Mahatma Gandhi Institute of Technology (Autonomous)

B.Tech. in Mechanical Engineering

Scheme of Instruction and Examination

(Choice Based Credit System)

V Semester

S.No	Course Code	Course Title	Instruction Hours PerWeek			Examination Max. Marks		Duration of SEE in Hours	Credits
			L	T	P/D	CIE	SEE		
1	MS501HS	Business Economics and Financial Analysis	3	0	0	40	60	3	3
2	ME501PC	Dynamics of Machinery	3	1	0	40	60	3	4
3	ME502PC	Thermal Engineering –II	3	1	0	40	60	3	4
4	ME503PC	Design of Machine Members -I	3	1	0	40	60	3	4
5	ME504PC	Operations Research	3	0	0	40	60	3	3
6	MC502ES	Artificial Intelligence	3	0	0	40	60	3	0
7	ME551PC	Kinematics and Dynamics Lab	0	0	2	40	60	3	1
8	ME552PC	Thermal Engineering Lab	0	0	2	40	60	3	1
Total Hours/Marks/Credits			**18**	**3**	**4**	**320**	**480**		**20**

VI Semester

S. No	Course Code	Course Title	Instruction Hours PerWeek			Examination Max. Marks		Duration of SEE in Hours	Credits
			L	T	P/D	CIE	SEE		
1	ME601PC	Heat Transfer	3	0	0	40	60	3	3
2	ME602PC	Metrology and Machine Tools	3	0	0	40	60	3	3
3	ME603PC	Design of Machine Members -II	3	0	0	40	60	3	3
4		Professional Elective – I	3	0	0	40	60	3	3
5		Open Elective - I	3	0	0	40	60	3	3
6	MC601HS	Intellectual Property Rights	3	0	0	40	60	3	0
7	MC602ES	Cyber Security	3	0	0	40	60	3	0
8	EN651HS	Advanced English Communication Skills Laboratory	0	0	2	40	60	3	1
9	ME651PC	Heat Transfer Lab	0	0	2	40	60	3	1
10	ME652PC	Metrology and Machine Tools Lab	0	0	2	40	60	3	1
11	ME653PC	Industry Oriented Mini Project / Internship	0	0	4	0	100	-	2
Total Hours/Marks/Credits			**21**	**0**	**10**	**400**	**700**		**20**

12	MC601BS	Environmental Science **(For Lateral Entry students)**	3	0	0	40	60	3	0

B.Tech. in Mechanical Engineering
Scheme of Instruction and Examination
(Choice Based Credit System)

VII Semester

S.No	Course Code	Course Title	Instruction Hours Per Week			Examination Max. Marks		Duration of SEE in Hours	Credits
			L	T	P/D	CIE	SEE		
1	ME701PC	CAD/CAM	2	0	0	40	60	3	2
2	ME702PC	Refrigeration & Air Conditioning	2	0	0	40	60	3	2
3		**Professional Elective - II**	3	0	0	40	60	3	3
4		**Professional Elective - III**	3	0	0	40	60	3	3
5		**Professional Elective - IV**	3	0	0	40	60	3	3
6		**Open Elective – II**	3	0	0	40	60	3	3
7	ME751PC	CAD/CAM Lab	0	0	2	40	60	3	1
8	ME752PC	Project Stage - I	0	0	6	100	-	-	3
Total hours/Marks/Credits			**16**	**0**	**8**	**380**	**420**		**20**

VIII Semester

S.No	Course Code	Course Title	Instruction Hours Per Week			Examination Max. Marks		Duration of SEE inHours	Credits
			L	T	P/D	CIE	SEE		
1		**Professional Elective - V**	3	0	0	40	60	3	3
2		**Professional Elective - VI**	3	0	0	40	60	3	3
3		**Open Elective – III**	3	0	0	40	60	3	3
4	ME851PC	Project Stage – II (Including Seminar)	0	0	22	40	60	-	11
Total hours/Marks/Credits			**9**	**0**	**22**	**160**	**240**		**20**

PROFESSIONAL ELECTIVES OFFERED IN MR22

Professional Elective - I

ME611PE	Finite Element Methods
ME612PE	Power Plant Engineering
ME613PE	Mechanical Vibrations
ME614PE	Microcontrollers in Automation

Professional Elective – II

ME711PE	Automobile Engineering
ME712PE	Artificial Intelligence in Mechanical Engineering
ME713PE	Industrial Robotics
ME714PE	Mechatronics

Professional Elective – III

ME715PE	Unconventional Machining Processes
ME716PE	Composite Materials
ME717PE	Computational Fluid Dynamics
ME718PE	Production Planning & Control

Professional Elective – IV

ME719PE	CNC Technology
ME720PE	Solar Energy Technology
ME721PE	Non-Conventional Energy Sources
ME722PE	Total Quality Management

Professional Elective – V

ME811PE	Automation in Manufacturing
ME812PE	Additive Manufacturing Technology
ME813PE	Turbo Machinery
ME814PE	Energy Conservation and Management

Professional Elective – VI

ME815PE	Digital Manufacturing & Industry 4.0
ME816PE	Electric and Hybrid Vehicles
ME817PE	Fluid Power Systems
ME818PE	Industrial Management

List of Open Electives

Open Elective: I

ME621OE: Basic Mechanical Engineering
ME622OE: Renewable Energy Sources

Open Elective: II

ME721OE: Quantitative Analysis for Business Decisions
ME722OE: Industrial Engineering &Management

Open Elective: III

ME821OE: Entrepreneurship Development
ME822OE: Elements of Electric and Hybrid vehicles

L	T	P	C
3	0	0	3

B.Tech. in Mechanical Engineering
B. Tech. V Semester

MS501HS: Business Economics and Financial Analysis

(Common to CIVIL, EEE, MEC, ECE, MCT, MME & CSE (AI & ML))

Course Objectives: The Objective of the course are:

1. Students will understand various forms of Business and the impact of economic variables on the business, concepts of Business Economics and its significance.
2. Gain the knowledge on various market dynamics namely Demand, elasticity of demand, and demand forecasting.
3. To disseminate the knowledge on production function, Laws of production, Market structures, while dealing with the concept of cost and breakeven analysis.
4. To acquaint the students regarding Accounting and various books of accounts.
5. To enable the students to analyze a company's financial statements through ratios and come to a reasoned conclusion about the financial situation of the company.

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

1. Select a suitable business organization with available resources.
2. Analyze various aspects of Demand, Elasticity of demand and Demand Forecasting.
3. Gain knowledge on different market structures, production theories, cost variables and pricing methods.
4. Prepare Books of accounts and Financial Statements.
5. Analyze financial well-being of the business while using ratios.

UNIT – I: INTRODUCTION TO BUSINESS AND ECONOMICS

Economics: Significance of Economics, Micro and Macro Economic Concepts, National Income - Concepts and Importance, Inflation, Business Cycle - Features and Phases.

Business: Structure of Business Firm, Types of Business Entities – Sole Proprietorship – Partnership – Cooperative Societies - Limited Liability Companies, Sources of Capital – Conventional sources and Non - Conventional Sources of Finance.

Business Economics: Nature and Scope of Business Economics, Role of Business Economist, Multidisciplinary nature of Business Economics.

UNIT – II: DEMAND AND SUPPLY ANALYSIS

Demand Analysis: Demand - Meaning, Determinants of Demand, Law of Demand, Exceptions of Law of Demand, Demand Function, Changes in Demand – Increase and decrease in Demand - Extension and Contraction in Demand.

Elasticity of Demand: Elasticity – Meaning, Types of Elasticity – Price Elasticity – Income Elasticity – Cross Elasticity–Advertising Elasticity of Demand, Factors affecting Elasticity of Demand, Measurement and Significance of Elasticity of Demand, Elasticity of Demand in decision making.

Demand Forecasting: Characteristics of Good Demand Forecasting, Steps in Demand Forecasting, Methods of Demand Forecasting – Survey methods, Statistical methods.

Supply Analysis: Supply – Meaning, Determinants of Supply, Supply Function & Law of Supply.

UNIT III: PRODUCTION, COST, MARKET STRUCTURES & PRICING

Production Analysis: Production – Meaning, Factors of Production, Production Function, Production Function with one variable input, two variable inputs, Returns to Scale, Cobb-Douglas production function.

Cost analysis: Cost–Meaning, Types of Costs, Short run and Long run Cost Functions.
Market Structures: Nature of Competition, Features of Perfect competition, Monopoly, Oligopoly, Monopolistic Competition.
Pricing: Pricing -Meaning, Objectives of pricing, pricing methods – Cost based pricing methods – Demand based pricing methods – Competition based pricing methods – Strategy based pricing methods - Product Life Cycle based Pricing, Break Even Analysis (simple problems), Cost Volume Profit Analysis.

UNIT IV: FINANCIAL ACCOUNTING

Accounting concepts and Conventions, Accounting Equation, Double-Entry system of Accounting, Rules for maintaining Books of Accounts, Journal, Posting to Ledger, Preparation of Trial Balance, Elements of Financial Statements, Preparation of Final Accounts along with adjustments– Trading account – Profit and loss account – Balance sheet (simple problems).

UNIT – V: FINANCIAL ANALYSIS THROUGH RATIOS

Concept of Ratio Analysis, Importance, Liquidity Ratios- Current Ratio – Quick Ratio – Absolute Liquid Ratio, Profitability Ratios – Gross Profit Ratio – Net Profit Ratio – Operating Ratio, Turnover Ratios – Stock Turnover Ratio – Debtors Turnover Ratio – Creditors Turnover Ratio, Leverage Ratios – Debt-to-Assets Ratio - Debt-Equity Ratio - Proprietary Ratios and interpretation (simple problems).

TEXT BOOKS:

1. Geethika Ghosh, Piyali Gosh, Purba Roy Choudhury,"Managerial Economics", 2e, Tata McGraw Hill Education Pvt. Ltd. 2012.
2. Dhanesh K Khatri, "Financial Accounting", Tata McGraw Hill, 2011.
3. Ramachandra Aryasri. A, "Business Economics and Financial Analysis", McGraw Hill Education India Pvt. Ltd. 2020.

REFERENCE BOOKS:

1. P. L. Mehta, Managerial Economics, Analysis, Problems & Cases, 8th Edition, Sultan Chand & Sons, 2001.
2. S.N. Maheshwari, Sunil K Maheshwari, Sharad K Maheshwari, Financial Accounting, 5e, Vikas Publications, 2013.
3. D.D. Chaturvedi, S.L. Gupta, "Business Economics - Theory and Applications", International Book House Pvt. Ltd. 2013.

L	T	P	C
3	1	0	4

B.Tech. in Mechanical Engineering
V Semester Syllabus
ME501PC: Dynamics of Machinery
(Common to ME, MCT Branch)

Pre-requisite: Kinematics of Machinery

Course Objectives:

During the course the student will learn about
- Gyroscopic effects in ships, aero planes and road vehicles. Analysis static and dynamics of various planarmechanisms.
- How friction plays a role in design of clutches and bearings.
- Design of flywheels and centrifugal governors.
- Analysis of unbalanced forces in rotary and reciprocating machinery.
- Free and Forced vibrations of single degree freedom systems.

Course Outcomes:

At the end of the course, the student will be able to:
- Understand the gyroscopic effects in ships, aero planes, and road vehicles. Analyze the dynamics forces on various planar mechanisms.
- Apply the concept of friction in designing clutches, bearings, brakes & dynamometers
- Analyze, design flywheels and design centrifugal governors.
- Analyze balancing problems in rotating and reciprocating machinery.
- Determine free and forced vibrations of single degree freedom systems.

UNIT–I

Precession: Gyroscopes – effect of precession – motion on the stability of moving vehicles such as motorcycle–motorcar–aeroplanes and ships.
Static and Dynamic Force Analysis: Static force analysis of planar mechanisms – Dynamic Force Analysis – D"Alembert"s principle, Dynamic Analysis of 4-link mechanism, Slider Crank Mechanism.

UNIT–II

Friction: pivots and collars–uniform pressure, uniform wear–friction circle and friction axis: lubricated surfaces – boundary friction – film lubrication. Clutches – Types – Single plate, multi-plate and cone clutches.
Brakes and Dynamometers: Types of brakes: Simple block brake, band and block brake-internal expanding shoe brake-effect of braking of a vehicle. Dynamometers–absorption and transmission types.

UNIT–III

Turning Moment Diagram and Flywheels: Engine Force Analysis – Piston Effort, Crank Effort, etc., Inertia Force in Reciprocating Engine, Turning moment diagram –fluctuation of energy – flywheels and their design.
Governors: Types of centrifugal governors - Watt, Porter and Proell governors. Spring loaded governors – Hartnell and Hartung with auxiliary springs. Sensitiveness, isochronism and hunting–stability–effort and power of the governors.

UNIT – IV

Balancing of rotating masses: Rotating masses in single and different planes
Balancing of Reciprocating masses: Primary and Secondary of reciprocating masses. Analytical and graphical methods. Unbalanced forces and couples. Examination of multi cylinder in-line and radial engines for primary and secondary balancing- locomotive balancing –Hammer blow– Swaying couple –variation of tractive effort.

UNIT–V

Vibrations: Free Vibration of mass attached to vertical spring– Damped free vibrations, Transverse loads– vibrations of beams with concentrated and distributed loads. Dunkerly‟s method – Raleigh‟s method. Whirling of shafts –critical speed – torsional vibrations– one, two and three rotor systems.

TEXTBOOKS:
1. Theory of Machines/S.S.Rattan/McGrawHill.
2. Theory of Machines/Sadhu Singh/Pearson

REFERENCEBOOKS:
1. Theory of Machines and Mechanisms/Joseph E.Shigley/Oxford
2. Theory of Machines/Rao,J.S & R.V.Duggipati/New Age

L	T	P	C
3	1	0	4

B.Tech. in Mechanical Engineering
V Semester Syllabus
ME502PC: Thermal Engineering –II

Course Objectives:

The objectives of the course is to make the students

- Deal with fundamentals of thermodynamics and Power plant engineering which helps an undergraduate student to have a better understanding.
- Understand the fundamentals phenomenon of combustion in boilers extended to reality in steam Power plant.
- Expose students to different methods of generating power with specific applications and limitations.
- Help the student to learn calculation procedures for designing steam turbines, steam condensers, nozzles etc. used in thermal power plants, steam engines and other industrial applications.
- Design the steam equipment's and jet propulsions so that R&D in industry is improved.

Course Outcomes:

At the end of the course the students will be able to

- Apply the laws of Thermodynamics to implement on nozzles and condensers , how to analyze thermodynamic cycles.
- Differentiate between vapor power cycles and gas power cycles.
- Infer from property charts and tables and to apply the data for the evaluation of performance parameters of the steam and gas turbine plants.
- Understand the functionality of major components of steam and gas turbine plants and to do the analysis of these components.
- Compare the working of various jet engines and calculate thrust & efficiency in .jet propulsion using gas dynamics principles, Classify rocket engines, calculate efficiency in rocket propulsion.

UNIT - I

Steam Power Plant: Rankine cycle - Schematic layout, Thermodynamic Analysis, Concept of Mean Temperature of Heat addition, Methods to improve cycle performance – Regeneration & reheating.
Boilers – Classification – Working principles with sketches including H.P.Boilers – Mountings and Accessories – Working principles- Boiler horse power, Equivalent Evaporation, Efficiency and Heat balance – Draught- Classification – Height of chimney for given draught and discharge- Condition for maximum discharge- Efficiency of chimney.

UNIT - II

Steam Nozzles: Function of nozzle – Applications and Types- Flow through nozzles- Thermodynamic analysis – Assumptions -Velocity of nozzle at exit-Ideal and actual expansion in nozzle- Velocity coefficient- Condition for maximum discharge- Critical pressure ratio- Criteria to decide nozzle shape- Super saturated flow, its effects, Degree of super saturation and Degree of under cooling - Wilson line.

UNIT - III

Steam Turbines: Classification – Impulse turbine; Mechanical details – Velocity diagram – Effect of friction – Power developed, Axial thrust, Blade or diagram efficiency – Condition for maximum efficiency. De-Laval Turbine - its features- Methods to reduce rotor speed-Velocity compounding and Pressure compounding-Velocity and Pressure variation along the flow – Combined velocity diagram for a velocity compounded impulse turbine.

Reaction Turbine: Mechanical details – Principle of operation, Thermodynamic analysis of a stage, Degree of reaction –Velocity diagram – Parson‟s reaction turbine – Condition for maximum efficiency.

UNIT - IV

Steam Condensers: Requirements of steam condensing plant – Classification of condensers – Working principle of different types – Vacuum efficiency and Condenser efficiency - Cooling water requirement.

Gas Turbines: Simple gas turbine plant – Ideal cycle, essential components – Parameters of performance – Actual cycle – Regeneration, Inter cooling and Reheating –Closed and Semi- closed cycles – Merits and Demerits- Combustion chambers and turbines of Gas Turbine Plant- Brief Concepts.

UNIT - V

Jet Propulsion: Principle of Operation –Classification of jet propulsive engines – Working Principles with schematic diagrams and representation on T-S diagram - Thrust, Thrust Power and Propulsion Efficiency – Turbo jet engines – Needs and Demands met by Turbo jet – Schematic Diagram, Thermodynamic Cycle, Performance Evaluation Thrust Augmentation – Methods.

Rockets: Application – Working Principle – Classification – Propellant Type – Thrust, Propulsive Efficiency – Specific Impulse – Solid and Liquid propellant Rocket Engines.

Text Books:

1. Thermal Engineering / Mahesh M Rathore/ Mc Graw Hill
2. Gas Turbines – V. Ganesan /Mc Graw Hill
3. Thermal Engineering, by R. K. Rajput.

Reference Books:

1. Gas Turbine Theory/ Saravanamuttoo, Cohen, Rogers/ Pearson
2. Fundamentals of Engineering Thermodynamics / Rathakrishnan/ PHI
3. Thermal Engineering/ Rajput/ Lakshmi Publications

L	T	P	C
3	1	0	4

B.Tech. in Mechanical Engineering
V Semester Syllabus
ME503PC: Design of Machine Members - I

Course Objectives:

The objectives of the course is to make the students
- Understand the stresses and strain in machine elements subjected to various loads.
- Learn static and fatigue failures criteria in the analysis and design of mechanical components.
- Learn the design process of structural joints such as riveted, welded and bolted joints.
- Understand design process of assembled joints such as cotter joints, knuckle joints.
- Understand design process of shafts and shaft couplings.

Course Outcomes:

At the end of the course the students will be able to
- Analyze the stress and strain on mechanical components and failure modes of mechanical parts.
- Calculate stresses and loads involved with fatigue effect and to create a Soderberg endurance failureline.
- Determine riveted, welded and bolted joint parameters in design.
- Determine cotter and knuckle joint parameters in design.
- Determine shaft and shaft coupling parameters in design.

UNIT – I

Introduction: General considerations in the design of Engineering Materials and their properties - selection -Manufacturing consideration in design. Tolerances and fits - BIS codes of steels.

Design for Static Strength: Simple stresses - Combined stresses - Torsional and Bending stresses - Impact stresses - Stress strain relation - Various theories of failure - Factor of safety - Design for strength and rigidity - preferrednumbers. The concept of stiffness in tension, bending, torsion and combined situations.

UNIT – II

Design for Fatigue Strength: Stress concentration - Theoretical stress Concentration factor - Fatigue stress concentration factor - Notch Sensitivity - Design for fluctuating stresses - Endurance limit - Estimation of Endurance strength - Gerber‟s curve - Goodman‟s line - Soderberg‟s line.

UNIT – III

Riveted, Welded and Bolted Joints: Riveted joints - methods of failure of riveted joints -strength equations - efficiency of riveted joints - eccentrically loaded riveted joints.

Welded joints - Design of fillet welds - axial loads - circular fillet welds under bending, torsion. Welded joints under eccentric loading. Bolted joints - Design of bolts with pre-stresses - Design of joints under eccentric loading - locking devices - bolts of uniform strength.

UNIT – IV

Keys, Cotters and Knuckle Joints: Design of keys - stresses in keys - cotter joints -spigot and socket, sleeve and cotter, Gib and cotter joints - Knuckle joints.

UNIT – V

Shafts: Design of solid and hollow shafts for strength and rigidity - Design of shafts for combined bending and axialloads - Shaft sizes - BIS code - Gaskets and seals (stationary & rotary)
Shaft Couplings: Rigid couplings - Muff, Split muff and Flange couplings.Flexible couplings - Flange coupling(Modified).

TEXT BOOKS:

1. Design of Machine Elements / V. Bhandari / Mc Graw Hill
2. Machine Design / Jindal / Pearson

REFERENCE BOOKS:

1. Design of Machine Elements / V. M. Faires / Macmillan
2. Design of Machine Elements-I / Kannaiah, M.H / New Age

L	T	P	C
3	0	0	3

B.Tech. in Mechanical Engineering

V Semester Syllabus

ME504PC: Operations Research

Course Objectives:

The objectives of the course is to make the students

- Set-up simplex tables and solves LP problems using simplex algorithm and interpret the optimal solution of LP problems.
- Recognize and formulate a transportation problem involving a large number of shipping routes and to drive optimal solution by using MODI method. And to apply the Hungarian method to solve an assignment problems.
- Study sequencing techniques and use Johnson‟s rule of sequencing or scheduling. And to realize the need to study replacement and maintenance analysis techniques.
- Apply various methods to select and execute various optimal strategies to win the game. And to know a broad classification of deterministic and probabilistic inventory control models.
- Identify and examine the situations that generate queuing problems. And develop recursive function based on Bellman‟s principle of optimality to get optimal solution.

Course Outcomes:

At the end of the course the students will be able to

- Formulate a real-world problem as a mathematical programming model and understand the theoretical working of the simple method of linear programming and perform iterations of it by hand.
- Solve specialized linear programming problems like the transportation and assignment problems.
- Study sequencing techniques and use Johnson‟s rule of sequencing or scheduling. And to apply replacement policy for items whose efficiency deteriorates with time and for items that fail completely.
- Understand how optimal strategies are formulated in conflict and competitive environment. And to calculate the EOQ for minimizing total inventory cost and compute the cycle time.
- Analyze the variety of performance measures (operating characteristics) of a queuing system. And understand how to construct a model and solve problems using dynamic programming problems.

UNIT - I

Basics of Operations Research and Linear Programming

Development- definition-characteristics and phases-Types of models-Operations Research models-applications. **Allocation:** Linear Programming Problem Formulation-Graphical solution- Simplex Method, Maximization and Minimization Problems -Artificial variabletechniques: Big-M method, Two-phase method.

UNIT - II

Transportation and Assignment Models

Transportation: Formulation-Optimal solution, unbalanced transportation problem-Degeneracy.

Assignment: Formulation-Optimal solution - Variants of Assignment problem- Travelling salesman problem.

UNIT - III

Sequencing and Replacement Models

Sequencing: Introduction- assumptions, Flow-Shop sequencing -n jobs through two machines – n jobs throughthree machines- Job shop sequencing-two jobs through „m‟ machines.

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

UNIT - IV

Theory of games and Inventory Models

Theory of Games: Introduction- Terminology, assumptions - Solution of games with saddle points and without saddle points. 2 x2 games- dominance principle- m x 2 & 2 x n games- Graphical method.

Inventory: Introduction- Single item, Deterministic models- purchase inventory models with one price break- Stochastic models-Demand may be discrete and continuous variable- single period model and no setup cost.

UNIT - V

Queuing Models and Dynamic Programming

Queuing: Introduction- Terminology, characteristics - Single channel- Poisson arrivals and exponential service times with infinitepopulation and unrestricted queue.

Dynamic Programming: Introduction- Terminology, characteristics - Bellman‟s principle of optimality- Applications of Dynamicprogramming- shortest path problem- linear programming problem to DPP.

Text Books:

1. Operations Research/ J. K. Sharma 4e./ Mac Milan
2. Operations Research/ Premkumar Gupta and D.S. Hira/ S.Chand

Reference Books:

1. Introduction to OR/Taha/PHI
2. Problems in Operations Research (Methods and solutions)/P. K Gupta and Manmohan/Sultan Chand &Sons.
3. Introduction to OR/ Hillier &Libemann/TMH
4. Operations Research/ S.D. Sharma/Kedarnath Ram nath&Co
5. Operations Research/ S.R Yadav and A.K Malik/Oxford university press.
6. Operations Research/ V.K Kapoor/ Sultan Chand & Sons.
7. Operations Research/NVS Raju/SMS Education/3rd Revised Edition
8. Operations Research /A.M. Natarajan, P. Balasubramaniam, A. Tamilarasi/Pearson Education.
9. Operations Research/ Wagner/ PHI Publications.
10. Operations Research/Pradeep J Jha/ McGraw Hill Education.
11. Operations Research/M.V. Durga Prasad, K. Vijaya Kumar Reddy, J. Suresh Kumar/Cengage Learning.

L	T	P	C
3	0	0	0

B.Tech. in Mechanical Engineering
V Semester
MC502ES: Artificial Intelligence
(Common to all branches except CSE, IT, CSBS, CSE(AI&ML))

Course Objectives:

- To train the students to understand different types of AI agents, various AI searchalgorithms, fundamentals of knowledge representation, building of simple knowledge-based systems and to apply knowledge representation, reasoning.
- Study of Markov Models enable the student readyto step into applied AI.

UNIT - I

Introduction: AI problems, Agents and Environments, Structure of Agents, Problem Solving Agents **Basic Search Strategies**: Problem Spaces, Uninformed Search (Breadth-First, Depth-First Search, Depth-first with Iterative Deepening), Heuristic Search (Hill Climbing, Generic Best-First, A*), Constraint Satisfaction (Backtracking, Local Search)

UNIT - II

Advanced Search: Constructing Search Trees, Stochastic Search, A* Search Implementation,Minimax Search, Alpha-Beta Pruning
Basic Knowledge Representation and Reasoning: Propositional Logic, First-Order Logic, Forward Chaining and Backward Chaining, Introduction to Probabilistic Reasoning, Bayes Theorem

UNIT - III

Advanced Knowledge Representation and Reasoning: Knowledge Representation Issues, Non- monotonic Reasoning, Other Knowledge Representation Schemes
Reasoning Under Uncertainty: Basic probability, Acting Under Uncertainty, Bayes‟ Rule, Representing Knowledge in an Uncertain Domain, Bayesian Networks

UNIT - IV

Learning: What Is Learning? Rote Learning, Learning by Taking Advice, Learning in Problem Solving,Learning from Examples, Winston‟s Learning Program, Decision Trees.

UNIT - V

Expert Systems: Representing and Using Domain Knowledge, Shell, Explanation, KnowledgeAcquisition.

TEXT BOOK:

1. Artificial Intelligence, Elaine Rich, Kevin Knight, Shivasankar B. Nair, The McGraw Hillpublications, Third Edition, 2009

REFERENCE BOOKS:

1. Russell, S. and Norvig, P, Artificial Intelligence: A Modern Approach, Third Edition, Prentice-Hall, 2010.
2. George F. Luger, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson Education, 6th ed., 2009.

L	T	P	C
0	0	2	1

B.Tech. in Mechanical Engineering
V Semester Syllabus
ME551PC: Kinematics and Dynamics Lab

Course Objectives:

The objectives of the course is to make the students

- Learn the types of motions of Cam and Followers.
- Study the effect of varying mass on the center of sleeve in Governors.
- Perform the effect of gyroscope for different motions.
- Study the time period and natural frequency of simple and compound pendulum.
- Identify the forces and torques acting through the static and dynamic analysis on rotating mass systems.
- Study the damped and undampedvibrations of spring mass system.

Course Outcomes:

At the end of the course the students will be able to

- Demonstrate different combinations of Cam and Follower arrangements.
- Design and operate the I.C, Engine valves by using the various types of Governors.
- Apply the knowledge of gyroscope principle in aerospace and ship applications.
- Analyze the effect of vibrations in various machines used in industrial mechanical applications.
- Implement the knowledge of static and dynamic analysis in turbines and propeller shaft applications
- Analyze the damped and undamped vibrations of various mechanical systems used in automobile applications.

Experiments: (A Minimum of 10 experiments are to be conducted)

1. Find the motion of the follower of the given profile of the cam
2. Determine the effect of varying mass on the centre of sleeve in porter governor
3. For a simple pendulum determine time period and its natural frequency
4. For a compound pendulum determine time period and its natural frequency
5. To determine the frequency of torsional vibration of a given rod
6. Determine the effect of varying mass on the centre of sleeve in proell governor
7. To balance the masses statically and dynamically for rotating mass systems
8. Determine the critical speed of a given shaft for different end conditions
9. Determine the effect of gyroscope for different motions
10. Determine time period, amplitude and frequency of undamped free longitudinal vibration of single degreespring mass systems
11. Determine the pressure distribution of lubricating oil at various load and speed of a Journal bearing
12. Determine time period, amplitude and frequency of damped free longitudinal vibration of single degreespring mass systems

L	T	P	C
0	0	2	1

B.Tech. in Mechanical Engineering
V Semester Syllabus
ME552PC: Thermal Engineering Lab

Course Objectives:

The objectives of the course is to make the students

- Achieve practical knowledge of operating an IC engine, i.e Spark ignition Engine and combustion ignition engine
- Possess the opportunity to learn experimentally the performance of IC engines
- Analyze performance characteristics and gain knowledge about compressors
- Learn various components of steam boilers
- Draw valve and port timing diagrams experimentally.

Course Outcomes:

At the end of the course the students will be able to

- Analyze the performance and operating characteristics of an IC engine using rope brake dynamometer.
- Draw the heat balance sheet for an IC engine.
- Able to analyze the performance of reciprocating air compressor.
- Know the principle of working of steam boilers and their accessories and mountings.
- Calculate & compare the performance characteristics and IC engine load variations with Air fuel ratio.

List of Experiments

1. I.C. Engine Performance Test of 4 -S single cylinder Diesel engine
2. I.C. Engine Performance Test of 4 -S Double cylinder Diesel engine
3. I.C. Engine Heat Balance test on 4-S single cylinder Diesel engine
4. I.C. Engine - Determination of A/F Ratio, Volumetric efficiency and motoring test on 4-S Single cylinder VCR engine
5. I C Engine Morse Test on 4 -S Double cylinder Diesel engine.
6. I.C. Engine -Performance Test on Variable Compression Ratio engine
7. Performance Test on Reciprocating Air Compressor
8. IC Engine Performance Test on a 4S Double cylinder Diesel engine at constant speed
9. I.C. Engine Valve / Port Timing Diagrams
10. Dis-Assembly and Assembly of engine
11. Study of Boiler Model

Note: Perform any 10 out of the 11 Experiments

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B.Tech. in Mechanical Engineering
VI Semester Syllabus
ME601PC: Heat Transfer

Course Objectives:

The objectives of the course is to make the students
- Learn the modes of heat transfer and applications of heat transfer
- Derive the equation for temp distribution in fins, & estimate the rate of heat transfer through conductionthrough slabs, cylindrical and spherical surfaces.
- Estimate the rate of heat transfer co-efficient for forced and free convection
- Analyze and design the boiling heat transfer problems and design the condensation heat transfer problems.
- Calculate the Effectiveness of heat exchangers, condensers & evaporator by using LMTD & NTUmethods.

Course Outcomes:

At the end of the course the students will be able to
- Understand the basic modes of heat transfer
- Compute one dimensional steady state heat transfer with and without heat generation
- Understand and analyze heat transfer through extended surfaces
- Interpret and analyze forced and free convective heat transfer
- Understand the principles of boiling, condensation, radiation heat transfer and design of heat exchangers.

UNIT-- I

Introduction: Modes and mechanisms of heat transfer – Basic laws of heat transfer –General discussion about applications of heat transfer.

Conduction Heat Transfer: Fourier rate equation – General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates – simplification and forms of the field equation – steady, unsteady, and periodic heat transfer – Initial and boundary conditions

One Dimensional Steady State Conduction Heat Transfer: Homogeneous slabs, hollow cylinders, and spheres-Composite systems– overall heat transfer coefficient – Electrical analogy – Critical radius of insulation

UNIT-- II

One Dimensional Steady State Conduction Heat Transfer: Variable Thermal conductivity – systems with heat sources or Heat Generation-Extended surface (fins) Heat Transfer – Long Fin, Fin with insulated tip and Short Fin, Application to error measurement of Temperature

One Dimensional Transient Conduction Heat Transfer: Systems with negligible internal resistance – Significance of Biot and Fourier Numbers –Infinite bodies- Chart solutions of transient conduction systems-Concept of Semi-infinite body.

UNIT-- III

Convective Heat Transfer: Classification of systems based on causation of flow, condition of flow, configuration of flow and medium of flow – Dimensional analysis as a tool for experimental investigation – Buckingham Theorem and method, application for developing semi – empirical non- dimensional correlation for convection heat transfer – Significance of non-dimensional numbers – Concepts of Continuity, Momentum and Energy Equations – Integral Method as approximate method -Application of Von Karman Integral Momentum Equation for flat plate with different velocity profiles.

Forced convection: External Flows: Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer -Flat plates and Cylinders.

UNIT-- IV

Internal Flows: Concepts about Hydrodynamic and Thermal Entry Lengths – Division of internal flow basedon this –Use of empirical relations for Horizontal Pipe Flow and annulus flow.
Free Convection: Development of Hydrodynamic and thermal boundary layer along a vertical plate - Use of empirical relations for Vertical plates and pipes.
Heat Exchangers: Classification of heat exchangers – overall heat transfer Coefficient and fouling factor – Concepts of LMTD and NTU methods - Problems using LMTD and NTU methods.

UNIT-- V

Heat Transfer with Phase Change:
Boiling: Pool boiling – Regimes – Calculations on Nucleate boiling, Critical Heat flux and Film boiling.
Condensation: Film wise and drop wise condensation –Nusselt's Theory of Condensation on a vertical plate -Film condensation on vertical and horizontal cylinders using empirical correlations.
Radiation Heat Transfer: Emission characteristics and laws of black-body radiation – Irradiation – total and monochromatic quantities – laws of Planck, Wien, Kirchoff, Lambert, Stefan and Boltzmann– heat exchange between two black bodies – concepts of shape factor – Emissivity – heat exchange between grey bodies – radiation shields – electrical analogy for radiation networks.

Text Books:

1. Heat and Mass Transfer – Dixit /Mc Graw Hill
2. Heat and Mass Transfer / Altamush Siddiqui/ Cengage.
3. Heat Transfer – P.K.Nag/ TMH

Reference Books:

1. Fundamentals of Engg. Heat and Mass Transfer / R.C.Sachdeva / New Age International
2. Heat Transfer – Ghoshdastidar – Oxford University Press – II Edition
3. Heat and Mass Transfer –Cengel- McGraw Hill.
4. Heat and Mass Transfer – R.K. Rajput – S.Chand& Company Ltd.
5. Essential Heat Transfer - Christopher A Long / Pearson Education
7. Heat and Mass Transfer – D.S.Kumar / S.K.Kataria& Sons
8. Heat and Mass Transfer-Kondandaraman

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B.Tech. in Mechanical Engineering
VI Semester Syllabus
ME602PC: Metrology and Machine Tools

Course Objectives:

The objectives of the course is to make the students
- Acquire the knowledge of Engineering metrology and its practice which is having increasing importance in industry.
- Improve applications aspect in the measurements and control of process of manufacture
- Impart the fundamental aspects of the metal cutting principles and their application in studying thebehavior of various machining processes.
- Identify basic parts and operations of machine tools including lathe, shaper, planer, drilling, boring,milling and grinding machine.
- Select a machining operation and corresponding machine tool for a specific application in real time.

Course Outcomes:

At the end of the course the students will be able to
- Identify techniques to minimize the errors in measurement.
- Identify methods and devices for measurement of length, angle, and gear & thread parameters, surfaceroughness and geometric features of parts.
- Understand working of lathe, shaper, planer, drilling, milling and grinding machines.
- Comprehend speed and feed mechanisms of machine tools.
- Estimate machining times for machining operations on machine tools

UNIT—I

Metal cutting: Introduction, elements of cutting process – Geometry of single point tools, Chip formation and types of chips. Engine lathe – Principle of working, types of lathe, specifications. Taper turning, Lathe attachments, Capstan and Turret lathe - Single spindle and multi-spindle automatic lathes.

UNIT—II

Drilling and Boring Machines – Principles of working, specifications, types, operations performed, twist Drill, Types of Boring machines and applications. Shaping, slotting and planning machines –Principles of working – machining time calculations.

UNIT—III

Milling machines – Principles of working – Types of milling machines – Geometry of milling cutters - methods of indexing – Simple and compound indexing only - Grinding – theory of grinding – classification of grinding machines. Types of abrasives, bonds. Selection of a grinding wheel. Lapping, honing and broaching machines.

UNIT-- IV

Limits, fits and tolerances- Types of Fits - Unilateral and bilateral tolerance system, hole and shaft basis system. Interchangeability and selective assembly.
Limit Gauges: Taylor's principle, Design of GO and NO-GO gauges, Bevel protractor, Sine bar, auto collimator.

UNIT-- V

Surface Roughness Measurement: Roughness, Waviness. CLA, RMS, Rz Values. Methods of measurement of surface finish, Talysurf. Gear Measurement, Screw thread measurement, Machine Tool Alignment Tests on lathe, milling and drilling machines.

TEXT BOOKS:

1. A course in Workshop Technology, Vol. II, B.S.Raghuvamshi
2. Machine Tool Practices / Kibbe, Johne. Neely, T. White, Rolando O. Meyer/ Pearson
3. Engineering Metrology / R.K. Jain/ Khanna Publishers.

REFERENCE BOOKS:

1. Principles of Machine Tools, Bhattacharyya A and Sen.G.C / New Central Book Agency.
2. Fundamentals of Dimensional Metrology / Connie Dotson / Thomson
3. Fundamentals of Metal Machining and Machine Tools / Geoffrey Boothroyd / McGraw Hill
4. A Text book of Metrology, M. Mahajan Dhanpat Rai & sons.

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B.Tech. in Mechanical Engineering
VI Semester Syllabus
ME603PC: Design of Machine Members - II

Note: Design Data Book is permitted. Design of all components should include design for strength and rigidity apart from engineering performance requirements.

Course Objectives:

The objectives of the course is to make the students

- Understand design process of sliding contact bearings by calculating heat generated, heat dissipation of bearings.
- Design of ball and roller contact bearings by calculating dynamic load carrying capacity.
- Learn the design process of piston, connecting rod of internal combustion Engine.
- Understand transmission of power by flat belts, V- belts and rope drives.
- Learn the design process of spur gears and helical gears which are subjected to dynamic loads.

Course Outcomes:

At the end of the course the students will be able to

- Calculate the dynamic load carrying capacity of selected suitable series of ball and roller bearings and its rated life.
- Determine the forces acting on the internal combustion engine parts by applying the principles of columns and struts by using Euler and Rankine's formula.
- Determine the deflections and energy storage capacity of the springs.
- Analyze the design parameters of pulleys and belts such as flat belts, V- belts and rope drives.
- Check the dynamic and wear considerations of designed spur gears and helical gears.

UNIT--I

Sliding contact bearings: Types of Journal bearings - Lubrication - Bearing Modulus - Full and partial bearings - Clearance ratio - Heat dissipation of bearings, bearing materials - journal bearing design.

UNIT– II

Rolling contact bearings: Ball and roller bearings - Static load - dynamic load - equivalent radial load - design and selection of ball & roller bearings.

UNIT– III

Engine Parts: Connecting Rod: Thrust in connecting rod – stress due to whipping action on connecting rod ends - Pistons, Forces acting on piston - Construction, Design and proportions of piston.

UNIT– IV

Mechanical Springs: Stresses and deflections of helical springs - Extension and compression springs - Design of springs for fatigue loading - natural frequency of helical springs - Energy storage capacity - helical torsion springs - Design of co-axial springs, Design of leaf springs.

Belts & Pulleys: Transmission of power by Belt and Rope Drives, Transmission efficiencies, Belts - Flat and V types -Ropes - pulleys for belt and rope drives.

UNIT– V

Gears: Spur gears& Helical gears - Brief introduction involving important concepts - Design of gears using AGMA procedure involving Lewis and Buckingham equations. Check for wear.

TEXT BOOKS:

1. Design of Machine Elements / Spotts/ Pearson
2. Machine Design / Pandya & Shah / Charothar

REFERENCE BOOKS:

1. Design of Machine Elements-II / Kannaiah / New Age
2. Design of Machine Elements / Sharma and Purohit/PHI
3. Design Data Book/ P.V. RamanaMurti& M. Vidyasagar/ B.S. Publications
4. Design Data Handbook/ S. Md. Jalaludeen/ Anuradha Publishers

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B.Tech. in Mechanical Engineering

VI Semester Syllabus

ME611PE: Finite Element Methods (Professional Elective – I)

Pre-requisites: Mechanics of Solids

Course Objectives:

The objectives of the course is to make the students

- To understand the concept of FEA, interpolation elements and stiffness matrix.
- To derive stiffness matrix for Truss and Beam elements and formulate problems.
- To derive stiffness matrix and formulate CST and axisymmetric problems
- To formulate one Dimensional steady state heat transfer problems.
- To formulate mass matrix and Eigen values for a stepped bar, truss and Beam

Course Outcomes:

At the end of the course, the students will be able to

- Formulate a stiffness matrix and determine the stress and strain in a 1D Bar element using FE methods
- Formulate or Evaluate stiffness matrix and determine stress, strain in Truss and Beam element
- Derive the stiffness matrix and determine stresses in a CST, axisymmetric element.
- Solve heat transfer problems of 1D, 2D slab and fins.
- Formulate mass matrices of Bar, Truss and Beam, Evaluate eigen values and vectors of stepped bar,Truss, Beam

UNIT– I

Introduction to Finite Element Methods: General Procedure – Engineering Applications – 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 boundaryconditions, Quadratic shape functions.

UNIT– II

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

Analysis of Beams: Element stiffness matrix for two noded, 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 Isoparametric elements.

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. Finite element – formulation to 3 D problems in stress analysis, convergence requirements, Mesh generation. techniques such as semi-automatic and fully Automatic use of software's.

TEXT BOOKS:

1. Finite Element Methods: Basic Concepts and applications/Alavala/PHI
2. Introduction to Finite Elements in Engineering, Chandrupatla, Ashok and Belegundu /Pearson

REFERENCE BOOKS:

1. An Introduction to the Finite Element Method / J. N. Reddy/ Mc Graw Hill
2. Finite Element Analysis / SS Bhavikatti / New Age
3. Finite Element Method/ Dixit/Cengage

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B.Tech. in Mechanical Engineering

VI Semester Syllabus

ME612PE: Power Plant Engineering (Professional Elective – I)

Course Objective: The goal of this course is to become prepared for professional engineering design of conventionaland alternative power-generation plants.

The objectives of the course is to make the students
- Analysis and preliminary design of the major systems of conventional fossil-fuel steam-cycle power plants.
- Obtain working knowledge of the basic design principles of diesel power plant and gas turbine power plant
- Understand working of hydro power plants, solar, wind, tidal power plants and about direct energy conversion systems
- Obtain working knowledge of nuclear power plant and radioactive waste disposal
- Get awareness of the economic, environmental, and regulatory issues related to power generation

Course Outcomes:

At the end of the course the students will be able to
- Understand the working of steam power plants
- Understand working of diesel and gas turbine power plants
- Understand the working of hydro plants and non-conventional energy sources.
- Understand the working of nuclear power plants and waste disposal importance
- Will get awareness of economics and also the importance of power plants waste disposals

UNIT – I

Introduction to the Sources of Energy – Resources and Development of Power in India.
Steam Power Plant: Plant Layout, Working of different Circuits, Properties of coal- Fuel and handling equipment's, types of coals, coal handling, choice of handling equipment, coal storage,
Combustion Process:– Stokers: overfeed and underfeed fuel beds, traveling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needsand draught system, cyclone furnace, designand construction, Dust collectors, Ash handling systems, cooling towers and heat rejection. Corrosion and feed water treatment.

UNIT – II

Internal Combustion Engine Plant: Diesel Power Plant: Introduction – IC Engines, types, construction– Plant layout with auxiliaries – fuel supply system, air starting equipment, lubrication and cooling system – super charging.
Gas Turbine Plant: Introduction – classification - construction – Layout with auxiliaries – Principles of working of closed and open cycle gas turbines. Combined Cycle Power Plants and comparison.

UNIT – III

Hydro Electric Power Plant: Water power – Hydrological cycle / flow measurement – drainage are characteristics –Hydrographs – storage and Pondage – classification of dams and spill ways.
Hydro Projects and Plant: Classification – Typical layouts – plant auxiliaries – plant operation pumped storage plants.
Non- conventional Energy: solar cell, solar collectors, Direct energy conversion systems, wind energy- vertical axis and horizontal axis wind turbines, tidal power

UNIT – IV

Nuclear Power Station: Nuclear fuel – breeding and fertile materials – Nuclear reactor – reactor operation. **Types of Reactors:** Pressurized water reactor, Boiling water reactor, sodium-graphite reactor, fast Breeder Reactor, Homogeneous Reactor, Gas cooled Reactor, Radiation hazards and shielding – radioactive waste disposal.

UNIT – V

Power Plant Economics and Environmental Considerations: Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution, Load curves, load duration curve, Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor – related exercises. Effluents from power plants and Impact on environment – pollutants and pollution standards – Methods of Pollution control.

TEXT BOOKS:

1. Power plant engineering /P.C.Sharma/kataria
2. Power Plant Engineering/ P. K. Nag / Mc Graw Hill
3. Power Plant Engineering / Hegde / Pearson.

REFERENCES BOOKS:

1. Power Plant Engineering / Gupta / PHI
2. Power Plant Engineering / A K Raja / New age

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B.Tech. in Mechanical Engineering
VI Semester Syllabus
ME613PE: Mechanical Vibrations (Professional Elective – I)

Course Objectives:

The objectives of the course is to make the students
- Understand various levels of vibrations and remedies.
- Understand the basic fundamentals of undamped, damped, free and forced vibrating system.
- Understand the causes and effects of vibration in mechanical systems.
- Understand the role of damping, stiffness and inertia in mechanical systems.
- Understand the role longitudinal, traverse vibrations and critical speed of the shaft in vibrating system.

Course Outcomes:

At the end of the course the students will be able to
- Analyze the vibrating equations for identifying the various levels of vibrations.
- Develop schematic models for physical systems and formulate governing equations of motion.
- Analyze rotating and reciprocating systems and compute critical speeds.
- Analyze and design machine supporting structures, vibration isolators and absorbers.
- Analyze the longitudinal, traverse vibrating equations and calculating the critical speed of the shaft for various industrial applications.

UNIT – I

Single degree of Freedom systems - I: Undamped and damped free vibrations; forced vibrations coulomb damping; Response to excitation; rotating unbalance and support excitation; vibration isolation and transmissibility.

UNIT – II

Two - degree freedom systems: Principal modes - undamped and damped free and forced vibrations; undamped vibration absorbers.

UNIT – III

Multi degree freedom systems: Matrix formulation, stiffness and flexibility influence coefficients; Eigen value problem; normal modes and their properties; Free and forced vibration by Modal analysis; Method of matrix inversion; Torsional vibrations of multi- rotor systems and geared systems; Discrete - Time systems.

UNIT – IV

Continuous system: Free vibration of strings - longitudinal oscillations of bars- traverse vibrations of beams - Torsional vibrations of shafts.

UNIT – V

Critical speeds of shafts: Critical speeds without and with damping, secondary critical speed.

Numerical Methods: Rayleigh's stodola's, Matrix iteration, Rayleigh - Ritz Method and Holzer's methods. Vibration measuring instruments: Vibrometers, velocity meters & accelerometers.

TEXT BOOKS:

1. Elements of Vibration Analysis / Meirovitch/ Mc Graw Hill
2. Principles of Vibration / Benson H. Tongue/Oxford

REFERENCE BOOKS:

1. Mechanical Vibrations / SS Rao / Pearson
2. Mechanical Vibration /Rao V. Dukkipati, J Srinivas/ PHI
3. Mechanical Vibrations/ G.K. Grover/ Nemchand & Brothers

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B.Tech. in Mechanical Engineering
VI Semester Syllabus
ME614PE: Microcontrollers in Automation (Professional Elective – I)

UNIT - I: Basic Concepts of Digital Circuits
Number Systems, Logic Gates, Combinational Circuits, Flip-flops, Sequential Logic Circuits: Counters, Shift Registers. Basic components and computer architecture- CPU, Memory and Peripherals

UNIT - II: Architecture of Microprocessor
Introduction, Origin, Historical Developments, Introduction to 8085 Functional Block Diagram, Registers, ALU, Bus Systems, Timing and Control Signals, PIN diagram, Machine Cycles, Instruction Cycle and Timing States, Instruction Timing Diagrams, Addressing Modes. Concept of Interrupt, Need for Interrupts, Interrupt structure, Multiple Interrupt requests and their handling, Programmable interrupt Controller

UNIT - III: Assembly Language Programming
Instruction Set, Simple programs in 8085 mainly on Addition, Subtraction, Multiplication, Rotation, Ascending and Descending of the given data

UNIT - IV: Memory and I/O Device Interfacing
Memory Interfacing - Memory structure and its requirements, Basic Concept in Memory Interfacing, Address Decoding, Interfacing Circuits, Address Decoding and Memory Addresses, Typical Examples on Memory interfacing: Interface (2k x 8) ROM, (8k x 8) EPROM, and (1k x 8) RAM with 8085. IO Interfacing – Basic Interfacing Concepts-Peripheral I/O instructions, I/O Execution, Device Selection and data transfer, absolute vs. Partial Decoding, Input Interfacing, Interfacing I/Os using Decoders

UNIT - V: Architecture of Microcontroller
Introduction to Microcontrollers and how they differ from microprocessors, Block diagram of Microcontrollers, Architecture of 8051 microcontroller, Pin Diagram, Instruction set, simple 8051 programming, introduction to ARM microcontroller and its applications.

TEXT BOOKS:
1. Microprocessor Architecture, Programming, and Applications with the 8085, Ramesh Gaonkar, PENRAM International Publishers.
2. The 8051 Microcontroller and Embedded Systems: Using Assembly and C, Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D, Mckinlay, 2nd Edition, Pearson publication, 2007.

REFERENCE BOOKS:
1. Microprocessors and Interfacing: Programming and Hardware, Douglas V. Hall
2. Microcomputer Experimentation with the Intel SDK-85, Lance A. Leventhal, Prentice Hall
3. Introduction to Microprocessors, Aditya P Mathur, Tata McGraw-Hill, Europe; 3rd Edition, 1990.
4. Digital Electronics: An Introduction to Theory and Practice, William H. Gothmann, PHI Learning Private Limited.
5. Digital and microprocessor technology, Patrick J O'Connor, Prentice-Hall, 1983.
6. Digital and Microprocessor Engineering, S.J.Cahill, Wllis Horwood Limited (John Wiley & Sons).
7. Digital Control Systems, Benjamin C. Kuo, Oxford University Press (2/e, Indian Edition, 2007).
8. Digital Computer Electronics: An Introduction to Microcomputers, Albert Pual Malvino, Tata McGraw-Hill Publishing Company Ltd.

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B.Tech. in Mechanical Engineering
VI Semester Syllabus
MC601HS: Intellectual Property Rights
(Common to CIVIL, MECH, ECE, MCT & MME)

Course Objectives: The objectives of the course are:

1. To enable the students to have an overview of Intellectual Property Rights.
2. To provide comprehensive knowledge to the students regarding Trademarks Registration process and law related to it.
3. To disseminate knowledge on Copyrights, its related rights and recent developments.
4. To make the students understand Patent Regime in India and abroad.
5. To understand the framework of Trade secrets.

Course Outcomes: By the end of the course students shall:

1. Gain knowledge on Intellectual property rights and their importance.
2. Understand Indian and International Trademark Law and procedure for registration of Trademarks.
3. Acquire knowledge on Copyright Law, and the privileges awarded to the copyright owners.
4. Familiarized with the process of acquiring the patent and relevant laws.
5. Learn the importance of trade secrets for business sustainability.

UNIT – I: INTRODUCTION TO INTELLECTUAL PROPERTY

Introduction of IPR-Meaning of intellectual property, types of intellectual property-trademarks, copyrights, patents, trade secrets, importance of intellectual property rights, International organizations-WTO-WIPO-USPTO-INTA, International Conventions, agencies and treaties- Paris Convention-Berne Convention- Madrid Protocol-NAFTA-PCT-GATT-TRIPS.

UNIT – II: TRADEMARKS

Trademarks: Purpose and functions of Trademarks-Categories of marks, acquisition of trademark rights - Protectable matter - Selecting and evaluating Trademark- Trademark registration process – Trademark Infringement - Remedies for infringement of Trademarks-New developments in Trademark Law- International Trademarks Law.

UNIT III: COPYRIGHT

Copyrights-Fundamentals of Copyright Law - Requirements of Copyrightability - Originality of material, fixation of material, Authorship works, exclusions from copyright protection- Rights of Copyright Owner-Right of reproduction of copyrighted work, right to do derivative works ,right to distribute copies of the copyrighted work, right to perform the work publicly, right to display the copyrighted work, – Copyright Ownership issues – Joint Works, Works made for Hire, Specially commissioned works, Copyright Registration - Notice of Copyright – Copyright Infringement - Remedies for infringement in Copyrights- New developments in Copyright Law-International Copyright Law.

UNIT IV: PATENTS

Concept of Patent - Classification – Utility Patents – Design Patents and Plant Patents, Patent searching process-Types of Patent Applications-Patent Registration Process, Ownership, Transfer, Assignment and Licensing of Patent-Patent Infringement, Remedies for Infringement of Patents, New developments in Patent Law-International Patent Law.

UNIT – V: TRADE SECRETS & LAW OF UNFAIR COMPETITION

Trade Secrets: Trade secret law, determination of trade secret status, measures for protecting trade secret - Liability for misappropriation of trade secrets, protection for submissions, trade secret litigation. New developments in Trade secrets Law - International Trade Secret law.
Law of Unfair Competition: Passing off, Misappropriation, Right of publicity, Dilution of trademarks, Product disparagement, False advertising, Internet Piracy.

TEXT BOOKS:

1. Deborah. E.Bouchoux, Intellectual property, Cengage learning India Pvt.Ltd., 4th edition, 2013.
2. Prabuddha Ganguli, Intellectual Property Right, Tata McGraw Hill Publishing Company, 8th edition, 2016.

REFERENCES:

1. Richard Stim, Intellectual Property, Cengage learning India Pvt. Ltd. 3rd edition, 2017.
2. Vinod.V. Sope, Managing Intellectual Property, Asoka K. Ghosh, 2nd edition, 2010.

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B.Tech. in Mechanical Engineering
VI Semester Syllabus
MC602ES – Cyber Security
(Common to all branches except CSE, IT, CSBS)

Course objectives:

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

Course Outcomes:

- The students will be able to understand cyber-attacks, types of cybercrimes, cyber laws and how to protec 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 defence, Security Models, risk management, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy.

UNIT - II

Cyberspace and the Law & Cyber Forensics: Introduction, Cyber Security Regulations, Roles of International Law. The INDIAN Cyberspace, National Cyber Security Policy. Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics, Special Techniques for Forensics Auditing.

UNIT - III

Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

UNIT – IV

Cyber Security: Organizational Implications: Introduction cost of cybercrimes and IPR issues, web Threats for organizations, security and privacy implications, social media marketing: security risks and perils for organizations, social computing, and the associated challenges for organizations.
Cybercrime and Cyber terrorism: Introduction, intellectual property in cyberspace, the ethical dimension of cybercrimes the psychology, mindset and skills of hackers and other cyber criminals.

UNIT - V

Privacy Issues: 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, etc.

Cybercrime: Examples and Mini-Cases Examples: Official Website of Maharashtra Government Hacked, Indian Banks Lose Millions of Rupees, Parliament Attack, Pune City Police Bust Nigerian Racket, e-mail spoofing instances.

Mini-Cases: The Indian Case of online Gambling, An Indian Case of Intellectual Property Crime, Financial Frauds in Cyber Domain.

TEXT BOOKS:

1. Nina Godbole and Sunit Belpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley
2. B. B. Gupta, D. P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335, 2018.

REFERENCES:

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
2. Introduction to Cyber Security, Chwan-Hwa(john) Wu,J. David Irwin, CRC Press T&F Group.

B.Tech. in Mechanical Engineering
VI Semester Syllabus
EN651HS: Advanced English Communication Skills Laboratory
(Common to CE, ECE, EEE, ME, MCT & MME)

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Introduction:

The introduction of the Advanced English Communication Skills Lab is considered essential at the B.Tech 3rd year level. At this stage, the students need to prepare themselves for their career which may require them to listen to, read, speak and write in English both for their professional and interpersonal communication in the globalized context.

The proposed course should be a laboratory course to enable students to use appropriate English and perform the following:

1. Gathering ideas and information to organize ideas relevantly and coherently.
2. Making oral presentations.
3. Writing formal letters.
4. Transferring information from non-verbal to verbal texts and vice-versa.
5. Writing project/research reports/technical reports.
6. Participating in group discussions.
7. Engaging in debates.
8. Facing interviews.
9. Taking part in social and professional communication.

Course Objectives:

This Lab focuses on using multi-media instruction for language development to meet the following targets:

1. Improve the students' fluency in English, with a focus on vocabulary.
2. Enable them to listen to English spoken at normal conversational speed by educated English speakers.
3. Respond appropriately in different socio-cultural and professional contexts.
4. Communicate their ideas relevantly and coherently in writing.
5. Prepare the students for placements.

Course Outcomes:

Students will be able to:

1. Enhance listening proficiency and reading comprehension and cultivate critical thinking ability.
2. Acquire essential vocabulary and develop strategic planning skills for effective technical writing and gain expertise in E-Correspondence and (N) etiquette.
3. Understand the nuances of oral skills (Speaking skills), gain competence in delivering effective presentations, employing suitable language and body language.
4. Communicate confidently in group discussions and enhance the employability skills of students.
5. Apply effective techniques and strategies for successful job interviews.

Syllabus:
The following course content to conduct the activities is prescribed for the Advanced English Communication Skills (AECS) Lab:

1. **Activities on Listening and Reading Comprehension:** Active Listening – Development of Listening Skills Through Audio clips - Benefits of Reading – Methods and Techniques of Reading – Basic Steps to Effective Reading – Common Obstacles – Discourse Markers or Linkers - Sub-skills of reading - Reading for facts, negative facts and Specific Details- Guessing Meanings from Context, Inferring Meaning - Critical Reading – – Reading Comprehension – Exercises for Practice.
2. **Activities on Writing Skills**: Vocabulary for Competitive Examinations - Planning for Writing – Improving Writing Skills - Structure and presentation of different types of writing – Free Writing and Structured Writing - Letter Writing –Writing a Letter of Application –Resume vs. Curriculum Vitae – Writing a Résumé **–** Styles of Résumé - e-Correspondence – Emails – Blog Writing - (N)etiquette – Report Writing – Importance of Reports – Types and Formats of Reports– Technical Report Writing– Exercises for Practice.
3. **Activities on Presentation Skills –** Dealing with Glossophobia or stage fear, starting a conversation – responding appropriately and relevantly – using the right language and body language – Role Play in different situations including Seeking Clarification, Making a Request, Asking for and Refusing Permission, Participating in a Small Talk – Oral presentations (individual and group) through JAM sessions- PPTs – Importance of Presentation Skills – Planning, Preparing, Rehearsing and Making a Presentation - Understanding Nuances of Delivery - Presentations through Posters/Projects/Reports – Checklist for Making a Presentation and Rubrics of Evaluation.
4. **Activities on Group Discussion (GD):** Types of GD and GD as a part of a Selection Procedure - Dynamics of Group Discussion - myths and facts (Dos and Don'ts) of GD - Intervention, Summarizing - Modulation of Voice, Body Language, Relevance, Fluency and Organization of Ideas - GD Strategies – Exercises for Practice.
5. **Activities on Interview Skills**: Concept and Process - Interview Preparation Techniques - Types of Interview Questions – Pre-interview Planning, Opening Strategies, Answering Strategies - Interview Through Tele-conference & Video-conference - Mock Interviews.

Suggested Books:

1. Effective Technical Communication by M Ashraf Rizvi. McGraw Hill Education (India) Pvt. Ltd. 2nd Edition.
2. Academic Writing: A Handbook for International Students by Stephen Bailey, Routledge, 5th Edition.

Reference Books:

1. Rizvi, M. Ashraf (2018). *Effective Technical Communication*. (2nd ed). McGraw Hill Education (India) Pvt. Ltd.
2. Suresh Kumar, E. (2015). *Engineering English.* Orient BlackSwan Pvt. Ltd.
3. Bailey, Stephen. (2018). Academic *Writing: A Handbook for International Students.* (5th Edition). Routledge.
4. Koneru, Aruna. (2016). *Professional Communication*. McGraw Hill Education (India) Pvt. Ltd.
5. Raman, Meenakshi & Sharma, Sangeeta. (2015). *Technical Communication, 3E: Principles and Practice.*Oxford University Press.
6. Anderson, Paul V. (2007). *Technical Communication***.** Cengage Learning Pvt. Ltd. New Delhi.
7. McCarthy, Michael; O'Dell, Felicity & Redman, Stuart. (2017). *English Vocabulary in Use* Series. Cambridge University Press.
8. Sen, Leela. (2009). *Communication Skills.* PHI Learning Pvt Ltd., New Delhi.
9. Elbow, Peter. (1998). *Writing with Power.* Oxford University Press.
10. Goleman, Daniel. (2013). *Emotional Intelligence*: *Why it can matter more than IQ*. Bloomsbury Publishing.
11. Professional Communication by Aruna Koneru, McGraw Hill Education (India) Pvt. Ltd, 2016.
12. Technical Communication by Meenakshi Raman & Sangeeta Sharma, Oxford University Press 2009.
13. How to Write and Speak Better, Reader's Digest, 2003.
14. TOEFL Reading & Writing Workout, The Princeton Review.
15. How to prepare for Group Discussions and Interviews by Harimohan Prasad and Rajneesh Prasad,TataMcgrawHill.
16. Keep Talking, Frederick Klippel, Cambridge University Press, South Asian edition (6 May 2010).
17. Objective English, Edgar Thorpe & Showick Thorpe, Pearson; 5th edition (1 August 2013).
18. Communication Skills for Engineers, Sunitha Mishra, C.Murali Krishna, Pearson; 4th Edition.

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B.Tech. in Mechanical Engineering

VI Semester Syllabus
ME651PC: Heat Transfer Lab

Course Objectives:

The objectives of the course is to make the students

- Attain practical knowledge of operating various heat transfer equipments
- Know the of different types of thermocouples and temperature indicators (including their calibration via voltmeters); measurement of current, voltage, temperature, flow rate/velocity, etc.
- Predict of transient behavior of various equipment during start–up period and finding heat transfer rates, heat transfer coefficients, efficiency, effectiveness, etc. in free and forced convection,.
- Evaluate radiation heat exchange between black and real surfaces, emissivity and Stefan Boltzmann constant.
- Find critical heat transfer during pool boiling and visualization of the phenomena.
- Determine thermal conductivity of insulating material

Course Outcomes:

At the end of the course the students will be able to

- Perform steady state conduction experiments to estimate thermal conductivity of different materials.
- Perform transient heat conduction experiment.
- Estimate heat transfer coefficients in condensation and correlatewith theoretical values.
- Obtain heat transfer coefficients for a given fin under forced and freeconvection.
- Perform radiation experiments: Determine surface emissivity of a test plate and Stefan-Boltzmann's constant and compare with theoretical value.

List of Experiments:

1. Heat Transfer through Composite Slab Apparatus.
2. Heat transfer through lagged pipe.
3. Heat Transfer through a Concentric Sphere
4. Thermal Conductivity of a given metal rod.
5. Transient Heat Conduction
6. Heat transfer in forced convection apparatus.
7. Heat transfer in natural convection
8. Parallel and counter flow heat exchanger.
9. Emissivity apparatus.
10. Stefan Boltzman Apparatus.
11. Critical Heat flux apparatus.
12. Film and Drop wise condensation apparatus

Note: Perform any 10 out of the 12 Exercises

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B.Tech. in Mechanical Engineering

VI Semester Syllabus
ME652PC: Metrology and Machine Tools Lab

Prerequisites: Theoretical exposure to Metrology and machine tools.

Course Objectives:

The objectives of the course is to make the students

- Impart practical exposure to the metrology equipment & Machine Tools
- Understand the basic operations involved in various machine tools such as lathe, drilling, milling and grinding.
- Identify and use different cutting tools for each machine tool.
- Understand and implement safety procedures while working in a machine shop.
- Generate knowledge and skill in use of various measuring tools and measuring techniques.
- Learn a basic understanding of various measuring instruments for the dimensional and geometric features of a given component.

Course Outcomes:

At the end of the course the students will be able to

- Undertake machining operation such as step turning and thread cutting on lathe machine
- Analyze plan and execute different sequence of machining operations for a given application.
- Prepare a cutting tool with required tool geometry using a tool and cutter grinder.
- Apply the procedures to measure angles, bore diameters, and surface roughness by using different instruments.
- Identify procedure for measurement of gear tooth profile using gear tooth Vernier.

List of Experiments:

1. Step turning, Thread cutting and taper turning operations on a lathe machine.
2. Drilling of holes using a drilling machine.
3. Making a flat surface and key way in a given bar using a milling machine.
4. Flat surface finishing for a given work piece using a surface grinding machine.
5. To make a single point cutting tool using tool and cutter grinding machine.
6. Measurement of Diameter of bores by internal micrometers and dial bore indicators.
7. Use of gear teeth Vernier calipers for checking the chordal addendum and chordal height of the spur gear.
8. Angle and taper measurements by Bevel protractor and sine bars.
9. Thread measurement by 3-wire method.
10. Surface roughness measurement by Talysurf.

B.Tech. in Mechanical Engineering

VI Semester Syllabus

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(MC601BS) Environmental Science
(Common to all branches**)**

Course Objectives:

- To understand the natural resources and their conservation.
- To understand the importance of ecosystem, biodiversity and ecological balance for sustainable development.
- To gain knowledge about environmental pollution, effects and controlling measures.
- To study about global environmental problems and global issues.
- To understand the environmental policies, regulations and sustainable development.

Course Outcomes:

After completing the course, the student will be able to:

- Learn about different types of natural resources and take up the measures to protect the resources.
- Get the information about ecosystem, biodiversity and their usage and conservation.
- Get the information about the types of pollution, understand their effects and controlling measures.
- Gain the knowledge about current global environmental issues and initiations to be taken to protect the environment.
- Gain the knowledge about environmental acts, EIA, sustainable development and follow the rules and regulations.

UNIT – I

Ecosystems: Definition, Scope, and Importance of ecosystem. Classification, structure, and function of an ecosystem, Food chains, food webs, and ecological pyramids. Flow of energy, Biogeochemical cycles, Bioaccumulation, Biomagnification, ecosystem value, services and carrying capacity.

UNIT – II Natural Resources:

Classification of Resources: Living and Non-Living resources, **water resources:** use and over utilization of surface and ground water, floods and droughts, Dams: benefits and problems. **Mineral resources:** use and exploitation, environmental effects of extracting and using mineral resources, **Land resources:** Forest resources, **Energy resources:** growing energy needs, renewable and non-renewable energy sources, use of alternate energy source, case studies.

UNIT – III

Biodiversity and Biotic Resources: Introduction, Definition, genetic, species and ecosystem diversity. Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega diversity nation, Hot spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; conservation of biodiversity: In- Situ and Ex-situ conservation. National Biodiversity act.

UNIT - IV

Environmental Pollution and Control Technologies: Environmental Pollution: Classification of pollution, **Air Pollution:** Primary and secondary pollutants, causes and effects, Ambient air quality standards. **Soil Pollution:** Sources and types, Impacts of modern agriculture, degradation of soil. **Solid waste:** Municipal Solid Waste management, composition and characteristics of e-Waste and its management. **Pollution control technologies:** Wastewater Treatment methods: Primary, secondary and Tertiary.
Global Environmental Issues and Global Efforts: Climate change and impacts on human environment. Ozone depletion and Ozone depleting substances (ODS). International conventions / Protocols: Earth summit, Kyoto protocol, and Montréal Protocol. NAPCC-GoI Initiatives.

UNIT – V

Environmental Policy, Legislation & EIA: Environmental Protection act, Legal aspects Air Act- 1981, Water Act, biomedical waste management and handling rules, hazardous waste management and handling rules.
Environmental Impact of Assessment (EIA): structure, methods of baseline data acquisition. Concepts of Environmental Management Plan (EMP).
Towards Sustainable Future: Concept of Sustainable Development Goals, Population and its explosion, Environmental Education, Human health, Environmental Ethics, Concept of Green Building, Green chemistry principles, Ecological Foot Print, Life Cycle assessment (LCA), Low carbon life style.

TEXT BOOKS:

1 Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission.
2 Environmental Studies by Anubha Kaushik, 4th Edition, New age international publishers.

REFERENCE BOOKS:

1. Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHLLearning Private Ltd. New Delhi.
2. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela. 2008 PHILearning Pvt. Ltd.
3. Environmental Studies by R. Rajagopalan, Oxford University Press.
4. Environmental Science by Daniel B. Botkin & Edward A. Keller, Wiley INDIA edition.
5. Text book of Environmental Science and Technology - Dr. M. Anji Reddy 2007, BSPublications.
6. Introduction to Environmental Science by Y. Anjaneyulu, BS. Publications.

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B.Tech. in Mechanical Engineering
VII Semester Syllabus
ME701PC: CAD/CAM

Course Objectives:

The Objectives of the Course are to make students

- Understand an overview on the applications of computers in mechanical Design
- Generate different geometric curves viz. 2D and 3D, surfaces and solids using mathematical tools.
- Develop NC Part Program and APT Part Program for part designs
- To impart the basic understanding of Group Technology, CAPP, MRP
- To understand the concepts of CIM in manufacturing automation

Course Outcomes:

After completion of the Course the student will be able to

- Understand use of computers in Design and Manufacturing.
- Develop geometric 2D and 3D models with suitable tools.
- Develop NC part programs and part programs using APT language.
- Describe GT, CAPP and MRP Techniques.
- Understand CIM, CAQC, FMS concepts related to automated manufacturing environment.

UNIT-I

Fundamentals of CAD/CAM, Types of Production Systems, Automation, Design and Product cycle, Application of computers for design, Benefits of CAD, Computer configuration for CAD applications, Computer peripherals for CAD, Design workstation, Graphic terminal, CAD software- definition of system software and application software, CAD Software Standards, CAD database and structure. Reverse Engineering and its Applications

UNIT-II

Geometric Modeling: **3-D Wire frame modeling**, wire frame entities and their definitions, Curve fitting techniques, and Introduction to Hermite, Bezier, and B-spline curves.
Surface modeling: Analytic and synthetic surfaces
Solid Modelling: Sweep representation, Constructive solid geometry, Boundary representations. Parametric representation of all Geometric Modeling Entities

UNIT-III

NC Control Production Systems: Numerical control, Elements of NC system, Methods of NC part programming, Computer assisted part programming (APT). DNC, Adaptive Control Systems

UNIT-IV

Group Technology: Part families, Parts classification, and coding system. Production flow analysis, Machine cell design.
Computer aided process planning: Difficulties in traditional process planning, Computer aided process planning with retrieval type and generative type. Computer aided manufacturing resource planning: Material resource planning, inputs to MRP, MRP output records, Benefits of MRP.

UNIT-V

Flexible manufacturing system: FMS layouts, Analysis and its benefits
Computer aided quality control: Automated inspection- Off-line, On-line, contact, Non- contact; Coordinate measuring machines, Machine vision.
Computer Integrated Manufacturing: CIM system, Benefits of CIM

Text Books:

1. M. Groover, CAD/CAM, Pearson education, 2003.
2. Ibrahim Zeid, R Sivasubramanian, CAD/CAM : Theory and Practice: Special Indian Edition, McGraw Hill Education; 2nd edition, 2009

Reference Books:

1. P.N. Rao, CAD/CAM Principles and Applications, McGraw Hill Education; 3rd edition, 2017.
2. Alavala Chennakesava R, CAD/CAM Concepts and Applications, Prentice Hall India Learning Private Limited, 2008.
3. Radhakrishnan and Subramanian, CAD / CAM / CIM, New Age International Pvt Ltd; Fourth edition, 2018.

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B.Tech in Mechanical Engineering
VII Semester Syllabus
ME702PC: Refrigeration and Air-Conditioning

Course Objectives:

The objectives of the course is to make the students
- Apply the principles of Thermodynamics to analyze different types of refrigeration systems and to understand the concepts of Air-refrigeration.
- Understand the concept of vapor compression systems and its analysis.
- Know the various components of a refrigeration system in detail.
- Understand the concepts of Vapor absorption systems, steam jet refrigeration system, and thermoelectric refrigeration and Vortex tube.
- Study the various principles of Psychrometric and to design air conditioning loads for various applications.

Course Outcomes:

At the end of the course the students will be able to
- Differentiate between different types of refrigeration systems with respect to application and evaluatethe performance parameters of air-refrigeration systems.
- Thermodynamically analyze Vapor Compression systems and evaluate performance parameters
- Differentiate between the various components of a refrigeration system.
- Thermodynamically analyze Vapor absorption systems and evaluate performance parameters.
- Apply the principles of Psychometrics to design the air conditioning loads for various applications.

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

Vapor 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.

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.

NOTE: Usage of refrigeration tables and steam tables are permitted.

Text Books:

1. Refrigeration and Air conditioning / CP Arora / Mc Graw Hill
2. Refrigeration and Air-Conditioning / RC Aora / PHI
3. Refrigeration and Air-Conditioning/ R.S. Khurmi

Reference Books:

1. Principles of Refrigeration - Dossat / Pearson
2. Basic Refrigeration and Air-Conditioning / Ananthanarayanan / Mc Graw Hill

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B.Tech. in Mechanical Engineering

VII Semester Syllabus

ME711PE: Automobile Engineering (Professional Elective – II)

Course Objectives:

The objectives of the course is to make the students

- Anatomy of the automobile and analyze the concept of frames, location and importance of each part of automobile and working of mechanical systems like lubrication and Fuel supply systems for S.I and C.I Engines
- Understanding and designing the automotive vehicle cooling and ignition systems and its trouble shooting and the basic knowledge in electronic devices which are sing for Automobile.
- Analyze the concepts of different types of transmission systems of gear, clutches and suspension system such as leaf springs, hydraulic springs, telescopic shock absorbers
- Apply fundamental knowledge of automobile engineering for design of comfort systems Like power steering, type of steering systems and understand the principles/types of brakes and different types of master cylinders in the braking system.
- An ability to understand and identify social, environmental issues related to automobile emission characteristic of an S.I , C.I Engine and Present international standards and alternative fuel technological systems and vehicle maintenance.

Course Outcomes:

At the end of the course, the students will be able to

- Gain the knowledge on automobile and its types and basic knowledge about engine and its lubrication, fuel supply system to the practical problems.
- Analyze the Type of cooling and new technology processes of cooling and ignition systems and its trouble shooting of simple problems on fuel, ignition, cooling, and electrical systems
- Develop an ability to analyze of transmission types, suspension system and braking systems.
- Analyze new technical challenges and design of Power steering systems and new technical advancements in the automotive industry and braking systems.
- Gain the knowledge about the alternative fuels used in automobile, performance and Emissions of automobile and its control of international standards.

UNIT– I

Introduction: Layout of automobile – introduction chassis and body components. Types of Automobile engines. – Power UNIT– Introduction to engine lubrication – engine servicing

Fuel System: S.I. Engine: Fuel supply systems, Mechanical and electrical fuel pump – filters – carburetor, types, airfilters – petrol injection.

C.I. Engines: Requirements of diesel injection systems, types of injection systems, DI Systems IDI systems. fuelpump, nozzle, spray formation, injection timing, testing of fuel pumps.

UNIT– II

Cooling System: Cooling Requirements, Air Cooling, Liquid Cooling, Thermo, water and Forced Circulation System – Radiators – Types – Cooling Fan - water pump, thermostat, evaporative cooling – pressure sealed cooling – antifreeze solutions. Ignition System: Function of an ignition system, battery ignition system, constructional features of storage, battery, auto transformer, contact breaker points, condenser and spark plug – Magneto coil ignition system, electronic ignition system using contact breaker, electronic ignition using contact triggers – spark advance and retard mechanism.

UNIT– III

Transmission System: Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel – gear boxes, types, sliding mesh, constant mesh, synchro mesh gear boxes, epicyclic gear box, over drive torque converter. Propeller shaft – Hotch – Kiss drive, Torque tube drive, universal joint, differential rear axles – types – wheels and tyres. Suspension System: Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system.

UNIT– IV

Braking System: Mechanical brake system, Hydraulic brake system, Master cylinder, wheel cylinder tandem mastercylinder Requirement of brake fluid, Pneumatic, and vacuum brakes. Steering System: Steering geometry – camber, castor, king pin rake, combined angle toein, center point steering. Types of steering mechanism – Ackerman steeringmechanism, Davis steering mechanism, steering gears – types, steering linkages.

UNIT– V

Emissions from Automobiles – Pollution standards National and international – Pollution Control – Techniques – Multipoint fuel injection for SI Engines. Common rail diesel injection Energy alternatives – Solar, Photo-voltaic, hydrogen, Biomass, alcohols, LPG, CNG, liquid Fuels and gaseous fuels, Hydrogen as a fuel for IC Engines. - Their merits and demerits.
Modern Vehicles: Introduction to Electric Vehicle & Hybrid Vehicle, advantages and Limitations

Text Books:

1. Automobile Engineering / William H Crouse
2. A Text Book Automobile Engineering–Manzoor, Nawazish Mehdi &Yosuf Ali, Frontline Publications.

Reference Books:

1. A Text Book of Automobile Engineering by R K Rajput. Laxmi Publications.
2. Automotive Mechanics / Heitner
3. Automotive Engineering / Newton Steeds & Garrett
4. Automotive Engines / Srinivasan

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B.Tech. in Mechanical Engineering

VII Semester Syllabus

ME712PE: Artificial Intelligence in Mechanical Engineering

(Professional Elective – II)

UNIT - I:

Introduction to Artificial Intelligence Definition, History, Present state of Artificial Intelligence (AI), Phases of AI, Approaches to AI - Hard or Strong AI, Soft or Weak AI, Applied AI, Cognitive AI, and Applications domains focused On mechanical engineering

UNIT - II:

Problem Solving Methods Problem solving methods-1. Uninformed search includes Depth First Search (DFS), Breadth First Search (BFS), Uniform Cost Search (UCS), Depth Limited Search, Iterative Deepening Depth First Search (IDDFS) and bidirectional search. 2. Informed Search (heuristic search) includes greedy best first search, A* search, memory bounded heuristic search, learning to search better, Simple problems

UNIT - III:

Neural Networks Introduction to Perceptron and Neural Networks, Activation and Loss functions, Single Neuron of Human and Human Brain Modelling, ANN architecture-Input layer, Hidden layer and output layer, Types of Neural Networks-Single layer feed-forward network, Multilayer feed-forward network, Multi-Layer Perceptron (MLP), Recurrent networks or feedback ANN, Characteristics of Neural Networks, Simple problems on Back Propagation Algorithms to minimize the error

UNIT - IV:

Machine Learning Unsupervised learning- Definition, basic concepts, applications, K-means Clustering, hierarchical Clustering, Dimension Reduction-PCA, Simple Examples Supervised Learning - Definition, basic concepts, applications, Linear Regression, Multiple Variable Linear Regression, Logistic Regression, Naive Bayes Classifiers, k-NN Classification, Support Vector Machine, Simple Examples. Reinforcement Learning (RL) - Framework, Component of RL Framework, Types of RL Systems. Qlearning, Examples of RL Systems, Simple Examples

UNIT - V:

Ensemble Learning Techniques Introduction on ensemble methods, Decision Trees, Bagging, Random Forests, Boostin, Simple Examples

TEXT BOOK:

1. Artificial Intelligence: A Modern Approach, Stuart Russell & Peter Norvig, Prentice-Hall, Third Edition (2009).

REFERENCE BOOKS:

1. Artificial Intelligence, Ela Kumar, Wiley, 2021
2. Artificial Intelligence: Concepts and Applications, Lavika Goel, Kindle Edition, Wiley, 2021.
3. Nature-Inspired Optimization in Advanced Manufacturing Processes and Systems, Edited by Ganesh M. Kakandikar and Dinesh G. Thakur, CRC press, First edition, 2021.

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B.Tech. in Mechanical Engineering
VII Semester Syllabus
ME713PE: INDUSTRIAL ROBOTICS (Professional Elective – II)

Pre-requisites: Basic principles of Kinematics and mechanics

Course Objectives:

The goal of the course is to familiarize the students with the concepts and techniques in robotic engineering, manipulator kinematics, dynamics and control, chose, and incorporate robotic technology in engineering systems.

- Make the students acquainted with the theoretical aspects of Robotics
- Enable the students to acquire practical experience in the field of Robotics through design projects and case studies.
- Make the students to understand the importance of robots in various fields of engineering.
- Expose the students to various robots and their operational details.

Course Outcomes:

At the end of the course, the student will be able to understand

- The basic components of robots.
- Differentiate types of robots and robot grippers.
- Model forward and inverse kinematics of robot manipulators.
- Analyze forces in links and joints of a robot. Programme a robot to perform tasks in industrial applications. Design intelligent robots using sensors.

UNIT – I

Introduction: Automation and Robotics – An over view of Robotics – present and future applications. **Components of the Industrial Robotics:** common types of arms. Components, Architecture, numberof degrees of freedom – Requirements and challenges of end effectors, Design of end effectors, Precision of Movement: Resolution, Accuracy and Repeatability, Speed of Response and Load Carrying Capacity.

UNIT – II

Motion Analysis: Basic Rotation Matrices, Equivalent Axis and Angle, Euler Angles, Composite Rotation Matrices. Homogeneous transformations as applicable to rotation and translation – problems. **Manipulator Kinematics**-H notation-H method of Assignment of frames-H Transformation Matrix, jointcoordinates and world coordinates, Forward and inverse kinematics – problems on Industrial Robotic Manipulators.

UNIT – III

Differential transformation of manipulators, Jacobians – problems. Dynamics: Lagrange – Euler andNewton – Euler formations – Problems. Trajectory planning and avoidance of obstacles, path planning, Slew motion, joint interpolated motion straight line motion.

UNIT - IV

Robot actuators and Feedback components: Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparison of Actuators, Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity sensors, Tactile and Range sensors, Force and Torque sensors – End Effectors and Tools

UNIT V

Robot Application in Manufacturing: Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting - Assembly and Inspection. Robotic Programming Methods – Languages: Lead Through Programming, Textual Robotic Languages such as APT, MCL.

TEXT BOOKS:

1. Industrial Robotics / Groover M P /Mc Graw Hill
2. Introduction to Industrial Robotics / Ramachandran Nagarajan / Pearson

REFERENCE BOOKS:

1. Robot Dynamics and Controls / Spony and Vidyasagar / John Wiley
2. Robot Analysis and control / Asada, Slotine / Wiley Inter-Science
3. Robotics – Fu et al / TMH Publications.

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B.Tech. in Mechanical Engineering
VII Semester Syllabus
ME714PE: MECHATRONICS (Professional Elective – II)

UNIT - I:

Introduction: Overview, History of mechatronics, Scope and significance of Mechatronics systems, elements of Mechatronic systems, Needs and benefits of Mechatronics in manufacturing. Sensors: Classification of sensors basic working principles, displacement sensor – linear and rotary potentiometers, LVDT and RVDT, incremental and absolute encoders, Proximity and range sensors – Eddy current sensor, ultrasonic sensor, laser interferometer transducer, hall Effect sensor, inductive Proximity switch, Light sensors – Photodiodes, Phototransistors, Flow Sensors – ultrasonic Sensor, Laser Doppler Anemometer, Tactile Sensors – PVDF tactile sensor, micro-switch and reed switch, Piezoelectric sensors, Vision Sensor.

UNIT - II:

Actuators: Electrical Actuators: Solenoids, relays, diodes, thyristors, triacs, BJT, FET, DC motor, Servo Motor, BLDC Motor, AC Motor, Stepper Motor, Hydraulic & pneumatic devices – Power supplies, valves, Cylinder sequencing, Design of hydraulic & pneumatic circuits. Piezo Electric Actuators, Shape memory alloys.

UNIT - III:

Basic System models & Analysis: Modeling of one & two degrees of freedom Mechanical, Electrical, fluid and thermal systems, block diagram representations of these systems. Dynamic Responses of System: Transfer function, modeling dynamic systems, first order systems, second order systems.

UNIT - IV:

Digital Electronics: Number systems, BCD codes and arithmetic, Gray codes, self-complimenting codes, Error detection and correction principles. Boolean functions using Karnaugh Map, Design of combinational circuits, design of arithmetic circuits, Design of code converters, encoders and decoders. Signal Conditioning: Operational amplifiers, inverting amplifier, differential amplifier, Protection, comparator, filters, multiplexer, Pulse width modulation counters, decoders. Data acquisition – Quantizing theory, Analog to digital conversion, digital to analog conversion. Controllers: Classification of Control systems, Feedback, Closed loop and open loop systems PLC

UNIT - V:

Programming: PLC Principles of operation, PLC sizes, PLC hardware components, I/O section Analog I/O section, Analog I/O modules, digital I/O modules, CPU processor memory, module programming, Ladder Programming, ladder diagrams, Timers, Internal relays and counters, data handling, analogue input and output. Application on real time industrial automation systems. Advanced Applications in Mechatronics: Sensors for condition monitoring, mechatronic control in automated manufacturing, Artificial intelligence in Mechatronics, micro sensors in mechatronics, Application of Washing machine as mechatronic device.

TEXT BOOKS:

1. W. Boton, “Mechatronics”, 5th edition, Adison Wesley Longman ltd, 2010.
2. Mechatronics system design by Devdas Shetty and Richard A. Kolk, P.W.S. Publishing company, 2001.
3. Alciatore David G & Histand Michael B, “Introduction to Mechatronics and Measurement systems”, 4th edition, Tata McGraw Hill, 2006

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B.Tech. in Mechanical Engineering
VII Semester Syllabus
ME715PE: Unconventional Machining Processes
(Professional Elective – III)

Course Objectives:

The objectives of the course is to make the students

- To differentiate conventional and unconventional machining process and need of unconventional machining in the current scenario and to understand the basic principle of USM, the elements of theprocess, MMR, process parameters, economic considerations, applications and limitations.
- To state the modern machining process and process selection. Understand the basic principle of AJM, AWJM and also the study the fundamentals of tool design, surface finishing and metal removal rate of electro chemical grinding, electro chemical machining and electro chemical honing.
- To classify the various thermal & non thermal machining processes and Machine tool selection inEDM & Electric Discharge grinding and wire cut process.
- To study thermal and non-thermal features of Electron Beam Machining and thermal features of Laser Beam Machining.
- To study the various process parameters and applications of plasma arc machining in manufacturing industries and also to study the Principle of chemical machining and the terms maskants, etchants and their applications.

Course outcomes:

At the end of the course, the students will be able to

- Identify the need for nontraditional machining methods and to understand the concepts of ultrasonic machining.
- Understand the nontraditional mechanical machining and electro chemical processes.
- Gain knowledge on thermal and non-thermal processes and understand Electric Discharge Machining processes and applications.
- To understand thermal features of Electron Beam Machining and Laser Beam Machining processes.
- Be familiar with Plasma ARC Machining, Chemical Machining and Finishing Methods.

UNIT- I

Introduction–Need for non-traditional machining methods-classification of modern machining processes–considerations in processes selection. Materials. Applications.

Ultrasonic machining – Elements of the process, mechanics of metal removal process, parameters, economic considerations, applications and limitations, recent development.

UNIT- II

Abrasive Jet Machining, Water Jet Machining And Abrasive Water Jet Machining: Basic principles, equipment, process variable, and mechanics of metal removal, MRR, applications and limitations.

Electro–Chemical Processes: Fundamentals of electro chemical machining, electrochemical grinding, electrochemical honing and deburring processes, metal removal rate in ECM, Tool design, Surface finish and accuracy, economic aspects of ECM – Simple problems for estimation of metal removal rate.

UNIT- III

Thermal Metal Removal Processes: General Principle and applications of Electric Discharge Machining, Electric Discharge Grinding and electric discharge wire cutting processes – Power circuits for EDM, Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, methods surface finish and machining accuracy, characteristics of spark eroded surface and machine tool selection. Wire EDM, principle, applications.

UNIT- IV

Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non-thermal processes –General Principle and application of laser beam machining –thermal features, cutting speed and accuracy of cut.

UNIT– V

Application of plasma for machining, metal removing mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries. Chemical machining –principle- maskants-applications.

Magnetic abrasive finishing, Abrasive flow finishing, Electro stream drilling, shaped tube electrolyte machining.

TEXTBOOKS:

1. Advanced Machining Processes/VK Jain /Allied publishers
2. Modern Machining Processes-P.C.Pandey, H.S.Shan / Mc Graw Hill

REFERENCEBOOKS:

1. Unconventional Manufacturing Processes/Singh M.K/New Age Publishers
2. Advanced Methods of Machining/J.A.Mc Geough/ Springer International
3. Non-Traditional Manufacturing Processes/ Benedict G.F./CRC Press

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B.Tech. in Mechanical Engineering
VII Semester Syllabus

ME716PE: COMPOSITE MATERIALS
(Professional Elective – III)

Course objectives:

- Develop understanding of the structure of ceramic materials on multiple length scales.
- Develop knowledge of point defect generation in ceramic materials, and their impact on transport properties.
- To describe key processing techniques for producing metal, ceramic-, and polymer-matrix composites.
- To demonstrate the relationship among synthesis, processing, and properties in composite materials.

Course Outcomes:

- Knowledge of the crystal structures of a wide range of ceramic materials and glasses.
- Able to explain how common fibers are produced and how the properties of the fibers are related to the internal structure.
- Able to select matrices for composite materials in different applications.
- Able to describe key processing methods for fabricating composites.

UNIT - I

Introduction: Definition, Classification of Composite materials based on structure, based on matrix, Advantages of composites, Applications of composites, Functional requirements of reinforcement and matrix.

UNIT - II

Types of reinforcements and their properties: Fibers: Carbon, Boron, Glass, Aramid, Al_2O_3, SiC, Nature and manufacture of glass, carbon and aramid fibres, Comparison of fibres. Role of interfaces: Wettability and Bonding, The interface in Composites, Interactions and Types of bonding at the Interface, Tests for measuring Interfacial strength.

UNIT - III

Fabrication of Polymeric Matrix Composites, Structure and properties of Polymeric Matrix Composites, Interface in Polymeric Matrix Composites, Applications; Fabrication of Ceramic Matrix Composites, Properties of Ceramic Matrix Composites, Interface in Ceramic Matrix Composites, Toughness of Ceramic Matrix Composites Applications of Ceramic Matrix Composites.

UNIT - IV

Fabrication of Metal Matrix Composites: Solid state fabrication, Liquid state fabrication and In-situ fabrication techniques; Interface in Metal Matrix Composites: Mechanical bonding, Chemical bonding and Interfaces in In-situ Composites; Discontinuously reinforced Metal Matrix Composites, Properties and Applications. Fabrication of Carbon fiber composites, properties, interface and applications.

UNIT - V

Micromechanics of Composites: Density, Mechanical Properties: Prediction of Elastic constants, Micro mechanical approach, Halpin-Tsai equations, Transverse stresses; Thermal properties: Hydrothermal stresses and Mechanics of Load transfer from matrix to fiber.

TEXTS BOOKS:

1. Composite Materials – Science & Engineering, K.K. Chawla, Springer-Verlag, New York, 1987.
2. An Introduction to Composite Materials, Hull, Cambridge, 2nd Edt. 1997.

REFERENCE BOOKS:

1. Composites, Engineered Materials Handbook, Vol. 1, ASM International, Ohio, 1988.
2. Structure and Properties of Composites, Materials Science and Technology, Vol. 13, VCH, Weinheim, Germany, 1993.
3. Composite Materials: Engineering and Science, F.L. Matthews and R.D. Rawlings, Chapman & Hall, London, 1994.

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B.Tech. in Mechanical Engineering
VII Semester Syllabus

ME717PE: COMPUTATIONAL FLUID DYNAMICS
(Professional Elective – III)

Pre-requisite: Heat Transfer and Fluid Mechanics

Course Objective:

To apply the principles of Heat Transfer and Fluid Mechanics to formulate governing equations for physical problems and to solve those using different numerical techniques

Course Outcomes:

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

- Differentiate between different types of Partial Differential Equations and to know and understand appropriate numerical techniques.
- Solve the simple heat transfer and fluid flow problems using different numerical techniques, viz., FDM.
- Understand and to appreciate the need for validation of numerical solution.

UNIT - I:

Basic Aspects of the Governing Equations – Physical Boundary Conditions – Methods of solutions of Physical Problems – Need for Computational Fluid Dynamics – Different numerical/CFD techniques – FDM, FEM, FVM etc., - Main working principle - CFD as a research and design tool – Applications in various branches of Engineering

Mathematical behavior of Partial Differential Equations (Governing Equations): Classification of linear/ quasi linear PDE – Examples - Physical Processes: Wave Equations and Equations of Heat Transfer and Fluid Flow – Mathematical Behavior - General characteristics – Its significance in understanding the physical and numerical aspects of the PDE – One way and Two Way variables – Well posed problems – Initial and Boundary Conditions

Solution of Simultaneous Algebraic Equations: Direct Method – Gauss Elimination – LU Decomposition - Pivoting – Treatment of Banded Matrices – Thomas Algorithm Iterative Method: Gauss Seidel and Jordan Methods - Stability Criterion

UNIT - II:

Finite Difference Method: Basic aspects of Discretization – Finite Difference formulae for first order and second order terms – Solution of physical problems with Elliptic type of Governing Equations for different boundary conditions - Numerical treatment of 1D and 2D problems in heat conduction, beams etc., - Solutions –Treatment of Curvelinear coordinates – Singularities – Finite Difference Discretization Solution of 1D heat conduction problems in Heat conduction in curve linear coordinates

UNIT - III:

FDM: Solution of physical problems with Parabolic type of Governing Equations – Initial Condition – Explicit, implicit and semi implicit methods – Types of errors – Stability and Consistency – Von Neumann Stability criterion– Solution of simple physical problems in 1D and 2D – Transient Heat conduction problems- ADI scheme - Simple Hyperbolic type PDE - First order and Second order wave equations – Discretization using Explicit method - Stability criterion – Courant Number – CFL Condition - Its significance - Treatment of simple problems

UNIT - IV:

Finite Difference Solution of Unsteady Inviscid Flows: Lax – Wendroff Technique – Disadvantages – Maccormack's Technique Fluid Flow Equations – Finite Difference Solutions of 2D Viscous Incompressible flow problems – Vorticity and Stream Function Formulation – Finite Difference treatment of Lid Driven Cavity Problem -Application to Cylindrical Coordinates with example of flow over infinitely long cylinder and sphere – Obtaining Elliptic Equations

UNIT - V:

Finite Difference Applications in Fluid flow problems: Fundamentals of fluid Flow modeling using Burger's Equation – Discretization using FTCS method with respect to Upwind Scheme and Transport Property – Upwind Scheme and Artificial Viscosity Solutions of Navier Stokes Equations for Incompressible Fluid Flows: Staggered Grid – Marker and Cell(MAC) Formulation – Numerical Stability Considerations – Pressure correction method - SIMPLE Algorithm

TEXT BOOKS:

1. Computational Fluid Dynamics: The basics with applications/ John D Anderson/McGraw Hill Publications
2. Numerical Heat Transfer and Fluid Flow/ S.V. Patankar/ Mc Graw Hill

REFERENCE BOOKS:

1. Computational Fluid Flow and Heat Transfer / K Muralidharan and T Sudarajan/ Narosa Publishers.
2. Computational Methods for Fluid Dynamics / Firziger & Peric/ Springer

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B.Tech. in Mechanical Engineering
VII Semester Syllabus
ME718PE: Production Planning and Control
(Professional Elective-III)

Course Objectives:

- To understand the problems and opportunities faced by the operations manager in manufacturing and service organizations.
- To develop an ability to apply PPC concepts in various areas like marketing, accounting, finance, engineering, personnel management, logistics, etc.
- To integrate operations concepts with other functional areas of business
- To understand the PPC function in both manufacturing and service organizations.
- To examine several classic Operations Management planning topics including production planning and inventory control.

Course Outcomes:

Upon completion of this course the student will be able to:

- Students can recognize the objectives, functions, applications of PPC and forecasting techniques.
- Students can summarize different Inventory control techniques.
- Students can solve routing and scheduling problems
- Students can summarize various aggregate production planning techniques.
- Students can describe way of integrating different departments to execute PPC functions.

UNIT– I

Introduction: Definition, Objectives of Production Planning and Control Functions of production planning and control - Types of production systems - Organization of production planning and control department.
Forecasting, Definition- uses of forecast- factors affecting the forecast- types of forecasting- their uses general principle of forecasting. Forecasting techniques- quantitative and 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 I, MRP II,ERP, JIT Systems - Basic Treatment only.

UNIT– III

Line Balancing: Terminology, Methods of Line Balancing, RPW method, Largest Candidate method and Heuristicmethod. Routing, Definition, Routing procedure, Factors affecting routing procedure, Route Sheet.

UNIT– IV

Scheduling Definition, Scheduling Policies, types of scheduling methods, differences with loading flow shop scheduling**,** job shop scheduling.
Aggregate planning, Definition, aggregate-planning strategies, aggregate planning methods transportation model.

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. Operations management – Heizer- Pearson.
2. Production and Operations Management / Ajay K Garg / Mc Graw Hill.

REFERENCE BOOKS:

1. Production Planning and Control - Text & cases/ SK Mukhopadhyaya /PHI.
2. Production Planning and Control - Jain & Jain – Khanna publications
3. Production and operations Management/ R. Panner Selvam/PHI
4. Operations Management /Chase/ PHI
5. Production and Operations Management (Theory and Practice)/ Diparkar Kumar Bhattacharyya/ University Press.
6. Operations Management/S.N. Chary/TMH.

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B.Tech. in Mechanical Engineering

VII Semester Syllabus
ME719PE: CNC Technology
(Professional Elective – IV)

Course Objectives:

- To make the students familiar with CNC Machine
- To Make students to be able to write computer aided part programming
- To Study the different tooling for CNC.
- To study the various types of post processors
- To use computers in the area of manufacturing to reduce manual processing and linking computers to all manufacturing machines and increase the productivity with DNC

Course Outcomes:

After completing this course, the students should be able to

- Familiarize the components of computer aided manufacturing CNC machines and its constructional features
- Know Part Programming Techniques
- Tools and its Automation process used in CNC
- Postprocessor significance and its functions
- DNC and Adaptive Control System

UNIT– I

INTRODUCTION TO CNC

Fundamentals of Numerical control machines, Advantages of NC machines, Classification of NC Machines, Features of NC Machines, Design considerations of NC Machines, Methods of Improving accuracy and Quality, Calculations of BLU, frequency, linear velocity For Various machines

UNIT– II

CNC HARDWARE

Machine structures of NC Machine Guide ways, feed drives spindle, Spindle bearings In NC Machines Measuring system, Tool monitoring systems

UNIT– III

CNC TOOLING

Tooling for CNC machines, Interchangeable tooling Systems, Preset and qualified tools, Coolant fed tooling system, Modular fixturing, quick change tooling system, Automatic head changers

UNIT– IV

PART PROGRAMMING

NC Part Programming, Manual Part Programming, Basic Concepts, Point to point and contour programming, Canned cycles, Parametric Programming, Computer aided Part Programming, General information on CNC. APT Programming, NC part programming, The Design and implementation of post processor, CAM Software, Automatic tool path generations

UNIT– V

DNC SYSTEMS AND ADAPTIVE CONTROL (9 hours)

Introduction, types of DNC, Advantages and disadvantages of DNC, Adaptive control Systems with Optimization and Adaptive control system with Constraints, Adaptive control of machining processes like turning, grinding.

Text Books:

1. Computer Cotrolof Manufacturing Systems /Yoram Koren/Mc Graw Hill Int.1983
2. CAD/CAM Principles and Applications – by P.N.Rao/Tata Mc Graw Hill Int.2002

Reference Books:

1. CAD/CAM –Michel Groove, TMH Publications
2. Machining ToolsHand book vol3, (Automation & control)/ Manfred Weck /John Wiley and Sons,1984.

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B.Tech. in Mechanical Engineering
VII Semester Syllabus
ME720PE: SOLAR ENERGY TECHNOLOGY
(Professional Elective – IV)

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
4. Power plant Technology/ El Wakil/TMH.

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B.Tech. in Mechanical Engineering
VII Semester Syllabus
ME721PE: Non-Conventional Energy Sources
(Professional Elective -IV)

Course Objectives:

The Objective of this course is 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.

REFERENCE BOOKS:

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.

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B.Tech. in Mechanical Engineering
VII Semester Syllabus
ME722PE: Total Quality Management
(Professional Elective -IV)

Course Objectives:

- Develop an understanding of the necessary information and skills needed to manage, control and improve quality practices in the organizations through TQM philosophy.
- To understands customer and supplier relationship and Bench marketing.
- Apply TQM in traditional organizations.
- Analysis of quality in cost and management.
- To understand various ISO around the world.

Course Outcomes:

After completion of the course the student will be able to

- Understand the concept of TQM and various control charts
- To analyze the relationship between customer and supplier
- Implement TQM in an organization
- To evaluate the cost of quality
- Understand the third-party audit and documentation of various ISO audits

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 Marketing: Evolution of Bench Marketing, meaning of Bench marketing, benefits of bench marketing, the bench marketing process, 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 organizing, Quality Circles. Productivity,

Quality and Reengineering: The leverage of Productivity and Quality, Management systems Vs. Technology, Measuring Productivity, Improving Productivity Re-engineering.

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/ASQCQ-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: Text, cases and Readings, Third Edition - Joel E. Ross.
2. Beyond TQM - Robert L. Flood.

REFERENCE BOOKS:

1. Statistical Quality Control – Eugene Grant, Richard McGraw-Hill, 2017.
2. Total Quality Management, Besterfiled D. H., Pearson Education Asia – 2015-4th Edition
3. The Management and Control of Quality, Evans J. R, and Lindsay W. M., Southwestern (Thomson Learning), Fifth Edition

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B.Tech. in Mechanical Engineering
VII Semester Syllabus
ME751PC: CAD/CAM Lab

Course Objectives:

- Understand and handle design problems in a systematic manner.
- Able to apply CAD in real life applications for 3D Modeling and assembly interface.
- Understand and analyze the basic principles of different types of analysis.
- Understand the various aspects in of manufacturing using CAM Software
- Learn the Manufacturing of 3 dimensional component using CNC.

Course Outcomes:

After completion of the Course the student be able to

- Create 2D, 3D CAD Models using different CADD Modeling Packages.
- Utilize CAD Modeling packages for Conversion of 3D object into 2-D drawings.
- Analyze and perform the displacements and stresses in 1D, 2D, 3D mechanical components.
- Generate NC Program with various aspects in manufacturing using CAM Software
- Manufacture of 3D component using CNC MILLING and TURNING Machines.

List of Experiments

1. 2D Drafting of orthographic Drawings for various Parts Using AutoCAD
2. 3D Part Modeling of various components through parent features like Extrude, Revolve, and Sweep using any 3D CAD Software.
3. 3D Part Modeling of various components through advanced features like Loft, Rib, Hole wizard using any 3D CAD Software.
4. Creation of Assembly Model from the part models of Knuckle Joint, Universal Coupling, IC Engine using any 3D CAD Software
5. Conversion of Part model and assembly model into Drawing Files with sectional views, detailing, Dimensions and Tolerances and other annotations using any 3D CAD Software
6. Determination of deflection, stresses of 2D and 3D trusses and beams with various types of loads using Ansys Software.
7. Determination of deflections, principal and Von-mises stresses in plane stress, plane strain and Axi-symmetric components using Ansys Software.
8. Estimation of natural frequencies and mode shapes, Harmonic response of 2D beam using Ansys Software.
9. Steady state heat transfer analysis of plane and axi-symmetric components Ansys Software.
10. Generation of NC code using any CAM software
11. Programming and simulation for Milling using CNC MILL
12. Programming and simulation for Turning operation using CNC LATHE

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B.Tech. in Mechanical Engineering
VIII Semester Syllabus
ME811PE Automation in Manufacturing (Professional Elective – V)

Course Objectives:

The objective of the course is to make the students
- Know the basic principles of automation, types, understanding the pneumatic and hydraulic component circuits in automation, machine tool control transfer the automation
- Understand the construction and working of work part transfer mechanisms, transfer methods, analysis of buffer storage with and without buffer storage and partial automation in automated flow lines.
- Learn the principles of line balancing methods, design of material handling systems, Automated guided vehicle systems.
- Understand the automated storage and retrieval systems, work in process, advantages and applications of adaptive control systems.
- Learn the basic concepts of Enterprise resource planning, rapid prototyping technology.

Course Outcomes:

At the end of the course the students will be able to
- Familiarize with the basic Illustrate the basic concepts of automation, strategies of automation, principles of importance of hydraulic and pneumatic controls circuits.
- Design and fabrication consideration of transfer machines, General
- Analyze various automated flow lines, to implementation of automated flow lines in processing lines.
- Possess for apply line balancing methods in assembly flow line, flexible assembly line, Describe the importance of automated material handling system and applications of automated guided vehicle system in assembly and manufacturing lines.
- Demonstrate automated storage and retrieval systems, interfacing handling and storage with manufacturing, Interpret the importance of adaptive control systems and applications of adaptive control systems in manufacturing line.
- Obtain knowledge of Business process re-engineering, software configuration of BPE, Concurrent engineering.

UNIT – I

Introduction: Types of automation, strategies of automation, Advantages and disadvantages of automation, pneumatic and hydraulic components circuits, mechanical feeders – spiral elevator, balanced feeders, reasons for automating, Arguments against automation, arguments in favour of automation, applications of automation

UNIT – II

Automated flow lines: Introduction, configuration of an automated flow line, Methods of work part transport, transfer mechanisms, buffer storage, control functions, design and fabrication consideration.
Analysis of Automated flow lines: General terminology and analysis, analysis of transfer lines without and with buffer storage, partial automation.

UNIT – III

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

UNIT – IV

Automated material handling: Material handling function, Types of material handling equipment, functions, Conveyor systems, types of conveyors, analysis of vehicle based system and analysis of conveyor systems, automatedguided vehicle systems (AGVS), AGVS types and its applications.

Automated storage systems: Storage system performance, Automated storage/ retrieval systems; basic components of an AS/RS, special features, applications, analysis of automated storage systems, work in process storage.

UNIT – V

Fundamentals of Industrial controls: Logic controls, Sensors and actuators, DATA communication and LAN in manufacturing.

Business process Re-engineering: Introduction to BPE logistics, ERP, software configuration of BPE Concurrent Engineering.

TEXT BOOK:

1. Automation, Production Systems and Computer Integrated Manufacturing: M.P. Groover
2. 3e./PE/PHI, 2009.
3. Computer control of manufacturing systems- Yoramcoreom
4. Automation by W. Buekinsham.

REFERENCE BOOKS:

1. Computer Aided Manufacturing, Tien-Chien Chang, Richard A. Wysk and Hsu-Pin Wang,
2. Pearson, 2009.
3. CAD/CAM/CIM by Radhakrishnan
4. 3.Advanced Manufacturing Technology , K. Varaprasad Rao

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B.Tech. in Mechanical Engineering
VIII Semester Syllabus
ME812PE: Additive Manufacturing Technology (Professional Elective – V)

Course Objectives:

The objective of the course is to make the students
- Understand the fundamental concepts of Additive Manufacturing (i.e. Rapid Prototyping)/ 3-D printing, its advantages, and limitations.
- Classify various types of Additive Manufacturing Processes and know their working principle,advantages, limitations etc.
- Study methods of additive manufacturing with introduction to common machines used for thetechnology.
- Learn the file formats and softwares used for additive manufacturing.
- To have a holistic view of various applications of these technologies in relevant fields such as mechanical, bio-medical, aerospace etc.

Course Outcomes:

At the end of the course the students will be able to
- Describe various CAD issues for 3D printing/additive manufacturing and related operations.
- Formulate and solve typical problems on reverse engineering for surface reconstruction from physical prototype models through digitizing and spline-based surface fitting.
- Formulate and solve typical problems on reverse engineering for surface reconstruction from digitized mesh models through topological modelling and subdivision surface fitting.
- Explain and summarize the principles and key characteristics of additive manufacturing technologies and commonly used 3D printing and additive manufacturing systems.
- Explain and summarize typical rapid tooling processes for quick batch production of plastic and metal parts.

UNIT – I

Introduction: Historical development, Fundamentals of Additive Manufacturing/Rapid Prototyping, Advantages and Limitations; Commonly used Terms; Classification of Additive Manufacturing process, Additive Manufacturing Process Chain: Fundamental Automated Processes.

UNIT – II

Additive Manufacturing Systems: Process, working principle, Applications, Advantages, Disadvantages, Case studies, Models and Specifications of: **Liquid-based Additive Manufacturing Systems -** (a) Stereo lithography Apparatus (SLA) and (b) Solid ground curing (SGC); **Solid-based Additive Manufacturing Systems -** (a) Laminated Object Manufacturing (LOM) and (b) Fused Deposition Modeling (FDM).

UNIT – III

Additive Manufacturing Systems: Process, working principle, Applications, Advantages, Disadvantages, Case studies, Models and Specifications of **Powder Based Additive Manufacturing Systems -** (a) Selective laser sintering (SLS) and (b)Three dimensional Printing (3DP):

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, Investment Casting, 3D Keltool process. **Direct Rapid Tooling Methods:** Direct AIM, LOM Tools, DTM Rapid Tool Process and Direct Metal Tooling using 3DP

UNIT – IV

Additive Manufacturing 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.

Additive Manufacturing Softwares: Features of various softwares like Magics, Mimics, Solid View, View Expert, 3D View, Velocity 2, Rhino, Data Expert and 3D doctor.

UNIT – V

Additive Manufacturing Applications : Applications in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture. Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices.

TEXT BOOKS:

1. 3D Printing and Additive Manufacturing: Principles and Applications (Fifth Edition of Rapid Prototyping) Chee Kai Chua and Kah Fai Leong - World Scientific Publications
2. Additive Manufacturing Technologies - Gibson, I., Rosen, D., Stucker, B., & Khorasan, M. - Springer.

REFERENCE BOOKS:

1. Rapid Manufacturing - D.T. Pham and S.S. Dimov - Springer
2. Terry Wohlers, Wholers Report 2000, Wohlers Associates
3. Rapid Prototyping and Manufacturing - PaulF.Jacobs - ASME

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B.Tech. in Mechanical Engineering
VIII Semester Syllabus
ME813PE: Turbo Machinery (Professional Elective – V)

Course Objectives:

The objectives of the course is to make the students
- Provide the knowledge of basic principles, governing equations and applications of Turbo machines
- Provide opportunities to apply basic flow equations
- acquire the knowledge and skill of analyzing different turbo machines.
- How to compare and chose machines for various operations
- Explain working and evaluate the performance characteristics of Turbo Machines

Course Outcomes:

At the end of the course the students 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
- Predict performance of Turbo machines using model analysis

UNIT-I

Fundamentals of Turbo Machines: Classifications, Applications, Thermodynamic analysis, Isentropic flow. Energy transfer. Efficiencies, Static and Stagnation conditions, Continuity equations, Euler's flow through variable cross- sectional areas, Unsteady flow in turbomachines

UNIT-II

Steam Nozzles: Convergent and Convergent-Divergent nozzles, Energy Balance, Effect of back pressure of analysis. Designs of nozzles.

Steam Turbines: Impulse turbines, Compounding, Work done and Velocity triangle,Efficiencies, Constant reactions, Blading, Design of blade passages, Angle and height, Secondary flow. Leakage losses, Thermodynamic analysis of steam turbines.

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 shockrecoveries, detached shocks, Aerofoil theory.

Centrifugal compressor: Types, Velocity triangles and efficiencies, Blade passage design, Diffuser and pressure recovery. Slip factor, Stanitz and Stodol as 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.

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B.Tech. in Mechanical Engineering
VIII Semester Syllabus
ME814PE: Energy Conservation and Management (Professional Elective – V)

Course Objectives:

The objective of the course is to make the students

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

- Understand 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 using 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 ofrefractors – 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 – discreteand 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 energyaudit – 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 - budgetcommittee – 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.

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B.Tech. in Mechanical Engineering
VIII Semester Syllabus
ME815PE: Digital Manufacturing & Industry 4.0 (Professional Elective – VI)

Course Objectives:

The objectives of the course is to make the students

- Introduce basics of Industry 4.0 and its application in the business world
- Understand the smart cities, smart factories concept
- Understand various systems used in Industry 4.0
- Learn integration of Robotics, IoT and smart sensors in manufacturing
- Know the benefits of any organization and individuals to reap benefits while relying on Industry 4.0

Course Outcomes:

At the end of the course the students will be able to

- Understand the drivers and enablers of 4.0
- Apply the technology to build future smart devices and services
- Outline the advantages of manufacturing unit in Industry 4.0
- Realize the power of cloud computing in a networked economy
- Understand the opportunities and challenges brought by Industry 4.0

UNIT- I

Introduction: core idea of Industry 4.0, origin concept of Industry 4.0, Industry 4.0 production system, current state of Industry 4.0, Technologies, how is India preparing for Industry 4.0

UNIT- II

A conceptual framework for Industry 4.0: Introduction, Main concepts and components of Industry 4.0, state of Art, supportive Technologies, Proposed Framework for Industry 4.0

UNIT- III

Technology Roadmap for Industry 4.0: Introduction, proposed framework for Technology road map, strategy Phase, New product and process development phase

UNIT- IV

Advances in Robotics in the Era of Industry 4.0: Introduction- recent technological components of the Robots – Advanced sensor technologies, Internet of Robotic things, Cloud Robotics, and cognitive Architecture for cyber – physical robotics, Industrial robotic applications – Manufacturing, Maintenance and Assembly

UNIT- V

The role of Augmented Reality in the age of Industry 4.0: Introduction, AR hardware and software Technology, Industrial Applications of AR

Obstacles and Framework conditions for Industry 4.0: Digital strategy alongside Resource scarcity, standards and data security, financing conditions, availability of skilled workers, comprehensive broad-band infrastructure, state support, legal framework, protection of corporate data, liability, handling personal data

REFERENCE BOOKS

1. ―Industry 4.0: Managing The Digital Transformation‖ by Alp Ustundag
2. ―The Concept Industry 4.0‖ by Christoph Jan Bartodzie
3. ―The fourth Industrial revolution‖ by Klaus Scab
4. ―The Challenges of Industry 4.0 for Small and Medium-sized Enterprises‖ by Christian Schrödertion to Industry 4.0

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B.Tech. in Mechanical Engineering
VIII Semester Syllabus
ME816PE: Electric and Hybrid Vehicles (Professional Elective – VI)

Course Objectives:

The objective of the course is to make the students

- 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.
- Analyze 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:

At the end of the course student will be able to

- 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:

Introduction To Hybrid and Electric Vehicles: 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, Configurationand 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 Explained‖, John Wiley & Sons Ltd.2003.
2. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, ―Modern Electric, Hybrid Electric, and Fuel CellVehicles: Fundamentals, Theory, and Design‖, CRC Press, 2004.

REFERENCE BOOKS

1. S. Onori, L. Serrao and G. Rizzoni, ―Hybrid Electric Vehicles: Energy Management Strategies‖,Springer, 2016.
2. Iqbal Hussein, ―Electric and Hybrid Vehicles: Design Fundamentals‖, CRC Press, 2010.

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B.Tech. in Mechanical Engineering
VIII Semester Syllabus
ME817PE: Fluid Power Systems (Professional Elective – VI)

Course Objectives:

The Objective of this course is to make students
- Impart the Knowledge on Hydraulic and Pneumatic systems
- Study the various components of fluid power systems.
- Study the various Control valves used in fluid power systems.
- Understand the governing laws and design of hydraulic and pneumatic circuits
- Study the trouble shooting of fluid power systems.

Course Outcomes:

At the end of the course, the student will be able to,
- Demonstrate the concepts of Hydraulic and Pneumatic systems
- Understand the working of various components of hydraulic and pneumatic systems.
- Understand the hydraulic systems and Pneumatic systems,
- Understand the working of control valves and their importance
- Understand the use of hydraulic and pneumatic systems, design of hydraulic and pneumatic circuits for industrial applications

UNIT-I

Introduction: 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. Pumpand motor analysis. Performance curves and parameters.

UNIT-II

Elements of Hydraulic systems: 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 andDesign.

UNIT-III

Control Valves: 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, Synchronization circuits, and accumulator sizing.

UNIT-IV

Pneumatic systems: Intensifier circuits Meter-in, Meter-out and Bleed-off circuits; Fail Safe and Counterbalancing circuits, accessories used in fluid power system, Filtration systems and maintenance of system. Components of pneumaticsystems; 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

Circuit diagrams: 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, Electro-pneumatic control and air-hydraulic control, Ladder diagrams. Applications in Assembly, Feeding, Metalworking, materialshandling 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: McGrawHill.
5. Lewis,E.E., and H.Stern, Design of Hydraulic Control Systems, New York: McGrawHill.
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: McGrawHill.
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.

REFERENCE BOOKS:

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 theprinciples‖, Vogel-Verlag.
5. Blaine W. Andersen, ―The analysis and Design of Pneumatic Systems‖, John Wiley

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B.Tech. in Mechanical Engineering

VIII Semester Syllabus

ME818PE: Industrial Management (Professional Elective – VI)

Course Objectives:

The Objective of this course is to make students

- Understand the philosophies of management gurus
- Understand the various types of organization structures
- Understand organizations' features, and theiradvantages and disadvantages.
- Learn various Industrial Engineering Practices like Operations Management techniques,work study.
- Learn statistical quality control techniques, Job evaluation techniques and network analysis techniques.

Course Outcomes:

At the end of the course, the student would be able to

- Apply principles of management
- Design the organization structure
- Apply techniques for plant location, design plant layout and value analysis
- Carry out work study to find the best method for doing the work and establish standard timefor a given method
- Apply various quality control techniques and sampling plans and do job evaluation and network analysis.

UNIT – I:

Introduction to Management: Entrepreneurship and organization – Nature and Importance of Management, Functions of Management, Taylor's Scientific Management Theory, Fayol's Principles of Management, Maslow's Theory of Human Needs, Douglas McGregor's Theory X and Theory Y, Herzberg's Two-Factor Theory of Motivation, Systems Approach to Management, Leadership Styles, Social responsibilities of Management

UNIT – II:

Designing Organizational Structures: Departmentalization and Decentralization, Types of Organization structures – Line organization, Line and staff organization, functional organization, Committee organization, matrix organization, Virtual Organization, Cellular Organization, team structure, boundary less organization, inverted pyramid structure, lean and flat organization structure and their merits, demerits and suitability.

UNIT – III:

Operations Management: Objectives- product design process- Process selection-Types of production system (Job, batch and Mass Production), Plant location-factors- Urban-Rural sites comparison- Types of Plant Layouts- Design of product layout- Line balancing (RPW method) Value analysis-Definition- types of values-Objectives- Phases of value analysis- Fast diagram

UNIT - IV:

Work Study: Introduction — definition — objectives — steps in work study — Method study — definition, objectives — steps of method study. Work Measurement — purpose — types of study — stop watch methods — steps — key rating — allowances — standard time calculations — work sampling.

Statistical Quality Control: variables-attributes, Shewart control charts for variables- chart, R chart, – Attributes- Defective-Defect- Charts for attributes-p-chart -c chart (simple Problems), Acceptance Sampling-Single sampling- Double sampling plans-OC curves.

UNIT – V:

Job Evaluation: Methods of job evaluation — simple routing objective systems — classification method factor comparison method, point method, benefits of job evaluation and limitations. **Project Management (PERT/CPM):** Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), Identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing. (simple problems)

TEXT BOOKS:

1. Industrial Engineering and Management/O.P. Khanna/Khanna Publishers.
2. Industrial Engineering and Management Science/T.R. Banga and S.C. Sarma/KhannaPublishers.

REFERENCE BOOKS:

1. Motion and Time Study by Ralph M Barnes! John Willey & Sons Work Study by lLO.
2. Human factors in Engineering & Design/Ernest J McCormick /TMH.
3. Production & Operation Management /Paneer Selvam/PHI.
4. Industrial Engineering Management/NVS Raju/Cengage Learning.
5. Industrial Engineering Hand Book/Maynard.
6. Industrial Engineering Management I Ravi Shankar/Galgotia.

B.Tech. in Mechanical Engineering

VI Semester Syllabus

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ME621OE: BASIC MECHANICAL ENGINEERING (OPEN ELECTIVE – I)

Course objectives:

To provide the essential basic knowledge of Mechanical Engineering to the students

Course Outcomes:

At the end of the course, student will be able to

- Understand different types of power generation, working of refrigerator
- Summarize different types of manufacturing processes and Power transmission systems
- Discuss about conventional and non-conventional sources of energy
- Identify automation of various manufacturing processes in engineering practice.
- Describe the basic concepts and applications of industrial robotics

UNIT- I:

Energy: Power Generation: External and internal combustion engines-Thermal Power Plants-Working Principle, layouts, element/component description, advantages, disadvantages, applications. 2-Stroke, 4-Stroke Engines and their Components.

Refrigeration: Mechanical Refrigeration and types – units of refrigeration – Air Refrigeration system, Vapour Compression Refrigeration System- Principle of operation.

UNIT- II:

Machine and Mechanisms-Degrees of Freedom, functions of Flywheel and Governors, Types of joints-Riveted, welded and bolted joints. Applications, Merits and Demerits. Power Transmission Elements: Gears terminology of spur, helical and bevel gears, gear trains. Beltdrives (types). Chain drives.

UNIT- III:

Manufacturing Processes: Primary and secondary process. Casting: Types, equipment, applications. Metal forming processes-rolling, extrusion

Welding: Types – Equipment –Techniques employed – advantages / disadvantages – Gas cutting – Brazing and soldering.

UNIT- IV:

Machine Tools: Introduction to lathe, drilling machine, milling machine, grinding machine- Operations performed. CNC Machines- Basic elements, advantages. Limits, fits and tolerances, Surface finish of various manufacturing process.

UNIT- V:

Non-conventional sources of energy-Solar, wind, tidal, biogas and nuclear- Principles.Robotics – Joints, end effectors, applications. Introduction to 3D Printing.

TEXT BOOKS:

1. Sadhu Singh, Basic Mechanical Engineering, S. Chand & Co. Ltd, New Delhi, 2013
2. Pravin Kumar, Basic mechanical Engineering, 2018, Pearson

REFERENCE BOOKS:

1. Hajra Choudhary, S.K. and Hajra Choudhary, A. K., Elements of Workshop Technology Vols.I& II, Indian Book Distributing Company Calcutta, 2007.
2. Nag, P.K., Power Plant Engineering, Tata McGraw-Hill, New Delhi, 2008.
3. Rattan, S.S., Theory of Machines, Tata McGraw-Hill, New Delhi, 2010.

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B.Tech. in Mechanical Engineering

VI Semester Syllabus

ME622OE: Renewable Energy Sources (Open Elective – I)

Course Objectives:

The objectives of the course are to:

- Explain the potential and benefits of renewable energy sources over conventional energy sources.
- Develop capacity to choose the best method of harnessing and storage of solar energy and develop solar energy harvesting systems.
- Develop capability to choose best wind energy harvesting system and select a proper site for plant installation.
- Explain the various systems available to harness biomass energy and biogas production technologies.
- Outline the various ways of harnessing renewable energy sources such as ocean thermal energy, tidal and wave energy, geothermal energy, and small hydro projects.

Course Outcomes:

After completion of course, the student will be able to:

- Understand the Sustainability Development Goals pertaining to Renewable Energy; summarize the benefits of renewable energy over fossil fuels.
- Understand the principles of solar energy radiation and design & analyze solar energy conversion devices and storage.
- Understand and analyze the design of wind energy conversion systems and demand side management concepts.
- Apply the knowledge of biomass energy conversion devices and analyze various biochemical conversion processes.
- Understand and analyze the design of tidal, wave, geothermal and ocean thermal energy conversion technologies.

UNIT- I

Global and National Energy Scenario: Overview of renewable and non-renewable energy sources, need & development of renewable energy sources, types of renewable energy systems, Global and Indian Energy scenario, greenhouse effect and global climate change, Potential of renewable energy sources, CO_2 reduction potential, demand side management, energy wheeling, and energy banking concepts, hybrid energy, and Cogeneration.

UNIT- II

Solar Energy: Solar energy system, Source of solar energy, Solar Radiation types and its variation, solar constant, solar angles, availability, measurement and Estimation, solar energy potential in India, Solar energy collectors : classification and applications, Solar Thermal energy systems design and constructional features, solar energy Storage: solar pond, Solar Photovoltaic Conversion, solar photovoltaic systems, and its components: off grid and on grid power plants, solar thermal systems-types and design principles, Indian solar projects, application of solar energy systems.

UNIT- III

Wind Energy: Source of wind energy, Wind Energy Conversion principle, Nature of the wind, factors influencing wind, wind speed monitoring, classification of wind, characteristics, wind energy data, energy estimation, wind energy potential in India, site selection, power in the wind, Betz limit, wind turbines, classification, components of wind turbines, functions, optimal wind speed for operation, wind energy farms, offshore wind energy systems and Hybrid systems, Safety and environmental aspects of wind energy systems.

UNIT- IV

Biomass Energy: Biomass resources and their classification, conventional and non-conventional applications of biomass, anaerobic digestion, biogas properties (Calorific value and composition), production process and factors effecting yield, biogas plant technology: fixed dome and floating gas holder, Bio energy systems, design, and constructional features. Applications of biogas for cooking, lighting, power generation. Biomass conversion processes, Thermochemical conversion, direct combustion, biomass gasification, pyrolysis and liquefaction, biochemical conversion, Urban waste to energy conversion, production of alcohol, biodiesel, and biochar, potential in India.

UNIT- V

Ocean Thermal Energy: Principle of Ocean Thermal Energy Conversion (OTEC), ocean thermal power plant types: open and closed, site selection and efficiency of OTEC plants.
Tidal and Wave Energy: Tidal and wave energy sources, principle of harnessing energy, tidal and wave energy power plant types, site selection, potential in India.
Small Hydro Power Plant: Importance of small hydro power plants and their Elements, classification, site selection, turbines for small hydro, estimation of primary and secondary power. **Geothermal Energy:** Geothermal Energy Sources, classification, Geothermal power plant types, cogeneration, potential in India and available sites.

TEXT BOOKS:

1. G.D Rai, Non-Conventional Energy Sources, Khanna Publishers, ISBN: 9788174090738
2. Twidell, J.W. and Weir, A., Renewable Energy Sources, EFN Spon Ltd., 1986. ISBN - 13: 9780415584371(978-0-415-58437-1)

REFERENCE BOOKS:

1. Bryan Leyland, Small Hydroelectric Engineering practice, CRC Press, 2014. International Standard Book No –13: 978-1-315-81653-1 (e-PDF)
2. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K, 1996.
3. Kishore VVN, Renewable Energy Engineering and Technology, Teri Press, New Delhi,2012
4. Siraj Ahmed, Wind Energy Theory & Practice, PHI Learning Publishing House, ISBN : 9788120351639
5. SP Sukhatme and JK Nayak, Solar Energy- Principles of Thermal Collection and Storage by, Tata McGraw-Hill, 1996.

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B.Tech. in Mechanical Engineering

VI Semester Syllabus

ME721OE: Quantitative Analysis for Business Decisions

(OPEN ELECTIVE – II)

Course Objectives:

- To impart knowledge of basic tools of Operations research in solving the management problemsusing mathematical approaches for decision making.
- To teach the methods of solving Linear Programming Problems.
- To impart knowledge on assignment model and transportation problem.
- To impart knowledge on the significance of decision tree and Network analysis.
- To highlight the importance of Queuing Theory.

Course Outcomes:

Students will be able to:

- Understand the origin and application of operations research.
- Learn about the Formulation of Linear Programming Problem for different areas.
- Appreciate the significance of variations of assignment problem, methods for finding Initialfeasible solution.
- Learn the aspects of Decision Theory and Network Analysis
- Gain insights of the theoretical principles and practical applications of different queuing models.

Unit – I:

Introduction to Operations Research: Nature and Scope of Operations Research: Origins of OR, Applications of OR in different Managerial Areas, Problem Solving and Decision-making, Quantitative and Qualitative Analysis. Defining a Model, Types of Models, Process for Developing an Operations Research Model, Practices, Opportunities and Shortcomings of using an OR Model.

Unit – II:

Linear Programming Method: Structure of LPP, Assumptions of LPP, Application Areas of LPP, Guidelines for Formulation of LPP, Formulation of LPP for Different Areas**,** Solving of LPP by Graphical Method: Extreme Point Method, Simplex Method, Converting Primal LPP to Dual LPP, Limitations of LPP.

Unit – III: Assignment Model: Algorithm for Solving Assignment Model, Hungarians Method for Solving Assignment Problem, Variations of Assignment Problem: Multiple Optimal Solutions, Maximization Case in Assignment Problem, Unbalanced Assignment Problem, Travelling Salesman Problem, Simplex Method for Solving Assignment Problem.

Transportation Problem: Mathematical Model of Transportation Problem, Methods for Finding Initial Feasible Solution: Northwest Corner Method, Least Cost Method, Vogels Approximation Method, Test of Optimality by Modi Method, Unbalanced Supply and Demand, Degeneracy and its Resolution.

Unit – IV: Decision Theory: Introduction, Ingredients of Decision Problems. Decision-making under Uncertainty, Cost of Uncertainty Under Risk, Under Perfect Information, Decision Tree, Construction ofDecision Tree.

Network Analysis: Network Diagram, PERT, CPM, Critical Path Determination, Project Completion Time, Project Crashing.

Unit – V: Queuing Theory: Queuing Structure and Basic Component of a Queuing Model, Distributionsin Queuing Model, Different Queuing Models with FCFS, Queue Discipline, Single and Multiple ServiceStation with Finite and Infinite Population. Game Theory, Suddle Point, Value of the Game.

Suggested Readings:

1. Mik Wisniewski, Dr Farhad Shafti, Quantiative Analysis for Decision Makers, Pearson,7e,2019.
2. Miguel Ángel Canela, Inés Alegre, Alberto Ibarra ,Quantiative Methods for Management: A Practical Approach, Springer International Publishing,1e,2019.
3. James E. Sallis, Geir Gripsrud, Ulf Henning Olsson, Ragnhild Silkoset ,Research Methods and Data Analysis for Business Decisions: A Primer Using SPSS,Springer International Publising,1e,2021.
4. R. Pannerselvam, Operations Research, Prentice Hall International, 3e, 2015.
5. N.V.S.Raju,Operations Research:Theory and Practice,CRC Press,2020.
6. R. Pannerselvam, Operations Research, Prentice Hall International, 3e, 2015
7. J.K. Sharma, Operations Research: Theory Dand applications, Macmillian,5e, 2013.

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B.Tech. in Mechanical Engineering

VI Semester Syllabus

ME722OE: Industrial Engineering & Management

(OPEN ELECTIVE – II)

Course Objectives:

1. To understand the concept of management and organizational structure.
2. To gain knowledge on work-study and allowances in work management.
3. To understand workplace designs.
4. To acquire knowledge of job evaluation and various wage schemes.
5. To estimate the cost of production in various manufacturing processes.

Course Outcomes:

After completion of the course the student will be able to

1. Make managerial decisions for effective business administration.
2. Explore various methods of work study and evaluate standard time.
3. Design various types of workspaces.
4. Explain and implement various job evaluation methods. 5: Evaluate the overall cost of production for a product.

UNIT - I

Introduction to Management concept & Organizational Structures

Concept of Management and organization - functions of management - Taylor's scientific management, Fayol's principles of management, Douglas Mc-Gregor's Theory X and Theory Y, Maslow's Hierarchy of Human Needs – Mintzberg's Managerial Roles Approach – Mc.Kensey's 7'S Framework Organizational Structure – Departmentation – Line and Staff Structure – Span of Management – Matrix Structure, Boundaryless Organization, Virtual Organization.

UNIT- II

WORK STUDY: Introduction – definition – objectives – steps in work study Method study definition – objectives, steps of method study, Outline process charts and Flow process charts.
Work Measurement – purpose – types of study – stop watch methods – steps – key rating – allowances – standard time calculations – work sampling.

UNIT- III

WORK PLACE DESIGN: Anthropometry. Structural body dimensions, use of anthropometry data, work space dimensions – work space for personal when seated – minimum requirement for restricted spaces work surfaces, work surfaces when seated, standing science of seating, principles of seat design.

Nature of Man – Machine system – Fundamental man – Machine system assumptions – types of Systems – Data base if human factors – Human performance – types of human error in system tasks – task data – empirical task data – Judgmental task data.

UNIT- IV

Visual displays – Process of seeing – types of visual activity – conditions that affect visual discriminations – Quantitative visual display – Basic design of dynamic quantitative displays, Quantitative visual display – Strategy indicators – signal and warning lights. Job design – job evaluation – methods of job evaluation – simple routing objective systems – classification method – factor comparison method – point method – benefits of job evaluation and limitations.

Merit rating – job evaluation Vs merit rating – objectives of merit rating – method for merit rating – ranking method – paid company method – checklist method. Wage incentive scheme – wages – objectives of a good wage incentive plan – basis of good wage – incentive plan – plan- types of wage – incentive plans – time method – straight piece rate method – differential piece rate method – Hasley premium plan – Emerson efficiency plan – Bedeaux point plan.

UNIT- V

ESTIMATING AND COSTING, ESTIMATION: Importance – Aims – functions – Qualities of estimator, Cost – definition Aims standard cost – difference between estimating and costing – costing methods – elements of costs – mensuration. Estimating of material cost & Overheads – machine shop – sheet metal shop – forging – welding Shop-Selling Price calculations.

REFERENCE BOOKS:

1. Motion and time Study / Ralph M Barnes/ John Willey & Sons.
2. Works Study / Ilo
3. Human factors in Engineering & Design / Ernest J Mc Cormick/TMH
4. Production Operation management / Paneer Selvam/PH1
5. Industrial Engineering Management / Ravi Shankar/Galgotia
6. Mechanical Estimating Costing / T. T Banga & S.C Sharma/Khanna Publishers
7. Industrial Engineering Hand Book/ Maynard.

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B.Tech. in Mechanical Engineering

VIII Semester Syllabus

ME821OE: Entrepreneurship Development (OPEN ELECTIVE – III)

Course Objectives:

- Study of this subject provides an understanding of the scope of an entrepreneur, key areas of development, financial assistance by the institutions, methods of taxation and tax benefits, etc.

Course Outcomes:

- Upon completion of the course, students will be able to
- Identify the factors affecting entrepreneurial growth
- Understand various programs supporting entrepreneurship
- Write preliminary project report
- Estimate the finances for the project
- Appraise and avail support rendered by the Government and other Appropriate Agencies

UNIT I

Entrepreneurship Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

UNIT II

Motivation Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self Rating, Business Game, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.

UNIT III

Business Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – Identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

UNIT IV

Financing and Accounting: Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Network Analysis Techniques of PERT / CPM – Taxation – Income Tax, Excise Duty – Sales Tax.

UNIT V

Support to Entrepreneurs Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting

TEXT BOOKS:

1. S.S. Khanka, "Entrepreneurial Development" S. Chand & Co. Ltd., 2020.
2. Kuratko & Hodgetts, "Entrepreneurship – Theory, process and practice", Thomson learning 6th edition.

REFERENCE BOOKS:

1. Hisrich R D, Peters M P, Dean Shepherd, "Entrepreneurship" 12th Edition McGraw-Hill.
2. Mathew J Manimala," Entrepreneurship theory at cross roads: paradigms and praxis" Dreamtech, 2nd edition 2006.
3. Rabindra N. Kanungo, "Entrepreneurship and innovation: Models for Development", Sage Publications, 1998.
4. EDII "Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development", Institute of India.

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B.Tech. in Mechanical Engineering
VIII Semester Syllabus
ME822OE: Elements of Electric and Hybrid vehicles (Open Elective – III)

Prerequisites: Should have Knowledge of basic electrical principles.

Course Objectives:

- Explain the need of hybrid and electric vehicles along with vehicles fundamentals.
- Explain the technology behind hybrid and electric vehicles and components of hybrid vehicles.
- Explore to basic concept of electric traction, Configuration and control of DC Motor drives,Configuration, and control of Induction Motor drives etc.
- Make capable to select energy storage system for hybrid and electric vehicles.
- Introduce the concept of energy management in hybrid and electric vehicles.

Course Outcomes:

At the end of the course student will be able to

- Justify the need of hybrid and electric vehicles and understand fundamentals of vehicles and requirements.
- Understand the basic Explain the technology behind hybrid and electric vehicles and components of hybrid vehicles.
- Understand the concept of electric traction, Configuration and control of DC Motor drives, Configuration, and control of Induction Motor drives etc.
- Evaluate different energy storage systems for hybrid and electric vehicles.
- Apply the energy management strategies in the hybrid and electric vehicles.

UNIT- I:

Introduction: Conventional Vehicles: Associated problems, efficiency, pollution, non- renewable fossil fuel problems and scarcity, reserves availability national and worldwide, **Vehicle Fundamentals:** Vehicle resistance, Types: Rolling Resistance, grading resistance, Aerodynamic drag, vehicle performance, power, tractive effort, Torque Required, Transmission: Differential, clutch & gear box, Braking performance.

UNIT- II:

Introduction To Hybrid and Electric Vehicles: History of electric Vehicles, Classification of hybrid and electric vehicles, Hybrid (ICE & others), Battery Electric Vehicle, Fuel Cell EV, Solar Powered Vehicles.

Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid Drive-train topologies, Hybrid Powertrains: Series HEVs, Parallel HEVs, Series– Parallel HEVs, Complex HEVs, Operating Modes, Degree of Hybridization, Comparison of HEVs, Plug-in Hybrid Electric Vehicles (PHEVs), power flow control in hybrid drive-train topologies, efficiency.

UNIT- III:

Electric Drive Trains: Basic concept of electric traction, introduction to various electric drivetrain topologies, Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Induction Motor drives, Permanent Magnet Motor drives, switch reluctance motor drives, power flow control in electric drive-train topologies, efficiency.

UNIT- IV:

Types of Storage Systems: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Energy storage using Battery, Fuel Cell, Super Capacitor, Flywheel, Selection of energy storage technology, Hybridization of different energy storage devices.

UNIT- V:

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies Case study of electric vehicles.

TEXT BOOKS

1. James Larminie, J. Lowry, “Electric Vehicle Technology Explained”, John Wiley & Sons Ltd.2003.
2. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, “Modern Electric, Hybrid Electric, and Fuel CellVehicles: Fundamentals, Theory, and Design”, CRC Press, 2004.
3. T. Denton, Electric and hybrid vehicles. Routledge, 2020.

REFERENCE BOOKS

1. S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”,Springer, 2016.
2. Iqbal Hussein, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press, 2010.