluid Dynamics", Mc Graw Hill Inc, 1995

REFERENCES

1.Patankar S. P, "Numerical Heat Transfer & Fluid flow"

2.Sunderarajan M.K., "Computational Fluid Flow and Heat Transfer", 2nd Ed.

3.Computational Fluid Flow and Heat Transfer – K Muralidharan and T Sudarajan.

4.Computational Fluid Dynamics : The basics with applications – John D Anderson,McGraw Hill

22ME4173: COMPOSITE MATERIALS
(PROFESSIONAL ELECTIVE – III)

B.Tech. IV Year I Sem

L	T	P	C
3	0	0	3

Pre-Requisites: Metallurgy and Material Science, Strength of Materials.

Course Objectives: To learn

- To study the importance of composites.
- To identify the components of composites for fabrication.
- To learn the manufacturing methods of composites.
- To study the various mechanical joints for composite joining.
- To predict the machining behavior of composite materials.

Course Outcomes: At the end of the course Student will be able to

- Understand the importance of composites and their applications.
- Understand the use of reinforcements in composite production.
- Comprehend various composite manufacturing methods.
- Examine the various mechanical joints for composite part assembly.
- Apply the machining operations to composites to know the material behavior.

UNIT I

Introduction: Conventional Engineering Materials, Functions of Fibbers and Matrix, Special Features of Composites, drawbacks of Composites, Composites Processing, Composites Product Fabrication, Composites Markets, Barriers in Composite Markets.

UNIT II

Raw Materials for Part Fabrication: Reinforcements - Glass Fiber Manufacturing, Carbon Fiber Manufacturing, Aramid Fiber Manufacturing; Matrix Materials - Thermoset Resins, Thermoplastic Resins; Fabrics, Prepregs, Performs, Honeycomb and Other Core Materials.

UNIT III

Manufacturing Techniques: Manufacturing Process Selection Criteria, Product Fabrication Needs, Basic Steps in a Composites Manufacturing Process, Manufacturing Processes for Thermo set Composites - Prepreg Lay-Up Process, Wet Lay-Up Process, Spray-Up Process, Filament Winding Process, Pultrusion Process, Resin Transfer Molding Process; Manufacturing Processes for Thermoplastic Composites - Thermoplastic Pultrusion Process, Autoclave Processing.

UNIT IV

Joining of Composite Materials: Adhesive Bonding, Types of Adhesives, Advantages of Adhesive Bonding over Mechanical Joints, Adhesive Selection Guidelines, Mechanical Joints.

UNIT V

Machining and Cutting of Composites: Machining and Cutting of Composites, Challenges during Machining of Composites, Failure Mode during Machining of Composites, Cutting Tools, Types of Machining Operations, Drilling Operation.

TEXT BOOKS

1. Isaac and M Daniel “Engineering Mechanics of Composite Materials” Oxford University Press.
2. R. M. Jones, “Mechanics of Composite Materials” McGraw-Hill Company.

REFERENCES

1.B. D. Agarwal and L.J. Broutman, Wiley “Analysis and Performance of Fiber composites”, Interscience.
2. Autar K. Kaw “Mechanics of Composite Materials” CRC Publications.
3. L. R. Calcote, Van NostrandRainfold “Analysis of Laminated Composite Structures”.
4.Madhujit Mukhopadhyay “Mechanics of Composite Materials and Structures”, Univ Press.

22ME4174: SOLAR ENERGY TECHNOLOGY
(PROFESSIONAL ELECTIVE – III)

B.Tech. IV Year –I Sem **L T P C**
Pre-Requisites: Nil **3 0 0 3**

Course Objectives

- Focus on solar energy utilization
- Explain the concepts of solar water heating and its layout
- Concepts of thermal energy storage
- Discuss the energy conversion technologies
- Concentrate the economic aspects of Solar Energy

Course Outcomes

- Explain the solar energy potential and construction details of collector with performance analysis
- Analyse the concepts of solar water heating technologies and its parameters
- Narrate the methods of solar energy storage and its working
- Infer the direct energy conversion and conversion efficiencies calculations
- Discuss the Principles of Economic Analysis and optimization with respect solar energy

UNIT-I:

INTRODUCTION – Solar energy option, specialty and potential – Sun – Earth – Solar radiation, beam and diffuse – measurement – estimation of average solar radiation on horizontal and tilted surfaces – problems – applications. Capturing solar radiation – physical principles of collection – types – liquid flat plate collectors – construction details – performance analysis – concentrating collection – flat plate collectors with plane reflectors – cylindrical parabolic collectors – Orientation and tracking – Performance Analysis.

UNIT-II:

DESIGN OF SOLAR WATER HEATING SYSTEM AND LAYOUT: Power generation – solar central receiver system – Heliostats and Receiver – Heat transport system – solar distributed receiver system – Power cycles, working fluids and prime movers, concentration ratio.

UNIT-III:

THERMAL ENERGY STORAGE: Introduction – Need for – Methods of sensible heat storage using solids and liquids – Packed bed storage – Latent heat storage – working principle – construction – application and limitations. Other solar devices – stills, air heaters, dryers, Solar Ponds & Solar Refrigeration, active and passive heating systems.

UNIT-IV:

DIRECT ENERGY CONVERSION: solid-state principles – semiconductors – solar cells – performance – modular construction – applications. conversion efficiencies calculations.

UNIT-V:

ECONOMICS: Principles of Economic Analysis – Discounted cash flow – Solar system – life cycle costs – cost benefit analysis and optimization – cost based analysis of water heating and photo voltaic applications.

TEXT BOOKS

1. Principles of solar engineering/ Kreith and Kerider/Taylor and Franscis/2nd Edition.
2. Solar energy thermal processes/ Duffie and Beckman/John Wiley & Sons

REFERENCE BOOKS

1. Solar energy: Principles of Thermal Collection and Storage/ Sukhatme/TMH/2nd edition
2. Solar energy/ Garg/TMH 5. Solar energy/ Magal/Mc Graw Hill
3. Solar Thermal Engineering Systems / Tiwari and Suneja/Narosa 7. Power plant Technology/ El Wakil/TMH

22ME4175: RE-ENGINEERING
(PROFESSIONAL ELECTIVE – IV)

B.Tech. IV Year –I Sem **L T P C**
3 0 0 3

Pre-Requisites:Nil

Course Objective: This course will develop students'knowledge in/on

- Introduce the concepts of reverse engineering
- Familiarize with methodologies and techniques for Reverse Engineering.
- Familiarize with hardware and software tools for collection of data
- Introduction to Rapid Prototyping and data processing techniques
- Integrate of Reverse Engineering and Rapid Prototyping techniques.

Course Outcomes: At the end of the course, the student should be able to

- Understand the process of reverse engineering and its applications.
- Understand the methodologies and techniques for Reverse Engineering.
- Knowledge on hardware and software tools for data collection
- Select a proper system the data processing to generate geometric representations of physical objects.
- Integrate Reverse Engineering and Rapid Prototyping with cause study.

UNIT-I Introduction: Reverse engineering fundamentals-The generic process-Three phases of reverse engineering-Phase I: Scanning, Phase II: Point processing, Phase III: Geometric model development.

UNIT-II Methodologies and techniques of Reverse Engineering: Computer aided reverse engineering, Computer vision and reverse engineering, Structured light range imaging, Scanner pipeline.

UNIT-III Reverse engineering hardware and software: Introduction, Reverse engineering hardware, Reverse engineering software, Selection of a reverse engineering system, Case studies with implementation.

UNIT-IV Introduction to rapid prototyping: Need & Development of RP systems, RP process chain, Impact of Rapid prototyping and Tooling on Product Development, Benefits, Digital prototyping, Virtual prototyping, Applications,

UNIT-V: Relationship between reverse engineering and rapid prototyping, Case studies with implementation.

Text Books:

1. K. Otto and K. Wood, Product Design: Techniques in Reverse Engineering and New Product Development, 1st edition, Prentice Hall, 2001. ISBN-13: 978-0130212719.

2. V. Raja and K. Fernandes, Reverse Engineering: An Industrial Perspective, Springer- Verlag, 2008. ISBN: 978-1- 84628-855-5.

3. K. A. Ingle, Reverse Engineering, McGraw-Hill, 1994. ISBN-13: 978-0070316935.

References:

1. L. Wills and P. Newcomb, Reverse Engineering, 1st edition, Springer-Verlag, 1996. ISBN-13: 978-1475788280.
2. C. K. Chua, K. F. Leong and C. S. Lim, Rapid Prototyping: Principles and Applications, 4th edition, World Scientific, 2010. ISBN: 978-981-277-897-0.

22ME4176:NON-CONVENTIONAL ENERGY SOURCES
(PROFESSIONAL ELECTIVE – IV)

B.Tech. IV Year –I Sem **L T P C**
3 0 0 3

Pre-requisites: RES

Course Objectives: The Objective of this course is to provide the student to

- Introduce the need of the non-convectional energy sources.
- Differentiate various solar collectors
- Identify the energy resources utilization systems
- Recognize the source and potential of wind energy and understand the classifications of wind mills.
- Summarize the principles of bio-conversion, ocean energy and geo thermal energy.

Course Outcomes: At the end of the course students will be able to

- Choose the appropriate renewable energy as an alternate for conventional power in any application.
- Understand principles of various solar collectors and use them in different applications
- Inculcate the knowledge on usage of alternate energy sources in I.C Engines
- Know various energy conversion techniques
- Analyze large scale demand of heat energy for meeting day to day domestic, institutional and industrial requirements can be met by utilizing solar thermal systems, biogas, PV cells, wind energy, Geothermal, MHD etc.

UNIT-I:

Principles of Solar Radiation, Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power - Physics of the sun, the solar constant, extra-terrestrial and terrestrial solar radiation, Solar radiation on titled surface, Instruments for measuring solar radiation and sun shine, solar radiation data.

UNIT-II:

Solar Energy Collection Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors. Solar Energy Storage and Applications: Different methods, sensible, latent heat and stratified storage, solar ponds. Solar applications - solar heating/ cooling techniques, solar distillation and drying, Photovoltaic energy conversion.

UNIT-III:

Wind Energy Sources and potentials, horizontal and vertical axis windmills, performance characteristics. Bio-Mass: Principles of Bio-Conversion, Anaerobic /aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C. Engine operation, and economic aspects.

UNIT-IV:

Geothermal Energy Resources, types of wells, methods of harnessing the energy, potential in India. OTEC: Principles, utilization, setting of OTEC plants, thermodynamic cycles. Tidal and Wave Energy: Potential and conversion techniques, mini-hydel power plants, their economics.

UNIT-V:

Direct Energy Conversion Need for DEC, Carnot cycle, limitations, Principles of DEC. Thermo-electric generators, Seebeck, Peltier and Joule Thompson effects, figure of merit, materials, applications, MHD generators, principles, dissociation and ionization, hall effect, magnetic flux, MHD accelerator, MHD engine, power generation systems, electron gas dynamic conversion, economic aspects. Fuel cells, principle, faraday's laws, thermodynamic aspects, selection of fuels and operating conditions.

TEXT BOOKS

1. Renewable Energy Sources/Twidell & Weir /Taylor and Francis / 2nd Special Indian Edition.
2. Non- conventional Energy Sources / G.D. Rai / Dhanpat Rai and Sons.

REFERENCES

1. Energy Resources Utilization and Technologies/Anjaneyulu & Francis/BS Publications/2012.
2. Principles of Solar Energy / Frank Krieth & John F Kreider / Hemisphere Publications.
3. Non-Conventional Energy / Ashok V Desai / Wiley Eastern.
4. Non-Conventional Energy Systems / K Mittal / Wheeler.
5. Renewable Energy Technologies /Ramesh & Kumar /Narosa.
6. Renewable Energy Resources /Tiwari and Ghosal /Narosa.

22ME4177: OPERATIONS RESEARCH
(PROFESSIONAL ELECTIVE – IV)

B.Tech. IV Year –I Sem **L T P C**
3 0 0 3

Pre-Requisites: Probability and Statistics for Complex variables

Course Objectives:

- To define scientific approach to problem solving for executive management.
- To illustrate modern methods to complex problems.
- To solve the assignment problem helps us to maximize our profit or minimize the cost.
- To develop game theory in which ones choice of action is determined after taking into account all possible alternatives.
- To build inventory models for solving the inventory problems.

Course Outcomes: At the end of the course, the students will able to

- List out various Operation Research models and Illustrate linear programming problem.
- Calculate transportation cost for a various transportation models.
- Assess the inventory requirements and find best replacement period for machines under different conditions.
- Construct a dynamic programming model.
- Decide the number of servers to minimize waiting time of customers and idle time of a server.

UNIT – I

Development: History, Definition, OR Models, OR Techniques and phases of implementing OR in practice.

Allocation: Introduction to linear programming formulation, graphical solution, Simplex method, artificial variable technique, Un restricted Variables, Duality principle, Dual Simplex method.

UNIT – II

Transportation Problem: Formulation – Optimal solution, unbalanced transportation problem – Degeneracy. **Assignment problem** – Formulation – Optimal solution - Variants of Assignment Problem- Traveling Salesman problem.

UNIT – III

Sequencing: Introduction – Flow –Shop sequencing – n jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through „m‟ machines

Replacement: Introduction – Replacement of items that deteriorate with time – when money value is not counted and counted – Replacement of items that fail completely- Group Replacement.

UNIT – IV

Theory of Games: Introduction –Terminology– Solution of games with saddle points and without saddle points- 2 x 2 games – dominance principle – m x 2 & 2 x n games –graphical method.

Inventory: Introduction – Single item, Deterministic models – Purchase inventory models with finite & infinite with one price break and multiple price breaks ,Models with shortages – Stochastic models – demand may be discrete variable or continuous variable – Single Period model and no setup cost.

UNIT – V

Queuing Theory: Introduction – Terminology-Single Channel – Poisson arrivals and Exponential Service times – with infinite population and finite population models– Multi channel – Poisson arrivals and exponential service times with infinite population. Machine Repair Model, Networks of Queues.

Dynamic Programming: Introduction – Terminology- Bellman‟s Principle of Optimality – Applications of dynamic programming- shortest path problem – linear programming problem.

TEXT BOOKS

1. J.K.Sharma, “Operation Research”, MacMilan, 4th Ed., 2009, ISBN Number: 978-9350593363.
2. R.Pannerselvam, “Operations Research”, PHI Publications, 2nd Ed. Jan. 2006, ISBN Number: 978-8120329287.

REFERENCES

1. Panneerselvam.R, “Operations Research”.
2. Belgundu, Ashok.D&Chandrupatla, Trupathi.R, “Optimization Concepts and Applications”.
3. Operations Research / S. D sharma
4. Operations Research / Er. Prem Kumar Gupta / Dr.D.S Hira / S.Chand

22ME4178: ELECTRIC AND HYBRID VEHICLES
(PROFESSIONAL ELECTIVE – IV)

B.Tech. IV Year –I Sem **L T P C**
3 0 0 3

Prerequisite: Electrical Machines, Power Semiconductor Drives,

Course Objectives

- Explain the history of Electric vehicles and development
- Discuss the Social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies
- Explore to basic concept of electric traction, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives etc.
- Analyse the Fuel Cell based energy storage and Super Capacitor based energy storage etc.
- Explore to types of Driving Cycles, Range modelling for Battery Electric Vehicle, Hybrid (ICE & others) etc.

Course Outcomes

- Choose the appropriate source of energy for the hybrid electric vehicle based on driving cycle.
- Analyze the power and energy need of the various hybrid electric vehicle and Measure and Estimate the energy consumption of the Hybrid Vehicles
- Evaluate energy efficiency of the vehicle for its drive trains
- Elaborate the types of storage systems such as battery based, fuel cell based etc.
- Explain the types of Driving Cycles, Fuel Cell EV, Solar Powered Vehicles

UNIT-I:

INTRODUCTION TO ELECTRIC VEHICLE: History of Electric Vehicles, Development towards 21st Century, Types of Electric Vehicles in use today – Battery Electric Vehicle, Hybrid (ICE & others), Fuel Cell EV, Solar Powered Vehicles. Motion and Dynamic Equations of the Electric Vehicles: various forces acting on the Vehicle in static and dynamic conditions.

UNIT-II:

INDUCTION TO HYBRID ELECTRIC VEHICLE: Social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid Drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis

UNIT-III:

ELECTRIC DRIVE TRAINS: Basic concept of electric traction, introduction to various electric drivetrain topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency

UNIT-IV:

TYPES OF STORAGE SYSTEMS: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Calculation for the rating.

UNIT-V:

MODELLING OF HYBRID ELECTRIC VEHICLE RANGE: Driving Cycles, Types of Driving Cycles, Range modelling for Battery Electric Vehicle, Hybrid (ICE & others), Fuel Cell EV, Solar Powered Vehicles. Case study of 2 wheeler, 3 wheeler and 4 wheeler vehicles.

TEXT BOOKS

1. James Larminie, J. Lowry, “Electric Vehicle Technology Explaned”, John Wiley & Sons Ltd. 2003.
2. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design”, CRC Press, 2004.

REFERENCE BOOKS

1. S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”, Springer, 2015.
2. Iqbal Hussein, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press, 2003.

22ME4151: COMPUTER AIDED ENGINEERING LABORATORY

B.Tech. IV Year -I Sem.

L	T	P	C
0	0	2	1

Course Objectives:

1. To be able to understand and handle design problems in a systematic manner.
2. To be able to apply CAD in real life applications.
3. To understand the basic principles of different types of analysis.
4. To expose students to modern control systems (Fanuc, Siemens etc,)
5. To prepare the part programs for CNC lathe and CNC milling machine.

Course Outcomes:

1. To understand the analysis of various aspects in design
2. To have exposure to usage of software tools for design and manufacturing.
3. To acquire the skills needed to analyze and simulate engineering systems.
4. Demonstrate the various features of CNC machines.
5. Implement the CAPP methods to CNC machines.

Note: conduct any TEN excercises from the list gien below:

1. Drafting: Development of part drawings for various components in the form of orthographic and isometric. Representation of dimensioning and tolerances.
2. Part Modeling: Generation of various 3D Models through Protrusion, revolve, sweep. Creation of various features. Study of parent child relation. Feature based and Boolean based modeling and Assembly Modeling. Study of various standard Translators. Design of simple components.
3. Determination of deflection and stresses in 2D and 3D trusses and beams.
4. Determination of deflections, principal and Von-mises stresses in plane stress, plane strain and Axi-symmetric components.
5. Determination of stresses in 3D and shell structures (at least one example in each case)
6. Estimation of natural frequencies and mode shapes, Harmonic response of 2D beam.
7. Study state heat transfer analysis of plane and axi-symmetric components.
8. Development of process sheets for various components based on Tooling and Machines.
9. Development of manufacturing defects and tool management systems.
10. Study of various post processors used in NC Machines.
11. Development of NC code for free form and sculptured surfaces using CAM software.
12. Machining of simple components on NC lathe and Mill by transferring NC Code / from CAM software.

22ME4181: INTERNSHIP

IV B. Tech. I Semester

L	T	P	C
0	0	4	2

22ME4182: PROJECT STAGE-I

IV B. Tech. I Semester

L	T	P	C
0	0	4	2

IV Year -II Semester

22ME4271: AUTOMATION IN MANUFACTURING
(PROFESSIONAL ELECTIVE-V)

B.Tech. IV Year -II Sem **L T P C**
3 0 0 3

Pre-Requisites: Production Planning and Control

Course Objectives:

- To understand types of Automation and production system technologies in modern manufacturing.
- To understand importance of automated flow lines in manufacturing a product.
- To understand the Assembly system and Line Balancing in Manufacturing System.
- To understand Automated Material handling equipments and Automated Storage Systems.
- To understand industrial control and automatic inspection techniques.

Course Outcomes: After completion of this course the student will be able to

- Understand the automation in manufacturing and automated flow lines
- Differentiate AMS and Manufacturing support systems
- Design and implement electro –pneumatic / Hydraulic solutions for automated systems
- Understand material handling and storage systems
- Understand automated storage and retrieval systems.

UNIT–I

Introduction Types and strategies of automation, pneumatic and hydraulic components circuits, Automation in machine tools. Mechanical feeding and tool changing and machine tool control transfer the automaton.

UNIT– II

Automated flow lines: Methods or work part transport transfer Mechanical buffer storage control function, design and fabrication consideration.

Analysis of Automated flow lines: General terminology and analysis of transfer lines without and with buffer storage, partial automation, implementation of automated flow lines.

UNIT–III

Assembly system and line balancing: Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

Automated material handling: Types of equipment, functions, analysis and design of material handling systems conveyor systems, automated guided vehicle systems.

UNIT-IV

Automated storage systems, automated storage and retrieval systems, work in process storage, interfacing handling and storage with manufacturing.

Adaptive control systems: Introduction, adaptive control with optimization, Adaptive control with constraints, Applications of A.C in machining operations. Use of various parameters such as cutting force, Temperatures, vibration and acoustic emissions.

UNIT–V

Business process Re-engineering: Introduction to BPE logistics, ERP, Soft ware configuration of BPE, concurrent Engineering, Techniques of Rapid Prototyping.

TEXTBOOKS

1. Automation Production systems and computer integrated manufacturing / M. P Groover / Pearson.
2. Industrial Automation / Vikalp Joshi Manoj Adhikari Raju Manoj Rajesh Singh Anita Gehlot. BPB Publications.

REFERENCES

1. CAD/CAM/CIM/ Radhakrishnan /NewAge
2. AdvancedManufacturingTechnology/KVaraPrasadaRao/KannaPublications.
3. Principles of Automation and Advanced Manufacturing Systems / Dr. K C Jain.
4. Manufacturing Processes and Automation / R. S Parmar / Khanna Publishers.

22ME4272: TURBO MACHINERY
(PROFESSIONAL ELECTIVE-V)

B.Tech. IV Year -II Sem **L T P C**
3 0 0 3

Pre-requisites: Thermal Engineering, Heat Transfer

Course Objectives:

- Provide students with opportunities to apply basic flow equations
- Train the students to acquire the knowledge and skill of analyzing different turbo machines.
- To understand gas flow dynamics, shock waves, and performance characteristics of centrifugal compressors.
- To analyze the aerodynamic performance and efficiency of axial flow compressors.
- To study the design, performance, and stress analysis of axial flow gas turbines.

Course Outcomes: After completion of this course the student will be able to

- Ability to design and calculate different parameters for turbo machines
- Prerequisite to CFD and Industrial fluid power courses
- Ability to formulate design criteria
- Ability to understand thermodynamics and kinematics behind turbo machines
- Analyze the thermodynamic performance and design aspects of axial flow gas turbines, including blade stress and cooling techniques.

UNIT - I

Introduction to Turbo machinery: Classification of turbo-machines, second law of thermodynamics applied to turbine and compressors work, nozzle, diffuser work, fluid equation, continuity, Euler‘s, Bernoulli‘s, equation and its applications, expansion and compression process, reheat factor, preheat factor

UNIT - II

Fundamental Concepts of Axial and Radial Machines: Euler‘s equation of energy transfer, vane congruent flow, influence of relative circulation, thickness of vanes, number of vanes on velocity triangles, slip factor, Stodola, Stanitz and Balje‘s slip factor, suction pressure and net positive suction head, phenomena of cavitation in pumps, concept of specific speed, shape number, axial, radial and mixed flow machines, similarity laws.

UNIT - III

Gas Dynamics: Fundamental thermodynamic concepts, isentropic conditions, mach numbers, and area, Velocity relations, Dynamic Pressure, Normal shock relation for perfect gas. Supersonic flow, oblique shock waves. Normal shock recoveries, detached shocks, Aerofoil theory. Centrifugal compressor: Types, Velocity triangles and efficiencies, Blade passage design, Diffuser and pressure recovery. Slip factor, Stanitz and Stodolas formula's, Effect of inlet mach numbers, Pre whirl, Performance

UNIT - IV

Axial Flow Compressors: Flow Analysis, Work, and velocity triangles, Efficiencies, Thermodynamic analysis. Stage pressure rise, Degree of reaction, Stage Loading, General design, Effect of velocity, Incidence, Performance

Cascade Analysis: Geometrical and terminology. Blade force, Efficiencies, Losses, Free end force, Vortex Blades.

UNIT - V

Axial Flow Gas Turbines: Work done. Velocity triangle and efficiencies, Thermodynamic flow analysis, Degree of reaction, Zweifels relation, Design cascade analysis, Soderberg, Hawthrone, Ainley, Correlations, Secondary flow, Free vortex blade, Blade angles for variable degree of reaction. Actuator disc, Theory, Stress in blades, Blade assembling, Material and cooling of blades, Performances, Matching of compressors and turbines, off design performance.

TEXT BOOKS

1. Principles of Turbo Machines/DG Shepherd / Macmillan.
2. Turbines, Pumps, Compressors/Yahya/ Mc Graw Hill.

REFERENCE BOOKS

1. A Treatise on Turbo machines / G. Gopal Krishnan and D. Prithviraj/ SciTech.
2. Gas Turbine Theory/ Saravanamuttoo/ Pearson.
3. Turbo Machines/ A Valan Arasu/ Vikas Publishing House Pvt. Ltd.

22ME4273: ADDITIVE MANUFACTURING
(Professional Elective – V)

B.Tech. IV Year II Sem. **L T P C**
3 0 0 3

Pre-requisites: Manufacturing process, Engineering Materials

Course Objectives:

- Explain the basic concepts of Additive Manufacturing, its advantages and limitations.
- Classify various types of Additive Manufacturing Processes and know their working principle, advantages, limitations etc.
- Interpret the applications of these manufacturing technologies in relevant fields such as mechanical, Bio-medical, Aerospace, electronics etc.
- To know Rapid Prototyping data formats
- Build the potential of additive manufacturing concepts in different industrial sectors.

Course Outcomes:

- Explain the principles and key characteristics of additive manufacturing technologies and commonly used 3D printing technology.
- Apply suitable process and materials used in Additive Manufacturing.
- Solve typical problems on reverse engineering for surface reconstruction from physical prototype models.
- Apply technique of CAD (softwares) & data formats for geometry transformation in Additive Manufacturing.
- Apply knowledge of additive manufacturing for various real-life applications.

UNIT - I

Introduction: Prototyping fundamentals, Historical development, Fundamentals of Rapid Prototyping, Advantages, and Limitations of Rapid Prototyping, Commonly used Terms, Classification of RP process, Rapid Prototyping Process Chain: Fundamental Automated Processes, Process Chain.

UNIT - II

Liquid-based Rapid Prototyping Systems: Stereo lithography Apparatus (SLA): Modelsand specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Solid ground curing (SGC): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

Solid-based Rapid Prototyping Systems: 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 Rapid Prototyping Systems: Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Three dimensional Printing (3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

Rapid Tooling: Introduction to Rapid Tooling (RT), Conventional Tooling Vs RT, Need for RT. Rapid Tooling Classification; Indirect Rapid Tooling Methods: Spray Metal Deposition, RTV Epoxy Tools, Ceramic tools, Investment Casting, Spin Casting, Die casting, Sand Casting, 3D Keltool process. Direct Rapid Tooling : Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP

UNIT - IV

Rapid Prototyping Data Formats: STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats.

Rapid Prototyping Software's: Features of various RP software's like Magics, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor.

UNIT - V

RP Applications : Application - Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry 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.

TEXT BOOKS:

1. Rapid prototyping; Principles and Applications /Chua C.K., Leong K.F. and LIM C.S/World Scientific Publications
2. Rapid Manufacturing /D.T. Pham and S.S. Dimov/Springer

REFERENCE BOOKS:

1. Terry Wohlers, Wholers Report 2000, Wohlers Associates
2. Rapid Prototyping and Manufacturing /PaulF.Jacobs/ASME
3. Rapid prototyping; Principles and Applications in manufacturing/ RAFIQ NOORANI 2006/ Wiley
4. Additive Manufacturing / Amit Bandyopadhyay 2015/ CRC press

22ME4274: ENERGY CONSERVATION AND MANAGEMENT
(Professional Elective – V)

B.Tech. IV Year II Sem. **L T P C**
3 0 0 3

Pre-requisites: Nil

Course Objectives:

- To understand the principles of energy conservation
- To understand thermal insulation & refractors.
- To know waste heat recovery systems.
- To gain knowledge about engineering economics.
- To impart knowledge Energy management programs.

Course Outcomes:

- Explain the basic concept of energy conservation and its role in energy management.
- Focus on thermal Insulation & refractors, classification and applications.
- Discuss the energy conservation opportunities in the energy intensive industries by waste heat recovery system.
- Analyze the quantum of electrical energy that can be saved by the use of energy efficient lighting systems and energy audit parameters.
- Understand concept of Project management and energy management Programs

UNIT-I:

ENERGY CONSERVATION: Rules for efficient energy conservation – technologies for energy conservation – outline of waste heat and material reclamation, load management, alternate energy sources, and energy storage.

UNIT-II:

THERMAL INSULATION & REFRACTORS: Heat loss through un-insulated surfaces, effects of insulation on current carrying wires – economic thickness of insulation – critical radius of insulation – properties of thermal insulators – classification of insulation materials – classification of refractors – properties of refractors – criteria for good refractory material – applications of insulating & refractory materials.

UNIT-III

WASTE HEAT RECOVERY SYSTEMS: Guideline to identify waste heat – feasibility study of waste heat – shell and tube heat exchanger – thermal wheel – heat pipe heat exchanger – heat pump – waste heat boilers – incinerators.

HEAT RECOVERY SYSTEMS & HEAT EXCHANGER NETWORKS: Liquid to liquid heat exchangers – gas to liquid heat recovery systems, regenerators, recuperators, rotating regenerators – miscellaneous heat recovery methods – selection of materials for heat exchangers – combined radiation and convective heat exchanger, U tube heat exchanger, tube heat exchanger, fluidized bed heat exchanger – economizer.

UNIT-IV

ENGINEERING ECONOMICS: Managerial objectives, steps in planning – efficiency of organization- capital budgeting – classification of costs – interest – types – nominal and effective interest rates – discrete and continuous compounding – discounting - time value of money – cash flow diagrams – present worth factor, capital recovery factor, equal annual payments – equivalent between cash flows.

ENERGY AUDITING: A definition – objectives – level of responsibility – control of energy – uses of energy – check lists – energy conservation schemes – energy index – cost index – pie charts – sankey diagrams – load profiles – types of energy audits – questionnaire – energy audit of industries – general energy audit – detailed energy audit – energy saving potential.

UNIT-V

PROJECT MANAGEMENT: Method of investment appraisal – rate of return method, pay back method, net present value method (NPV) – adoption of the methods in energy conservation campaign – types of projects — propose of project management – classification – role and qualities of project manager – types of budgets - budget committee – budgeting.

ENERGY MANAGEMENT PROGRAMS: Necessary steps of energy management programme – concepts of energy management – general principles of energy management – energy management in manufacturing and process industries – qualities and functions of energy managers – duties of energy manager - language of energy manager – checklist for top management.

TEXT BOOKS:

1. Waste heat recovery systems -D.A. Reay/Pergmon Press.
2. Energy Management -W.R. Murphy & G.Mickay, Butterworths

REFERENCE BOOKS:

1. Energy Conservation -P.W.O' Callaghan, Pargamon Press 1981.
2. Engineering Heat Audits -C.P. Gupta & Rajendra Prakash, Nechand & Bros.
3. Hand book of energy audits -Albert Thumann, The F.Airmont Press Inc., Atlanta Georgia, 1979.
4. Energy Management Principles -Craig B. Smithm, Pergarmon Press

22ME4275: INDUSTRY 4.0
(Professional Elective – VI)

B.Tech. IV Year II Sem. **L T P C**
Pre-Requisites: Nil **3 0 0 3**

COURSE OBJECTIVES: The objectives of this course are

- To understand the basics of Industry 4.0
- To understand the Business model and impact of IIoT
- To understand the concepts of virtual reality, lean manufacturing
- To gain knowledge of various sensors and actuators.
- To understand various data transmission technologies.

COURSE OUTCOMES: On completion of the course, student will be able to

- Explain Smart Business Perspective, Cyber security, Impacts of Industry 4.0.
- Understand the basics of the Industrial Internet of Things.
- Understand various key technologies.
- Implement various sensors and actuators.
- Understand different industrial transmission technologies and IIOT applications in real life.

UNIT 1

INTRODUCTION TO INDUSTRY 4.0: Introduction, Historical Context, General framework, Application areas, Dissemination of Industry 4.0 and the disciplines that contribute to its development, Artificial intelligence, The Internet of Things and Industrial Internet of Things, Additive manufacturing, Robotization and automation, Current situation of Industry 4.0. Introduction to Industry 4.0 to Industry 5.0 Advances

UNIT 2

INDUSTRY 4.0 AND CYBER PHYSICAL SYSTEM: Introduction to Cyber Physical Systems (CPS), Architecture of CPS- Components, Data science and technology for CPS, Emerging applications in CPS in different fields. Case study: Application of CPS in health care domain.

UNIT 3

SMART ENERGY SOURCES: Energy Storage for Mitigating the Variability of Renewable Electricity Sources-Types of electric energy storage, Potential of Sodium-Sulfur Battery Energy Storage to Enable Integration of Wind-Case study. Electric Vehicles as Energy Storage: V2G Capacity Estimation.

UNIT 4:

SMART GRID: Smart grid definition and development Smart Grid, Understanding the Smart Grid, Smart grid solutions, Design challenges of smart grid and Industry 4.0.

UNIT 5:

SMART APPLICATIONS: Understanding Smart Appliances -Smart Operation-Smart Monitoring-Smart Energy Savings-Smart Maintenance, Case study-Smart Cars, Self-Driving Cars, Introducing Google's Self-Driving Car, Intellectual Property Rights.

TEXT BOOKS :

1. Jean-Claude André, ―Industry 4.0‖, Wiley- ISTE, July 2019, ISBN: 781786304827, 2019.
2. Diego Galar Pascual, Pasquale Daponte, Uday Kumar, ―Handbook of Industry 4.0 and SMART Systems‖ Taylor and Francis,2020
3. Miller M, ―The internet of things: How smart TVs, smart cars, smart homes, and smart cities are changing the world‖, Pearson Education, 2015, ISBN: 9780134021300.

REFERENCES:

1. Pengwei Du and Ning Lu, ―Energy storage for smart grids: planning and operation for renewable and variable energy resources VERs ‖, Academic Press, 2018, Reprint edition, ISBN-13:978-0128100714
2. Hossam A. Gabbar, ―Smart Energy Grid Engineering‖, Academic Press, 2017, ISBN 978- 0-12-805343-0. 6. Mini S. Thomas, John Douglas McDonald, ―Power System SCADA and Smart Grids‖, CRC Press, 2017.

22ME4276: FLUID POWER SYSTEM
(Professional Elective - VI)

B.Tech. IV Year II Sem. **LT P C**
3 0 0 3

Pre-requisites: Fluid Mechanics and Hydraulics Machinery

Course Objectives:

1. To understand the basic types of pumps and motors
2. To explain different types of valves.
3 To analyze different hydraulic circuits.
4. To analyze the functions of Pneumatic and Hydraulic circuits.
5. To design electro-hydraulics, electro-pneumatics for a given application.

Course outcomes: At the end of the course, student will be able to:

1. Understand the basic types of pumps and motors
2. Analyse different types of valves
3. Design and analysis of hydraulic circuits
4. Visualize how a hydraulic/pneumatic circuit works to accomplish the function.
5. Design an appropriate hydraulic or pneumatic circuit or combination circuit like electro-hydraulics, electro-pneumatics for a given application.

UNIT-I

Introduction to oil hydraulics and pneumatics, their structure, advantages and limitations. ISO symbols, energy losses in hydraulic systems. Applications, Basic types and constructions of Hydraulic pumps and motors. Pump and motor analysis. Performan curves and parameters.

UNIT-II

Hydraulic actuators, types and constructional details, lever systems, control elements – direction, pressure and flow control valves. Valve configurations, General valve analysis, valve lap, flow forces and lateral forces on spool valves. Series and parallel pressure compensation flow control valves. Flapper valve Analysis and Design.

UNIT-III

Proportional control valves and servo valves. Nonlinearities in control systems (backlash, hysteresis, dead band and friction nonlinearities). Design and analysis of typical hydraulic circuits. Regenerative circuits, high low circuits, Synchronization circuits, and accumulator sizing.

UNIT-IV

Intensifier circuits Meter-in, Meter-out and Bleed-off circuits; Fail Safe and Counter balancing circuits, accessories used in fluid power system, Filtration systems and maintenance of system. Components of pneumatic systems; Direction, flow and pressure control valves in pneumatic systems. Development of single and multiple actuator circuits. Valves for logic functions; Time delay valve; Exhaust and supply air throttling;

UNIT-V

Examples of typical circuits using Displacement – Time and Travel-Step diagrams.Will dependent control, Travel-dependent control and Time dependent control, combined control, Program Control, Electropneumatic control and air-hydraulic control, Ladder diagrams. Applications in Assembly, Feeding, Metalworking, materials handling and plastics working.

TEXT BOOKS

1. John Watton: Fundamentals of Fluid Power Control. 1 st Ed. Cambridge University Press, 2009
2. Blackburn, J. F.,G.Reethof, and J. L.Shearer, Fluid Power Control, New York: Technology Press of M. I.T. and Wiley.
3. Anthony Esposito,"Fluid Power with applications", Pearson Education.
4. Ernst, W., Oil Hydraulic Power and its Industrial Applications, New York: McGraw Hill.
5. Lewis,E.E., and H.Stern, Design of Hydraulic Control Systems, New York: McGraw Hill.
6. Morse,A. C., Electro hydraulic Servomechanism, New York: McGraw Hill.
7. Pippenger, J.J., and R. M. Koff, Fluid Power Control systems, New York: McGraw Hill.
8. Fitch, Jr., E.C., Fluid Power Control Systems, New York: McGraw Hill.
9. Khaimovitch, "Hydraulic and Pneumatic Control of Machine Tools"
10. John Watton, "Fluid Power Systems: modeling, simulation and microcomputer control", Prentice Hall International.
11. Herbert E. Merritt: Hydraulic control systems, John Wiley and Sons Inc.

REFERENCES

1. Ian Mencal, Hydraulic operation and control of Machine tools Ronald Press
2. Sterwart Hydraulic and Pneumatic power for production-Industrial Press.
3. Hasebrink J.P., and Kobler R., "Fundamentals of Pneumatics/electropeumatics", FESTO Didactic publication No. 7301, Esslingen Germany, 1979.
4. Werner Deppert and Kurt Stoll, "Pneumatic Control-An introduction to the principles", Vogel-Verlag.
5. Blaine W. Andersen, "The analysis and Design of Pneumatic Systems", John Wiley

22ME4277: FUZZY LOGIC AND ANN
(Professional Elective - VI)

B.Tech. IV Year II Sem. **LT P C**
3 0 0 3

Prerequisite: Operations research, Optimisation Techniques**,** Control Systems

Course Objectives:

- Introduce the evolution and foundational concepts of neural networks and fuzzy logic systems.
- gain the knowledge about fuzzy sets, relations, inference mechanisms, and decision-making approaches.
- Learn various neural network architectures, learning algorithms, and their practical applications.
- Demonstrate the structure, design, and real-world implementation of fuzzy logic control systems.
- Provide in-depth understanding of recurrent networks and their dynamics.

Course outcomes: After completion of this course, the student should be able to

- Explain the basic models, topologies, and learning algorithms of artificial neural networks.
- Design feedforward and self-organizing neural networks such as MLP, RBF, and Kohonen networks using suitable learning algorithms.
- Analyze recurrent neural networks and Hopfield networks,in industrial and commercial scenarios.
- Distinguish between classical and fuzzy sets, and apply fuzzy relations, fuzzification, defuzzification, and decision-making techniques.
- Apply fuzzy control systems and theory in real-world control and decision systems.

UNIT-I

Evolution of neural networks; Artificial Neural Network: Basic model, Classification, Feed forward and Recurrent topologies, Activation functions; Learning algorithms: Supervised, Un-supervised and Reinforcement; Fundamentals of connectionist modeling: McCulloach – Pits model, Perceptron, Adaline, Madaline.

UNIT–II

Topology of Multi-layer perceptron,Back propagation learning algorithm, limitations of Multi-layer perceptron. Radial Basis Function networks: Topology, learning algorithm; Kohenen's self-organising network: Topology, learning algorithm; Bidirectional associative memory Topology, learning algorithm, Applications.

UNIT–III

Recurrent neural networks: Basic concepts, Dynamics, Architecture and training algorithms, Applications; Hopfield network: Topology, learning algorithm, Applications; Industrial and commercial applications of Neural networks: Semiconductor manufacturing processes, Communication, Process monitoring and optimal control, Robotics, Decision fusion and pattern recognition.

UNIT–IV

Classical and fuzzy sets: Introduction, Operations and Properties, Fuzzy Relations: Cardinality, Operations and Properties, Equivalence and tolerance relation, Value assignment: cosine amplitude and max-min method; Fuzzification: Membership value assignment- Inference, rank ordering, angular fuzzy sets. Defuzzification methods, Fuzzy measures, Fuzzy integrals, Fuzziness and fuzzy resolution; possibility theory and Fuzzy
arithmetic; composition and inference; Considerations of fuzzy decision-making.

UNIT-V

Basic structure and operation of Fuzzy logic control systems; Design methodology and stability analysis of fuzzy control systems; Applications of Fuzzy controllers. Applications of fuzzy theory.

TEXT BOOKS:

1. Neural Networks in Computer Intelligence by Limin Fu, McGraw Hill, 2003.
2. Soft Computing and Intelligent Systems Design, Theory, Tools and Applications by Fakhreddine O. Karray and Clarence De Silva., Pearson Education, India, 2009.

REFERENCE BOOKS:

1. Fuzzy Logic with Engineering Applications by Timothy J. Ross, McGraw Hill, 1995.
2. Artificial Neural Networks by B.Yegnanarayana, PHI, India, 2006.

22ME4278: TOTAL QUALITY MANAGEMENT
(Professional Elective - VI)

B.Tech. IV Year II Sem. **L T P C**
3 0 0 3

Prerequisite: Industrial Management**.**

Course Objectives:

- Provide a comprehensive introduction to Total Quality Management..
- Emphasize the importance of customer focus and satisfaction in quality improvement.
- Introduce tools and techniques used in TQM such as Quality Circles and statistical methods.
- Gain the knowledge about the cost implications of quality to measure and manage quality costs.
- Familiarize with international quality standards, particularly ISO 9000.

Course Outcomes: By the end of this course, Students should be able to

- Explian the fundamental concepts of Total Quality Management .
- Apply quality techniques for Customer satisfaction
- Organize quality initiatives using systems approaches, quality circles, and the seven basic tools of TQM.
- Measure the cost of quality to improve performance of product or service..
- Illustrate ISO 9000 standards, certification processes,benefits and documentation.

UNIT - I

Introduction, The concept of TQM, Quality and Business performance, attitude, and involvement of top management, communication, culture and management systems. Management of Process Quality: Definition of quality, Quality Control, a brief history, Product Inspection vs. Process Control, Statistical Quality Control, Control Charts and Acceptance Sampling.

UNIT -II

Customer Focus and Satisfaction: Process vs. Customer, internal customer conflict, quality focus, Customer Satisfaction, role of Marketing and Sales, Buyer – Supplier relationships. Bench Marking: Evolution of Bench Marking, meaning of bench marking, benefits of bench marketing, the bench marking procedure, pitfalls of bench marketing.

UNIT- III

Organizing for TQM: The systems approach, organizing for quality implementation, making the transition from a traditional to a TQM organization, Quality Circles, seven Tools of TQM: Stratification, check sheet, Scatter diagram, lshikawa diagram, paneto diagram, Kepner &Tregoe Methodology.

UNIT- IV

The Cost of Quality: Definition of the Cost of Quality, Quality Costs, Measuring Quality Costs, use of Quality Cost information, Accounting Systems and Quality Management.

UNIT -V

ISO9000: Universal Standards of Quality: ISO around the world, The ISO9000 ANSI/ASQC Q-90. Series Standards, benefits of ISO9000 certification, the third party audit, Documentation ISO9000 and services, the cost of certification implementing the system.

TEXT BOOKS:

1. Total Quality Management / Joel E. Ross/Taylor and Franscis Limited.
2. Total Quality Management/P. N. Mukherjee/PHI.

REFERENCES:

1. Beyond TQM / Robert L.Flood.
2. Statistical Quality Control / E.L. Grant.
3. Total Quality Management:A Practical Approach/H. Lal.
4. Quality Management/Kanishka Bedi/Oxford University Press/2011.

22ME4281: PROJECT STAGE – II INCLUDING SEMINAR

IV B. Tech. II Semester

L	T	P	C
0	0	22	11