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Mechanical Engineering Department

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Scheme

S. No.	Subject Code	Category	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours per week			Total Credits
				Theory			Practical						
				End Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem	Term work / Lab Work & Sessional		L	T	P	
1.	ME 701	DC	Heat and Mass Transfer	70	20	10	30	20	150	2	1	2	4
2.	ME702	DE	Departmental Elective	70	20	10	-	-	100	3	1	-	4
3.	ME703	OE	Open Elective	70	20	10	-	-	100	3	0	0	3
4.	ME 704	D Lab	CAD/CAM/CIM	-	--	-	30	20	50	-	-	6	3
5.	ME 705	O/E lab	MATLAB and R Programming	-	-	-	30	20	50	-	-	6	3
6.	ME706	P	Major Project-I	-	-	-	100	50	150	-	-	8	4
7.	ME 607		Evaluation of Internship -III	-	-	-	-	100	100	-	-	6	3
8.	Additional Credits[#]	*[#]Additional credits can be earned through successful completion of credit based MOOC's Courses available on SWAYAM platform (MHRD) at respective UG level.*											
Total				**210**	**60**	**30**	**190**	**210**	**700**	**8**	**2**	**28**	**24**

*MST: Minimum of two mid semester tests to be conducted. L: Lecture T: Tutorial P: Practical

S. No.	Departmental Electives	Open Electives
1	702(A) Advance Machining Processes	703(A) Operation Research and Supply Chain
2	702 (B) Internet of Things (IOT)	703(B) Artificial Intelligence Techniques
3	702 (C) Power Plant Engineering	703(C) Systems Engineering
4	702 (D) Advance Machine Design	703 (D)Reliability Engineering

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Syllabus

ME-701	**Heat & Mass Transfer**	**3L:1T: 2P (05 hrs)**	**Credits:04**

Course Content:

Unit I **(08 hrs)**

Basic Concepts: Modes of heat transfer, Fourier's law, Newton's law, Stefan Boltzman law; thermal resistance and conductance, analogy between flow of heat and electricity, combined heat transfer process; Conduction: Fourier heat conduction equation, its form in rectangular, cylindrical and spherical coordinates, thermal diffusivity, linear one dimensional steady state conduction through a slab, tubes, spherical shells and composite structures, electrical analogies, critical - insulation-thickness for pipes, effect of variable thermal conductivity.

Unit II **(08 hrs)**

Extended Surfaces (fins): Heat transfer from a straight and annular fin (plate) for a uniform cross section; error in measurement of temperature in a thermometer well, fin efficiency, fin effectiveness, applications; Unsteady heat conduction: Transient and periodic conduction, heating and cooling of bodies with known temperatures distribution, systems with infinite thermal conductivity, response of thermocouples.

Unit III **(09 hrs)**

Convection: Introduction, free and forced convection; principle of dimensional analysis, Buckingham 'pie' theorem, application of dimensional analysis of free and forced convection, empirical correlations for laminar and turbulent flow over flat plate and tubular geometry; calculation of convective heat transfer coefficient using data book.

Unit IV **(08 hrs)**

Heat Exchangers: Types- parallel flow, counter flow; evaporator and condensers, overall heat transfers coefficient, fouling factors, log-mean temperature difference (LMTD), method of heat exchanger analysis, effectiveness of heat exchanger, NTU method;

Mass transfer: Fick's law, equi-molar diffusion, diffusion coefficient, analogy with heat transfer, diffusion of vapour in a stationary medium.

Unit V **(09 hrs)**

Thermal Radiation : Nature of radiation, emissive power, absorption, transmission, reflection and emission of radiation, Planck's distribution law, radiation from real surfaces; radiation heat exchange between black and gray surfaces, shape factor, analogical electrical network, radiation shields.

Boiling and condensation: Film wise and drop wise condensation; Nusselt theory for film wise condensation on a vertical plate and it s modification for horizontal tubes; boiling heat transfer phenomenon, regimes of boiling, boiling correlations.

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Course Objectives: Students will be able to

1. Explain various modes of heat transfer and Determine thermal conductivity of different materials.
2. Analyse the phenomenon of heat transfer through extended surface and to describe unsteady state conduction.
3. Evaluate heat transfer coefficient for free and forced convection & apply the concept of dimensional analysis.
4. Study different types of heat exchanger and evaluate their performance characteristics.
5. Explain the concept of thermal radiation and examine the phenomenon of boiling and condensation.

Text Books:

1.R K Rajput, Heat & Mass Transfer
2.D. S Kumar, Heat & Mass Transfer

References Books:

1. Sukhatme SP; Heat and mass transfer; University Press Hyderabad
2. Holman JP; Heat transfer; TMH
3. Nag PK; heat and Mass Transfer; TMH
4. Domkundwar, Heat and Mass Transfer, Dhanpat Rai & Co.
5. Sachdeva R.C., Fundamentals of Engineering Heat and Mass Transfer, New Age Science
6. Dutta BK; Heat Transfer Principles And App; PHI Learning
7. Mills AF and Ganesan V; Heat transfer; Pearson
8. Cengel Yunus A; Heat and Mass transfer; TMH
9. Yadav R; Heat and Mass Transfer; Central India pub-Allahabad
10. Incropera FP and Dewitt DP; Heat and Mass transfer; Wiley

List of Experiments:

1. To determine the thermal conductivity of metal rod.
2. To determine the equivalent thermal conductivity of composite wall.
3. To determine the heat transfer coefficient in natural convection.
4. To determine the heat transfer coefficient in force convection.
5. To determine the heat transfer coefficient with the help of Stefan Boltzmann Apparatus.
6. To determine the heat transfer coefficient in Finned Tube Heat Exchanger.
7. To demonstrate the film-wise and drop-wise condensation and determination of heat transfer coefficient.
8. To calculate emissivity of the test plate by emissivity measurement apparatus.
9. To determine the heat transfer characteristics of a concentric tube heat exchanger.
10. To observe pool boiling phenomena and to determine the critical heat flux at different bulk temperature.

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ME- 702(A)	**Advance Machining Processes**	**3L:1T: 0P (04 hrs)**	**Credits:04**

Course Content:

Unit I **(10 Hrs)**

Mechanical Processes: Process selection, mechanics of cutting, metal removal rate, cutting tool system design, ultrasonic machining, abrasive jet machining, water jet machining, , effect of parameters and variables, applications and limitations, recent developments in mechanical processes.

Unit II **(08 Hrs)**

Electrochemical and Chemical Metal Removal Processes: Electrochemical machining[ECM], elements of ECM, power source and control system, electrolytes, tool work system, chemistry of the process, tool design and metal removal rate, process faults, material removal and surface finish, electrochemical grinding, electrochemical deburring, electrochemical honing, chemical machining,

Unit III **(10 Hrs)**

Thermal Metal Removal Processes: Electric discharge machining[EDM], spark erosion, mechanism of metal removal, spark erosion generator, electrode feed control, vibrating electrode system, dielectric fluid, flushing, accuracy, plasma arc machining[PAM], non thermal generation of plasma, mechanisms and parameters, equipments, electron beam machining[EBM],generation and control of electron beam, theory and process capabilities, neutral particle etching, laser beam machining, hot machining, methods of local heating, tool lie and production rate.

Unit IV **(08 Hrs)**

Rapid Prototyping: Fundamentals, technologies, applications, principles and working of 3D printing, subtractive v/s additive manufacturing process, VAT photo polymerization, material and binder jetting, continuous liquid inter phase production, direct metal laser sintering.

Unit V **(08 Hrs)**

Technologies of Micro Fabrication: Types of micro system devices, industrial applications, micro fabrication processes, LIGA process . Technologies of nano fabrication, importance of size, scanning probe microscope, carbon Buckyballs and nano tubes, nano fabrication processes,

Course Outcomes: Students will be able to

1. Understand the fundamentals and technologies used in different advance machining processes.
2. Understand the concept of Electrochemical and Chemical Metal Removal Processes
3. Understand the concept of Thermal Metal Removal Processes
4. Develop an ability to create automated solid model
5. Understand the fundamentals of Technologies of Micro Fabrication

Text Books:

1. Mikell P. Groover, Fundamentals of Modern Manufacturing, Wiley India
2. Pandey P.C, Shan H.S., Modern Machining Processes, Tata McGraw
3. Lal G.K,Gupta V, Reddy N.V., Narosa Publishing House
4. Chua C.K., Leong K.F. and LIM C.S," Rapid prototyping: Principles and Applications" - World Scientific publications

References Books:

1. Gibson, Ian, Rosen, David, Stucker, Brent, "Additive Manufacturing Technologies, 3D Printing, Rapid Prototyping, And Direct Digital Manufacturing
2. Jain V.K. Introduction To Micro Machining Process Narosa Publication
3. Jain V.K., Micromanufacturing Processes , Crc Press.

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ME-702 (B)	**Internet of Things**	**3L:1T: 0P (04 hrs)**	**Credits:04**

Course Content:

Unit I **(08 Hrs)**

Internet of Things (IoT): Vision, Definition, Conceptual Framework, Architectural view, technology behind IoT, Sources of the IoT, M2M Communication, IoT Examples . Design Principles for Connected Devices: IoT/M2M systems layers and design standardization, communication technologies, data enrichment and consolidation, ease of designing and affordability.

Unit II **(08 Hrs)**

Hardware for IoT: Sensors, digital sensors, actuators, radio frequency identification (RFID) technology, wireless sensor networks, participatory sensing technology. Embedded Platforms for IoT: Embedded computing basics, Overview of IOT supported Hardware platforms such as Arduino, Raspberry pi, Beagle Bone, Intel Galileo.

Unit III **(08 Hrs)**

IoT PROTOCOLS: IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks, Zigbee – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition – Application Layer Protocols: CoAP and MQTT.

Unit IV **(08 Hrs)**

Security Understanding the risks, Modes of attack: Denial of Service Guessing the credentials , Getting access to stored credentials, Man in the middle , Sniffing network communication , Port scanning and web crawling ,Search features and wildcards ,Breaking ciphers , Tools for achieving security - Virtual Private Networks , X.509 certificates and encryption , Authentication of identities , Usernames and passwords , Using message brokers and provisioning servers ,Centralization versus decentralization .

Unit V **(08 Hrs)**

IoT Applications Home Automation: Smart Appliances , Smoke/ Gas Detection, Cities – Smart Parking ,Smart Lighting , Smart Road , Health and Lifestyle- Health and fitness monitoring, Retail- Smart Payments. Case Studies: Smart city streetlights:- control and monitoring.

Course Outcomes: The student will be able:

1. Understand the vision of IoT from a global context.
2. Understand the application of IoT.
3. Determine the Market perspective of IoT.
4. Use of Devices, Gateways and Data Management in IoT.

5. Building state of the art architecture in IoT.
6. Application of IoT in Industrial and Commercial Building Automation and Real World Design Constraints.

References:

1. Raj Kamal "Internet of Things", McGraw-Hill, 1st Edition, 2016
2. Olivier Hersent,David Boswarthick, Omar Elloumi "The Internet of Things key applications and protocols", Wiley.
3. Peter Waher, "Learning Internet of Things", Packt publishing.
4. Arshdeep Bahga, Vijay Madisetti, "Internet of Things (A hands on approach)" University Press (India).
5. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1 st Edition, Apress Publications, 2013.
6. Cuno Pfister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 978-1- 4493-9357-1.

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ME702(C)	**Power Plant Engineering**	**3L:1T: 0P (04 hrs)**	**Credits:04**

Course Content

Unit I **(07 hrs)**

Introduction: Introduction to methods of converting various energy sources to electric power, direct conversion methods renewable energy sources, solar, wind, tidal, geothermal, bio-thermal, biogas and hybrid energy systems, fuel cells, thermoelectric modules, MHD-Converter

Unit II **(08 hrs)**

Fossil fuel steam stations: Basic principles of sitting and station design, effect of climatic factors on station and equipment design, choice of steam cycle and main equipment, recent trends in turbine and boiler sizes and steam conditions, plant design and layout, outdoor and indoor plant, system components, fuel handling, burning systems, element of feed water treatment plant, condensing plant and circulating water systems, cooling towers, turbine room and auxiliary plant equipment., instrumentation, testing and plant heat balance.

Unit III (**08 hrs)**

Nuclear Power Station: Importance of nuclear power development in the world and Indian context, Review of atomic structure and radio activity, binding energy concept, fission and fusion reaction, fissionable and fertile materials, thermal neutron fission, important nuclear fuels, moderators and coolants, their relative merits, thermal and fast breeder reactors, principles of reactor control, safety and reliability features.

Unit IV **(07 hrs)**

Hydro-Power Station: Elements of Hydrological computations, rainfall run off, flow and power duration curves, mass curves, storage capacity, salient features of various types of hydro stations, component such as dams, spillways, intake systems, head works, pressure tunnels, penstocks, reservoir, balancing reservoirs, Micro and pico hydro machines, selection of hydraulic turbines for power stations, selection of site.

Unit V **(08 hrs)**

Power Station Economics: Estimation and prediction of load. Maximum demand, load factor, diversity factor, plant factor and their influence on plant design, operation and economics; comparison of hydro and nuclear power plants typical cost structures, simple problems on cost analysis, economic performance and tariffs, interconnected system and their advantages, elements of load dispatch in interconnected systems.

Course Outcomes: Students will be able to

1. Understand the conversion of renewable energy system into electrical power.
2. Design & enhance the performance of fossil fuel based power plant.
3. Analyze the nuclear power plant and its safety
4. Design & enhance the performance of hydro based power plant.
5. Determine economics of the power plant of renewable and non renewable / nuclear power system

Text Books:

1. Rajput RK; A text book of Power plant Engg.; Laxmi Publications.

Reference Books:

1. Nag PK; Power plant Engg; TMH
2. Al-Wakil MM; Power plant Technology; TMH
3. Sharma PC; Power plant Engg; Kataria and sons, Delhi
4. Domkundwar; Power Plant Engg; Dhanpatrai & sons.

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ME702(D)	**Advance Machine Design**	**3L:1T: 0P (04 hrs)**	**Credits:04**

Course Contents:

Unit I **(07 hrs)**

Design of Belt, Rope and Chain Drives: Methods of power transmission, design of flat belt drive and V-belt drive; Design of chain drives, roller chain and its selection; Design of rope drives.

Unit II **(10 hrs)**

Spur and Helical Gears: Force analysis of gear tooth, AGMA Bending stress equation and AGMA Contact stress equation, modes of failure, beam strength, Lewis equation, form factor, formative gear and virtual number of teeth; Gear materials; Surface strength and wear of teeth; strength against wear; Design of straight tooth spur and Helical Gears.

Unit III **(08 hrs)**

Bevel Gears: Application of bevel, formative gear and virtual number of teeth; Force analysis; Lewis equation for bevel gears; Strength against wear; Design of bevel gear.

Unit IV **(08 hrs)**

Design of I.C. Engine Components: General design considerations in I C engines; design of cylinder; design of piston and piston-rings; design of connecting rod; design of crankshaft.

Unit V **(08 hrs)**

Design of Miscellaneous Components: Design of Knuckle joint, Design of Cotter joint, Design of keys, Design of Flanged coupling; Rigid coupling and Flexible coupling ,Design of Pressure vessels subjected to internal pressure, Design of power screw.

Course Outcomes: Students will be able to

1. Apply concept of design process, standardization, uncertainty and reliability to component design.
2. Analyze the design based on theory of elasticity, theory of plasticity and failure theories.
3. Analyze design based on tribological aspects.
4. Simplify design of parts subjected to unsymmetrical bending.
5. Explain the concept of strain gauge, gauge factor, measuring circuits, application of strain gauge & stress analysis.

References:

1. Shigley J.E.; Machine Design; TMH
2. Bhandari VB; Design of Machine Elments; TMH
3. Abdul Mubeen; Machine Design; Khanna Publishers
4. Sharma & Agrawal; Machine Design; Katson
5. Sharma CS and Purohit K; Design of Machine Elements; PHI Learning.
6. Dwivedi and Pandey; Machine Drawing and Design, Dhanpat Rai & Co.
7. Wentzell TH; Machine Design; Cegage Learning

8. Hall and Somani; Machine Design; Schaum Series; TMH
9. Kulkarni SG; Machine Design; TMH
10. Norton R; Design Of Machinery; TMH

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ME- 703(A)	**Operation Research & Supply Chain**	**3L:1T: 0P (04 hrs)**	**Credits:04**

Course Content:

Unit 1 **(12 Hrs)**

Linear System and Distribution Models: Mathematical formulation of linear systems by LP, solution of LP for two variables, Simplex method, special cases of LP- transportation and assignment model and their graphical solution, Vogels Approximation Method (VAM) or penalty method, cell evaluation degeneracy, basics of SW Lindo, Tora, Excell.

Unit II **(10 Hrs)**

Inventory Models: Necessity of inventory in process and safety stock, problem of excess inventory and cycle time, JIT/ Lean Mfg; basics of inventory models with deterministic demand, Classical EOQ Model, ABC, VED and other analysis based on shelf life, movement, size, MRP technique and calculations, lot sizing in MRP, linking MRP with JIT; evolution of MRP to ERP to SCM and e-business.

Unit III **(10 Hrs)**

Queuing Theory and Game Theory: Waiting Line Models: Introduction, Input process, service mechanism, Queue discipline, single server (M/M/1), average length and average time calculations, optimum service rate; basic multiple server models (M/M/s)

Competitive strategy: concept and terminology, assumptions, pure and mixed strategies, two- person zero sum games, saddle point, dominance, graphical, algebraic and LP methods for solving game theory problems.

Unit IV **(10 Hrs)**

Network Analysis and Meta-Heuristics: Network Analysis: Project Planning, Scheduling and Controlling; Project management; Network Techniques and its role in project management, Network logics, Fulkerson's Law, Merits and Demerits of AON Diagrams; Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), Determination of critical path, Float/Slack.

Meta-Heuristics: Definition of heuristic and meta-heuristic algorithms; introduction to Tabu search, Simulated Annealing and Genetic algorithms and solution of traveling salesman, non linear optimization problems.

Unit V: **(08 Hrs)**

Supply Chain Management: Definition, importance, expenditure and opportunities in SCM; integration of inbound, outbound logistics and manufacturing to SCM, flow of material money and information, difficulties in SCM due to local v/s system wide (global) optimization and uncertainties in demand and transportation; Bull-whip effect; customer value; IT, info-sharing and strategic partnerships; plant and warehouse-network configuration; supply contracts and revenue sharing; outsourcing; transportation, cross docking and distribution, forecasting models in SCM; coordination and leadership issues; change of purchasing role and vendor rating, variability from multiple suppliers.

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Course Outcomes: The student able to

1. Understand the concept of operation research and optimization methods.
2. Understand the concept of various inventory control techniques.
3. Understand the concept of Queuing and Game Theory
4. Implement project management concepts, tools and techniques in order to achieve project success
5. Understand the role of logistics in the supply chain within a focal firm as well as between organizations linked within a given supply chain network.

Text Books :

1. Hillier FS and Liberman GJ; Introduction to Operations Research concept and cases; TMH
2. Simchi-Levi, Keminsky; Designing and managing the supply chain; TMH.
3. Heera and Gupta,Operation Research, S Chand Pub.
4. Sharma JK; Operations Research; Macmillan
5. Kantiswaroop,Operation Research, Sultan Chand

Reference Books:

1. Taha H; Operations research; PHI
2. Jain, Pandey & Shrivastava; Quantitative techniques for management, New Age publishers.
3. Srinivasan G; Quantitative Models In Operations and SCM; PHI Learning
4. Mohanty RP and Deshmukh SG; Supply Chain Management; Wiley India
5. Sen RP; Operations Research-Algorithms and Applications; PHI Learning
6. Bowersox DJ, Closs DJ, Cooper MB; Supply Chain Logistic Mgt; TMH
7. Bronson R ;Theory and problems of OR; Schaum Series; TMH

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ME- 703(B)	**Artificial Intelligence Techniques**	**3L:1T: 0P (04 hrs)**	**Credits:04**

Course Content:

Unit I **(08 Hrs)**

Introduction to Artificial Intelligence: Main components and characteristics of AI (Feature Engineering, ANN, Deep Learning),Applications of AI, Advantages and disadvantages of AI, Goals of AI, Comparision of Programming of a System with AI and without AI, Challenges in AI, Programming languges preferably used in AI, Techniques/Algorithms used in AI,AI Software platforms, Future of AI.

Unit II **(08 Hrs)**

Various types of production systems and search techniques: Types of production systems, Characteristics of production systems, Study and comparison of breadth first search and depth first search. Techniques, other Search Techniques like hill Climbing, Best first Search. A* algorithm, AO* algorithms etc, and various types of control strategies.

Unit III **(08 Hrs)**

Knowledge Representation and Probabilistic Reasoning: Problems in representing knowledge, knowledge representation using propositional and predicate logic, comparison of propositional and predicate logic, Resolution, refutation, deduction, theorem proving, inferencing, monotonic and non monotonic reasoning. Probabilistic reasoning, Baye's theorem, semantic networks, scripts, schemas, frames, conceptual dependency, fuzzy logic, forward and backward reasoning.

Unit IV **(06 Hrs)**

Game playing techniques: Minimax procedure, alpha-beta cut-offs etc, planning, Study of the block world problem in robotics, Introduction to understanding and natural languages processing.

Unit V **(08 Hrs)**

Introduction to learning ANN: Various techniques used in learning, introduction to Artificial neural networks, common sense, reasoning, Convolution Neural Network, Feed forward Neural Network, Recurrent Neural Network, Multilayer perceptron, Architecture / Three Layers in Artificial Neural Networks, Implementation of ANN, Applications of ANN in images, signals and language some example of expert systems.

Course Outcomes: The Students will be able to

1. Learn about importance and adoption of Artificial Intelligence (AI) technologies in our society.
2. Know the Various types of production systems and search techniques used in the AI Techniques.

3. Understand the working of Modern AI based systems. It often involves Knowledge Representation and Probabilistic Reasoning.
4. Know about Game playing techniques and natural languages processing used in AI.
5. Apply Various techniques used in machine learning like Artificial neural networks.

References:

1. Rich E and Knight K, "Artificial Intelligence", TMH, New Delhi.
2. Nelsson N.J., "Principles of Artificial Intelligence", Springer Verlag, Berlin.
3. Stuart Russell , Artificial Intelligence: A Modern Approach , 3rd Edition), Peter Norvig, PHI, ISBN13: 978-0136042594, ISBN-10: 0136042597
4. B. Yegnanarayana , Artificial Neural Networks ,PHI 5.Schalkoff, Artificial Neural Networks . Mc Graw HILL Education

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ME- 703(C)	System Engineering	3L:1T: 0P (04 hrs)	Credits:04

Course Content:

Unit I **(08 Hrs)**

Overview of Systems Engineering: Introduction, Origin, Examples of Systems requiring systems engineering, Systems Engineer Career Development Model, Perspectives of Systems Engineering, Systems Domains, Systems Engineering Fields, System Engineering Approaches.

Unit II **(08 Hrs)**

Structure of Complex Systems: System Building Blocks and Interfaces, Hierarchy of Complex Systems, System Building Blocks, The System Environment, Interfaces and Interactions, Complexity in Modern Systems.

Unit III **(08 Hrs)**

Concept Development and Exploration: Originating a New System, Operational Analysis, Functional Analysis, Feasibility, System Operational Requirements, Implementation of Concept Exploration. Exploration in system life cycle, Concept definition phase, Activities involved in concept definition phase.

Unit IV **(08 Hrs)**

Engineering Development: Reducing Program Risks, Requirements Analysis, Functional Analysis and Design, Prototype Development as a Risk Mitigation Technique, Development Testing, Risk Reduction. Place of engineering design phase in system life cycle, Various activities involved in engineering design phase.

Unit V **(08 Hrs)**

Integration and Evaluation: Integrating, Testing, And Evaluating The Total System, Test Planning And Preparation, System Integration, Developmental System Testing, Operational Test And Evaluation, Engineering For Production, Transition From Development To Production, Production Operations. Operation and support phase.

Course Outcomes: The Students will be able to

1. Define the scope, field and different approaches of System Engineering.
2. Explain the structure of complex systems, System building blocks of engineering systems.
3. Evaluate Apply the principle of concept development and implementation of concept exploration.
4. Analyze system development, testing and risk reduction techniques during system development.
5. Develop a total system integration and evaluation plan from development to production phase.

Reference Books:

1. Alexander Kossiakoff, William N Sweet, “System Engineering Principles and Practice, Wiley India
2. Blanchard Fabrycky, Systems engineering and analysis, Pearson
3. Dwivedi Krishna K, Pandey M., Fundamentals of Systems Engineering , Wiley Precise Text

book Series, Wiley India. ISBN: 978-265-6654-9.
4. Dennis M. Buede, William D.Miller, "The Engineering Design of Systems: Models & Methods" Wiley India.
5. JeffreyL Whitten, Lonnie D Bentley, "System Analysis and Design Methods"
6. Richard Stevens, Peter Brook," System Engineering – Coping with complexity, Prentice Hall of India.
7. Eisner, H. Essentials of Projects and Systems Engineering Management, 2nd edition. John Wiley & Sons, New Jersey, USA.
8. Buede, D. M.. The Engineering Design of Systems, Models and Methods. John Wiley & Sons, New Jersey, USA.

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ME-703 (D)	**Reliability Engineering**	**3L:1T: 0P (04 hrs)**	**Credits:04**

Course Content:

Unit I **(08 Hrs)**

Reliability: Definition, Importance, History, Reliability Vs. Quality, Failure pattern of complex product, Factor of safety and reliability, Reliability analysis procedure, Reliability management , Some examples of system failures., Reliability function-MTTF, Hazard rate function, Bath tub curve.

Unit II **(08 Hrs)**

Basic Probability Theory: Set theory, Laws of probability, Probability theorem Random variables and probability distributions, Bay's Theorem, Central limit theorem.

Unit III **(10 Hrs)**

Functions of Random Variables: Single , two and several random variables, Probability distribution functions, density functions for different types of discrete and continuous variables, mean, mode and median, Numerical solutions, Extremal distributions, derivation of the reliability function -constant failure rate model – time dependent failure models. Weibull distribution – normal distribution – the lognormal distribution.

Unit IV **(10 Hrs)**

Modeling of Geometry, Strength and Loads: Fatigue strength, Time dependent reliability of components, Failure rate versus time, reliability and hazard functions and different distributions, Estimation of failure rate, Expected residual life, Se ries, parallel and mixed systems, complex systems, Reliability enhancement.

Unit V **(08 Hrs)**

Reliability Based Design: Optimization problems, Failure modes and effect analysis, Event tree and fault tree analysis, Reliability testing, Reliability data and analysis, measurement of reliability, Monte Carlo Simulati on, Computation of reliability, Optimization techniques for system reliability with redundancy – heuristic methods applied to optimal system reliability - redundancy allocation by dynamic programming – reliability optimization by non linear programming.

Course Outcomes: Students will be able to

1. Understand the basic concepts of reliability, various models of reliability.
2. Understand the basic Probability Theory
3. Understand the basic concepts of Functions of Random Variables
4. Estimation the failure rate and Expected residual life of the process
5. Understand the Reliability Based Design

Text Book :

1. Singiresu S. Rao, Reliability Engineering, Pearson
2. Grant E. L. & Leave Worth, Statistical Q. C., T.M.H.

3. Balagurusamy, Reliability Engg., T.M.H.
4. Mahajan , Statistical Q.C.
5. Juran and Grayan, Quality Planning Analysis, T.M.H

Reference Books:

1. Charles E. Ebling, "An introduction to Reliability and Maintainability Engg", Tata McGraw -Hill
2. Atrick D To'connor, "Practical Reliability Engineringt", John -Wiley and Sons inc
3. David J Smith, "Reliability, Maintainability and Risk: Practical Methods for Engineers", Butterworth

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ME-704	**CAD/CAM/CIM Lab**	**0L:0T: 6P (06 hrs)**	**Credits:03**

The purpose of this laboratory is to provide the complete practical exposure of Computer aided design software tools such as Solid works, CATIA, Unigraphics etc., Computer assisted manufacturing processes such as CNC Turning, CNC Milling, CNC Drilling etc as well Computer integrated manufacturing (i.e. demonstrating remotely over the internet the operations of actual CIM cell established in the dept of Institute /industry) to the students so that they will become industry ready just after completing their graduation.

Suggested list Experiments; (Pl expand it)

1. 2D and 3D modeling on CAD software
2. Use of CAM software for writing CNC programs
3. Study of automatic and semi automatic control system and writing the electrical analogy.
4. Production & layout for GT for group of jobs to be manufactured
5. A case study / tutorial using CAPP Software
6. Writing M & G codes for given operations.
7. Robot and AGV programming
8. Modelling and simulation of computer integrated manufacturing system'
9. Modelling, offline manual part programming and simulation of the operation of 3 axis CNC milling machine
10. Programming and operation of a 5 axis robot Manipulator
11. Remote monitoring and operation of Computer integrated manufacturing system
12. To write the part program for any component (stepped cylindrical rod) . Assuming the work piece is Aluminum and the speed is 1200 rpm, feed 20 mm/min and maximum depth of cut is 1 mm.

a. With Canned cycle

b. Without Canned cycle.

IPS Academy, Institute of Engineering & Science

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Mechanical Engineering Department

B. Tech, VII Sem

ME-705	MATLAB & R Programming	0L:0T: 6P (06 hrs)	Credits:03

The purpose of this laboratory is to provide the knowledge of latest research tools/techniques such as MATLAB and R Programming which is being used in finding out the solution of most of the engineering problems. MATLAB is a multi-paradigm numerical computing environment and proprietary programming language developed by MathWorks. MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages.

Following are the suggested list of experiments related to MATLAB (Pl expand)

1. Introduction to MATLAB
2. Working with matrices
3. Rational and logical operation of MATLAB
4. Creating a plot using Plot function
6. Complex and stastical functions (e,g.: Produce ten elements vector of random complex numbers and find the summation of this vector)
7. Numbers and strings

(1.Write a program in M-File to read 3 x 3 Matrix, then display the diagonal of matrix as shown below: The Diagonal of This Matrix = [ ] 2. Write a program to read a string, then replace each character in the string with its following character in ASCII code*.)

R Programming is a programming language and free software environment for statistical computing and graphics supported by the R Foundation for Statistical Computing. The R language is widely used among statisticians and data miners for developing statistical software and data analysis. In this lab, students are supposed to learn how to program in R and how to use R for effective data analysis. Students need to learn how to install and configure software necessary for a statistical programming environment and describe generic programming language concepts as they are implemented in a high-level statistical language. The lab should cover practical issues in statistical computing which includes programming in R, reading data into R, accessing R packages, writing R functions, debugging, profiling R code, and organizing and commenting R code.

Following are the suggested tutorials to be covered:

1. What is R Programming Language?
2. How to Download & Install R, R Studio, Anaconda on Mac or Windows
3. Weite R Data Types, Arithmetic & Logical Operators with Example
4. Write about R Matrix : Create, Print, add Column, Slice
5. Explain Factor in R: Categorical & Continuous Variables
6. Explain about R Data Frame: Create, Append, Select, Subset.

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Course Outcome's: Students will be able to

1. Aware of MATLAB software and perform basic programs.
2. Perform Real time application and know about basic key features of MATLAB software.
3. Perform program to develop image using image processing in MATLAB Software.
4. Knowledge about image processing programming and develop application of system.
5. Perform program on different image compression and restoration technique.

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Mechanical Engineering Department

B. Tech, VII Sem

ME-706	Major Project I	0L:0T: 8P (08 hrs)	Credits:04

Course Objectives:

- To provide students with a comprehensive experience for applying the knowledge gained so far by studying various courses.
- To develop an inquiring aptitude and build confidence among students by working on solutions of small industrial problems.
- To give students an opportunity to do something creative and to assimilate real life work situation in institution.
- To adapt students for latest development and to handle independently new situations.
- To develop good expressions power and presentation abilities in students**.** The focus of the Major Project I is on preparing a working system or some design or understanding of a complex system using system analysis tools and submit it the same in the form of a write up i.e. detail project report.

The student should select some real life problems for their project and maintain proper documentation of different stages of project such as need analysis market analysis, concept evaluation, requirement specification, objectives, work plan, analysis, design, implementation and test plan. Each student is required to prepare a project report and present the same at the final examination with a demonstration of the working system (if any).

Working schedule:

The faculty and students should work according to following schedule:

Each student undertakes substantial and individual project in an approved area of the subject and supervised by a faculty of the department. In special case, if project is huge, then maximum 03 students may be permitted to work together as a team to do the same. The student must submit outline and action plan for the project execution (time schedule) and the same be approved by the concerned faculty and Head of department.

Project guide should motivate students to develop some Innovative working models in the area of Advanced Automotives, Aero modelling, Renewable Energy based systems, Mechatronics, Robotic systems, Advanced Manufacturing Technology based systems etc. which can contribute to the society.

Course Outcome's: Students will be able to

1. Identify a topic in areas of Mechanical Engineering.
2. Review literature to identify gaps and define objectives & scope of the work.
3. Generate and implement innovative ideas for social benefit.
4. Develop a prototypes/models, experimental set-up and software systems necessary to meet the objectives.
5. Prepare a report as per recommended format and defend the work.