INSTITUTE OF ENGINNERING AND TECHNOLOGYLUCKNOW

(An Autonomous Constituent Institute of Dr. A.P.J. Abdul Kalam Technical University, Lucknow)

Proposed Evaluation Scheme &Syllabus

For

B.Tech.4thYear

(Mechanical Engineering)

[Effective from the Session:2025-26]

B. Tech Mechanical Engineering

4th Year (Semester-VII)															
Sl. No.	**Subject Code**	**Subject Name**	**Type of Course**	**Periods**			**Evaluation Scheme**				**End Semester**		**Total**	**Credit**
				L	**T**	**P**	**CT**	**TA**	**Total**	**PS**	**TE**	**PE**		
1	IMU 701	Project Management & Entrepreneurship	HSMC	3	0	0	20	10	30		70		100	3
2	IME070-075	Program Elective Course-IV	PEC/MOOCS	3	0	0	20	10	30		70		100	3
3	IOE 070-079	Open Elective Course-II	OEC	3	0	0	20	10	30		70		100	3
4	IOE 080-089	Open Elective Course-III	OEC/MOOCS	3	0	0	20	10	30		70		100	3
5	IME 751	Project	PL	0	0	8				100			100	4
6	IME 752	Internship Assessment/ Mini Project/ Start-up & Entrepreneurship Assessment	PL	0	0	2				100			100	2
		MOOCS (for Honors Degree)/ Minor Degree												
		Total		**12**	**0**	**10**							**600**	**18**

*Internship Assessment/ Mini Project(5-6weeks) conducted duringsummerbreakafterVIthsemesterwillbeassessedduringVIIthsemester.

Abbreviation Used:

HSMC: Humanities, Social Science and Management Course

PEC: Program Elective Course

PL: Program Lab

OEC: Open Elective Course

B. Tech Mechanical Engineering

4th Year (Semester-VIII)														
Sl. No.	**Subject Code**	**Subject Name**	**Type of Course**	**Periods**			**Evaluation Scheme**				**End Semester**		**Total**	**Credit**
				L	**T**	**P**	**CT**	**TA**	**Total**	**PS**	**TE**	**PE**		
1	IME 851	Project/ Industrial Project	PL	0	0	24				150		350	500	12
		MOOCS (for Honors Degree)/ Minor Degree												
		Total		**0**	**0**	**24**							**500**	**12**

Abbreviation Used:

PL: Program Lab

Program Elective Courses

Program Elective Course – IV
Mode: Offline/MOOCS

IME 071: Additive Manufacturing

IME 072: Power Plant Engineering

IME 073: Machine Learning

IME 074: Hybrid Vehicle

IME 075: Sustainable Power Generation Systems (Link: https://nptel.ac.in/courses/127103236)

IME 076: Introduction to Composites (Link: https://nptel.ac.in/courses/112104229)

IME 077: Energy Conversion and Waste Heat Recovery (Link: https://nptel.a)c.in/courses/112105221)

Open Elective Course

Open Elective Course -II

IOE 077: Operation Research

IOE 079: Automation and Robotics

Open Elective-III

IOE 082: Quality Management

Syllabus

IME 071	Additive Manufacturing	3L:0T:0P	3Credits

Unit	Topics	No. of Hours
I	Introduction to Additive Manufacturing (AM): Evolution of AM/3D printing; Comparison with subtractive and forming processes; Advantages of AM; Classification of AM processes; Key steps in AM.	7
II	Liquid State-based AM Processes: Stereo lithography – Process and working principle; Photopolymers; Photo polymerization, layering technology, Laser and Laser scanning; Micro-stereolithography; Equipment and specifications; Applications, advantages, disadvantages, examples; Solid ground curing: Process, Working principle; Equipment and specifications; Applications, advantages, disadvantages, examples.	8
III	Solid State-based AM Processes: Fused Deposition Modelling – Process, working principle and materials; Equipment and specifications; Laminated object manufacturing – Process and working principle; Equipment and specifications; Applications, advantages, disadvantages, examples; Other solid-state processes – Ultrasonic consolidation, Gluing, Thermal bonding; Demonstration of equipment.	9
IV	Powder Based AM Processes: Powder Bed Fusion Processes – Working principle and materials; Powder fusion mechanism and powder handling; Various LBF processes (principle, materials, applications and examples) – Selective laser Sintering, Electron Beam Melting, Laser Engineered Net Shaping, Binder Jetting and Direct Metal Deposition; Comparison between LBF processes; Materials-process-structure-property relationships; relative advantages and limitations.	9
V	Applications of AM: Product development lifecycle applications – Rapid prototyping, concept models, visualization aids, replacement parts, tooling, jigs and fixtures, mould and casting; Application sectors – aerospace, automobile, medical, jewelry, sports, electronics, food, architecture, construction and others.	8

Course Outcomes:

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

COs	Statements
CO1	Explain the evolution, principles, advantages, and classifications of additive manufacturing in comparison with conventional manufacturing processes
CO2	Differentiate and analyze various liquid AM processes in terms of working principles, materials, equipment, advantages, disadvantages, and applications.
CO3	Demonstrate and apply the operation of solid-state AM equipment, including ultrasonic consolidation, gluing, and thermal bonding, for prototype fabrication
CO4	Apply knowledge of powder-based AM processes to establish materials–process–structure–property relationships and evaluate the relative merits of Laser Beam Fusion (LBF) processes
CO5	Assess and recommend suitable AM techniques for diverse industrial applications across aerospace, automotive, medical, architecture, and consumer sectors considering

	sustainability and innovation

Reference Books:

1. Sabrie Soloman, 3D Printing & Design, Khanna Book Publishing Company, New Delhi, 2020.
2. Ian Gibson, David W Rosen, Brent Stucker, “Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping and Direct Digital Manufacturing”, Springer, 2015
3. Chua Chee Kai, Leong Kah Fai, “3D Printing and Additive Manufacturing: Principles & Applications,” World Scientific, 2015.
4. C.P Paul, A.N Junoop, “Additive Manufacturing: Principles, Technologies and Applications,” McGrawHill, 2021.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc21_me115/preview
2. https://onlinecourses.nptel.ac.in/noc20_mg70/preview

IME 072	Power Plant Engineering	3L:0T:0P	3 Credit

Unit	Topics	No. of Hours
I	**Introduction:** Power plants – types and classification based on energy sources. Present status and future trends. **Thermal Power Plants:** General Layout of modern thermal power plant;Site selection for Thermal Power Plant, Material balance, Coal handling, storage and preparation, Ash and dust collection and handling, pulverized fuel firing, Fluidized bed combustion, feed water treatment. Turbine auxiliary systems such as governing, feed water heating, reheating, flange heating and gland sealing.	8
II	**Hydroelectric Power Plant:**, General arrangement of hydroelectric power plant, Plant layout, site selection, Rainfall and its measurement, classification of hydro-plant, Pumped storage plant. **Gas turbine power plant:** Layout of gas turbine power plant, Elements of gas turbine power plants, auxiliary systems such as fuel, combustion chamber, controls and lubrication, combined cycle power plants, Integrated Gas fire based Combined Cycle (IGCC) systems.	8
III	**Nuclear Power Plants:** Classification of nuclear reactors, Thermal fission reactors and power plant and their location, Pressurized water reactor, Boiling water reactor, CANDU heavy water reactor, Gas-cooled reactor, Fast breeder reactors, Organic substance cooled reactor, Radiation hazards, Radioactive waste disposal. **Solar Power Plant:** Introduction to solar energy, Solar energy collectors, Photovoltaic power system, Solar central receiver system,	8
IV	**Power Plant Economics:** Types of loads, Effect of variable load on power plant design and operation, Methods to meet variable load, Prediction of future loads, Terminology used in power supply, Cost of electrical energy, Depreciation, Energy rates (tariffs) for electrical energy, Factors affecting economics of generation and distribution of power.	8
V	**Wind energy:** Types of wind turbines- HAWT & VAWT. Aerodynamic considerations of wind mill design Coefficient of performance of wind mill motor. **Tidal and ocean energy:** Introduction to Tidal Energy, tidal energy conversion principle, Tidal Power plants and its application. Principle of working of Ocean energy conversion, The open or Claude cycle, The closed or Anderson OTEC cycle Environmental Aspects of Power Station: Environmental aspects: Different pollutants due to thermal power plant and their effect on human health.	8

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

COs	Statements
CO1	Classify different types of power plants, their layouts, and auxiliary systems, and explain the present status and future trends of power generation
CO2	Analyze the design considerations, site selection criteria, and working principles of thermal, hydro, gas turbine, nuclear, and solar power plants.
CO3	Apply concepts of fuel handling, combustion, water treatment, and turbine auxiliaries to evaluate plant performance and operational efficiency.

CO4	Examine the economics of power generation by evaluating load characteristics, cost of generation, tariffs, and factors influencing distribution economics
CO5	Assess the feasibility of renewable energy systems (wind, tidal, ocean, solar) and evaluate environmental impacts of power stations for sustainable energy development

Reference Books:

1. Power Plant Engineering, by F.T. Morse, Affiliated East-West Press Pvt. Ltd.
2. Power Plant Engineering by Hedge, Pearson India.
3. Power Plant Technology, by Wakil, McGraw Hill.
4. Power Plant Engineering by P.K. Nag, Tata McGraw Hill.
5. Steam & Gas Turbines & Power Plant Engineering by R.Yadav, Central Pub.House.
6. Power Plant Engineering by Gupta, PHI India.
7. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.
8. Power Plant Engineering. Mahesh Verma, Metropolitan Book Company Pvt. Ltd.

NPTEL Web Course:

1. http://nptel.ac.in/courses/112106133/1
2. http://nptel.ac.in/courses/112106133/2
3. http://nptel.ac.in/courses/112106133/3
4. http://nptel.ac.in/courses/112106133/4
5. http://nptel.ac.in/courses/112106133/5

NPTEL Video Course:

1. http://nptel.ac.in/courses/108105058/8
2. http://nptel.ac.in/courses/108105058/9
3. http://nptel.ac.in/courses/108105058/10

IME 073	Machine Learning	3L:0T:0P	3Credit

Unit	Topics	No. of Hours
I	Introduction to Machine Learning: Introduction to Machine Learning, Learning Paradigms, PAC learning, Basics of Probability, Version Spaces, performance Measures for ML Model, Issues in Machine Learning, AI vs. ML, and Essential Math for ML and AI, Data Science Vs Machine Learning	7
II	Supervised Learning: Linear and Nonlinear examples, Multi-Class & Multi-Label classification, Linear Regression, Multilinear Regression, Naïve Bayes Classifier, Decision Trees, ID3, CART, Error bounds. Classifiers: K-NN classifier, Logistic regression, Perceptron, Single layer & Multi-layer, Support Vector Machines, Linear & Non-linear.	9
III	Unsupervised Learning: Clustering basics (Partitioned, Hierarchical and Density based), K-Means clustering, K-Mode clustering, Self-organizing maps, Expectation maximization, Principal Component Analysis.	8
IV	Decision Trees: Basics of Decision Tree, Issues in Decision tree learning, ID3 Algorithm, Information gain and Entropy. Introduction to Neural Networks: Perceptron, The Back propagation Algorithm, The Convergence analysis and universal approximation theorem for back propagation algorithm, Concept of Convolution Neural Networks, Types of Layers of CNN, Case Study of CNN (either on Self driving car, Building a smart speaker, etc.)	8
V	Genetic Algorithm: Introduction, Components of Genetic Algorithm, Cross Over, Mutation, Model of Evolution and Learning, Applications of Genetic Algorithm. Reinforcement Learning: Introduction to Reinforcement Learning, Learning task, Model-Based Learning Q- Learning, Markov Decision Process, Q Learning Function, Temporal Difference Learning, Generalization,	8

Course Outcomes:

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

COs	Statements
CO1	Explain fundamental concepts of machine learning, learning paradigms, and essential mathematical foundations, while distinguishing ML from AI and Data Science.
CO2	Apply and analyze supervised learning algorithms to solve real-world prediction and classification problems.
CO3	Implement and evaluate unsupervised learning techniques such as clustering, self-organizing maps, and dimensionality reduction for data pattern discovery
CO4	Design and assess decision tree models and neural networks, including CNN architectures, for practical case studies in domains such as autonomous systems and smart devices.
CO5	Apply and critically evaluate advanced learning paradigms such as Genetic Algorithms and Reinforcement Learning to model optimization and sequential decision-making problems.

ReferenceBooks:

1. Tom M. Mitchell, ―Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.
2. Ethem Alpaydin, ― Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press 2004.
3. Stephen Marsland, ―Machine Learning: An Algorithmic Perspective, CRC Press, 2009.
4. Bishop, C., Pattern Recognition and Machine Learning. Berlin: Springer-Verlag.

IME 074	Hybrid Vehicle	3L:0T:0P	3 Credits

Unit	Topics	No. of Hours
I	Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance.	8
II	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. Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.	8
III	Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.	8
IV	Energy Storage: 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, Communications, supporting subsystems	8
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.	8

Course Outcomes:

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

COs	Statements
CO1	Explain the evolution, societal relevance, and environmental importance of hybrid and electric vehicles, along with fundamentals of conventional vehicle performance and modeling.
CO2	Analyze different hybrid and electric drive-train topologies, their power flow control, and fuel efficiency characteristics.
CO3	Apply knowledge of electric propulsion units by configuring and controlling various motor drives (DC, induction, permanent magnet, switched reluctance) and evaluate their efficiencies

CO4	Examine and compare energy storage technologies (battery, fuel cell, supercapacitor, flywheel) and select appropriate systems by matching propulsion motor, ICE, and power electronics requirements.
CO5	Assess and recommend suitable energy management strategies for hybrid and electric vehicles by considering classification, comparison, and implementation issues

Text Books:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press , 2003.

2. MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press , 2004.

Reference Books:

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley , 2003.

2. Chris Mi, M. Abul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, John Wiley & Sons Ltd., 2011.

Open Elective Courses-II

IOE 077	Operation Research	3L:0T:0P	3 Credits

Unit	Topics	No. of Hours
I	Linear Programming: Historical development of optimization, engineering application of optimization, formulation of design problems as a mathematical programming problem. Graphical method of solution, Simplex method, Dual Simplex method and its application in engineering. Transportation and Assignment: Introduction, Mathematical formulations, optimal solution of transportation model. Assignment problems: mathematical formulation, solution of Assignment models (Hungarian method), variation of the Assignment problem, the travelling sales man problem and their application in Engineering.	8
II	Sequencing and Network Analysis: Introduction of sequencing, General assumptions, n Jobs through 2 machines, n jobs through 3 machines, n jobs through m machines, 2 jobs through m machines and their applications in Engineering. Network Analysis: Introduction, Network logic (Network or arrow diagram), Rules for drawing network diagrams, time analysis, forward and backward computation CPM and PERT, and their applications in Engineering.	8
III	Theory of Games and Queueing Models: Introduction, 2-person zero sum games, Maximin and minimax principle, game with saddle point and without saddle point, Principle of dominance, rectangular games, graphical solution of 2xn or mx2games. Queuing model: Introduction, Application of Queuing model, generalized Poisson queuing model, single server models and multiple channel Queuing model and their applications in Engineering.	8
IV	Dynamic Programming and Simulation: Introduction Formulation of Dynamic Programming Problem, Dynamic Programming Algorithm, Forward recursions, Capital Budgeting Problem, Cargo-loading Problem. Solution of LPP by DPP Simulation: Introduction, definition and types of simulation, need for Simulation advantage and disadvantage, application of simulation, simulation procedure, MonteCarlo simulation and their applications in Engineering.	8
V	Inventory Control and Replacement Models: Introduction, types of inventories, Inventory cost, Deterministic and probabilistic (nondeterministic) inventory models and their application in engineering. Replacement models: Introduction, definition, Replacement of items that deteriorate, Replacement of items that fail suddenly, Equipment Renewal Problem, Individual and Group Replacement policies & their applications in Engineering	8

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

COs	Statements
CO1	Apply linear programming, transportation, and assignment models to formulate and solve real-world optimization problems in engineering.

CO2	Analyze sequencing and network problems using CPM/PERT techniques for effective project planning and scheduling.
CO3	Evaluate competitive strategies and queuing systems to support decision-making in uncertain and resource-constrained environments.
CO4	Implement dynamic programming and simulation techniques for solving complex optimization and resource allocation problems.
CO5	Apply inventory and replacement models for resource management.

Text Books:

1. Singiresu S. Rao. “Engineering Optimization” Theory and Practice”. New AgeInternational, New Delhi.
2. R. Panneerselvam. “Operations Research “. Prentice- Hall of India, New Delhi
3. Eliezer Naddor. “Inventory Systems”. John Wiley & Sons, Inc. New York

Reference Books:

1. H.A. Taha: Operations Research – An Introduction, Macmillan Publishing Company,Inc., New York.
2. K. Swarup, P.K. Gupta, M. Mohan: “Operations Research”, Sultan Chand and Sons, New Delhi.
3. P.K. Gupta, D.S. Hira: “Operations Research”– An Introduction, S. Chand & CompanyLimited, New Delhi.
4. S.S. Rao: “Optimization Theory and Applications”, Wiley Eastern Ltd., New Delhi.
5. J.K. Sharma: “Operations Research: Theory and Applications”, Mac Millan India

IOE 079	Automation and Robotics	3L:0T:0P	3 Credits

Unit	Topics	No. of Hours
I	Automation: Definition, Advantages, goals, types, need, laws and principles of Automation. Elements of Automation. Fluid power and its elements, application of fluid power, Pneumatics vs. Hydraulics, benefit and limitations of pneumatics and hydraulics systems, Role of Robotics in Industrial Automation.	8
II	Manufacturing Automation: Classification and type of automatic transfer machines; Automation in part handling and feeding, Analysis of automated flow lines, design of single model, multimode and mixed model production lines. Programmable Manufacturing Automation CNC machine tools, Machining centers, Programmable robots, Robot time	8
III	Robotics: Definition, Classification of Robots – Geometric classification and Control classification, Laws of Robotics, Robot Components, Coordinate Systems, Power Source. Robot anatomy, configuration of robots, joint notation schemes, work volume, manipulator kinematics, position representation, forward and reverse transformations, homogeneous transformations in robot kinematics, D-Hnotations, kinematics equations, introduction to robot arm dynamics.	8
IV	Robot Drives and Power Transmission Systems: Robot drive mechanisms: Hydraulic/Electric/Pneumatics, servo & stepper motor drives, Mechanical transmission method: Gear transmission, Belt drives, Rollers, chains, Links, Linear to Rotary motion conversion, Rotary-to-Linear motion conversion, Rack and Pinion drives, Leadscrews, Ball Bearings. Robot end Effectors: Classification of End effectors – active and passive grippers, Tools as end effectors, Drive system for rippers. Mechanical, vacuum and magnetic grippers. Gripper force analysis and gripper design.	8
V	Robot Simulation: Methods of robot programming, Simulation concept, Off-line programming, advantages of offline programming. Robot Applications: Robot applications in manufacturing-Material transfer and machine loading/unloading, Processing operations like Welding & painting, Assembly operations, Inspection automation, Limitation of usage of robots in processing operation. Robot cell design and control, Robot cell layouts-Multiple robots & Machine interference.	8

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

COs	Statements
CO1	Explain the fundamental principles of automation, the application of fluid power systems, and the role of robotics in industry
CO2	Analyze automated flow lines and describe the function of CNC machines and programmable robots in manufacturing
CO3	Apply principles of kinematics, including D-H notations, to analyze robot manipulator position and work volume
CO4	Analyze robot drive systems, power transmission methods, and design appropriate end effectors for specific tasks
CO5	Evaluate robot applications in manufacturing and design robot cells using simulation and

	offline programming methods

Text Books:

1. An Introduction to Robot Technology, by Coifet Chirroza, Kogan Page.
2. Robotics for Engineers, by Y. Koren, McGraw Hill.
3. Robotic: Control, Sensing, Vision and Intelligence, by Fu, McGraw Hill.
4. Introduction to Industrial Robotics, by Nagrajan, Pearson India.
5. Robotics, by J.J. Craig, Addison-Wesley.
6. Industrial Robots, by Groover, McGraw Hill.
7. Robotic Engineering - An Integrated Approach : Richard D. Klafter Thomas A.
8. Robots & Manufacturing Automation, by Asfahl, Wiley.

Open Elective Courses-III

IOE 082	Quality Management	3L:0T:0P	3 Credits

Unit	Topics	No. of Hours
I	Quality Concepts: Evolution of Quality Control, concept change, TQM Modern concept, Quality concept in design, Review of design, Evolution of proto type. Control on Purchased Product: Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure. Manufacturing Quality: Methods and techniques for manufacture, inspection and control of product, quality in sales and services, guarantee, analysis of claims.	8
II	Quality Management: Organization structure and design, quality function, decentralization, designing and fitting, organization for different type products and company, economics of quality value and contribution, quality cost, optimizing quality cost, seduction program. Human Factor in quality Attitude of top management, cooperation of groups, operators attitude, responsibility, causes of apparatus error and corrective methods.	8
III	Control Charts, Theory of control charts, measurement range, construction and analysis of R charts, process capability study, use of control charts. Attributes of Control Chart, Defects, construction and analysis of charts, improvement by control chart, variable sample size, construction and analysis of C charts	8
IV	Defects diagnosis and prevention defect study, identification and analysis of defects, correcting measure, factors affecting reliability, MTTF, calculation of reliability, building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality circle	8
V	ISO-9000 and its concept of Quality Management, ISO 9000 series, Taguchi method, JIT in some details	8

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

COs	Statements
CO1	Explain the evolution of quality concepts and apply quality assurance methods in product design and procurement.
CO2	Analyze organizational structures and human factors to optimize quality cost and management practices.
CO3	Construct and interpret control charts to monitor and improve process capability.
CO4	Evaluate product defects and reliability parameters to ensure maintainability and zero-defect production.
CO5	Apply ISO 9000 standards, Taguchi methods, and JIT concepts for modern quality management.

Text Books:

1.Lt. Gen. H. Lal, “Total Quality Management”, Eastern Limited, .
2. Greg Bounds, “Beyond Total Quality Management”,McGraw Hill
3. Menon, H.G, “TQM in New Product manufacturing”,McGraw Hill

MOOC Courses

IME 074	Sustainable Power Generation Systems	3L:0T:0P	3 Credits

Unit	Topics	No. of Hours
I	Introduction, Fundamentals of solar thermal collector, Low temperature solar thermal power plant, Medium and high temperature solar thermal power plant, Thermal analysis of solar thermal power plant, Fundamentals and concept of solar PV power plant, off grid solar photovoltaic systems design, Grid connected solar photovoltaic systems, Performance of grid connected solar photovoltaic systems	9
II	Introduction to wind power generation, Wind data analysis, Performance parameters and blade geometry, Betz limit and optimum tip speed ratio, Design of wind farm, Fundamentals and working principle, Analysis of small hydro power generation, Introduction to biomass power generation, Biochemical conversion for electricity generation, Thermochemical conversion of solid fuels and gasification system	9
III	Hydrogen energy, Fuel cells technologies, Hydrogen energy tutorial, Fundamentals and methods of geothermal energy harvesting, Analysis of geothermal plant and resources,	7
IV	Fundamentals and working of ocean thermal energy conversion systems Analysis of close Rankine cycle OTEC system, Fundamentals and working of tidal energy conversion systems, Fundamentals and working of wave energy conversion systems	7
V	Overview and analysis of thermal energy storage, Fundamentals and analysis of mechanical energy storage system, Fundamentals and analysis of electro chemical energy storage system, Fundamentals and methodology of evaluation of energy economics, Case study involving energy economics of biomass power generation system and LCA	8

Course Outcomes:

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

COs	Statements
CO1	Explain and analyze the working principles, design, and performance of solar thermal and photovoltaic power plants for both off-grid and grid-connected systems.
CO2	Evaluate wind, small hydro, and biomass-based power generation systems through performance analysis, design parameters, and conversion techniques.
CO3	Examine and compare hydrogen energy, fuel cell technologies, and geothermal energy harvesting methods for sustainable electricity generation.
CO4	Analyze the working principles and performance of ocean, tidal, and wave energy conversion systems for marine-based renewable power generation.
CO5	Assess and apply concepts of thermal, mechanical, and electrochemical energy storage systems, and evaluate energy economics using life cycle assessment (LCA) and case studies

IME 075	Introduction to Composites	3L:0T:0P	3 Credits

Unit	Topics	No. of Hours
I	Definition of the composite materials, Composite materials and its applications, Classification of the composite materials, Advantages and limitations of composite materials, Properties of the composite materials, Different Types of Fiber, Production process and different types of Glass Fiber, Graphite Fibers, Aramid and Boron Fibers, Ceramic Fibers, Matrix - Properties and classifications, Polymers as matrix material and its classification, Thermosets and thermoplastics, Properties of thermosets and thermoplastics, Thermoset materials and its production methods, Thermoplastics and metals as matrix materials, Ceramic and carbon matrices.	8
II	Fabrication of Thermoset Composites, Hand Lay-Up Process, Bag Molding Process, Resin Transfer Molding Process etc., Fabrication of Thermoplastic, Metal and Ceramic Matrix based Composites, Terminologies and basic concepts, Orthotropic material,	8
III	Modeling of unidirectional composites, Composite density as a function of mass fraction and volume fraction, Calculation of longitudinal modulus for unidirectional composites, Failure modes of unidirectional composite, Failure of Unidirectional Lamina, Minimum Volume Fraction and Critical Volume Fraction, Transverse Modulus of Unidirectional Composite, Halpin-Tsai Relation for Transverse Modulus Transverse modulus of unidirectional composites, Transverse strength of unidirectional composites, Poisson's ratio of unidirectional composites, Failure modes of composite materials, Analysis of Specially Orthotropic Lamina	8
IV	Variation of elastic constants with respect to fiber orientation for generally orthotropic lamina, Generalized Hooke's law for anisotropic materials and anisotropic materials, Elastic constants for Especially orthotropic materials in plane stress, Relation Between Engineering Constants and Elements of Stiffness and Compliance Matrices- Part I, Relation between Engineering Constants and Elements of Stiffness and Compliance Matrices, Stress Strain Relations for A Lamina With Arbitrary Orientation, Importance of Sign of Shear Stress in context of Strength of A Unidirectional Lamina	8
V	Strain displacement relations for a laminate, Stress-strain relations for individual layers of a laminate, Resultant forces and moments, Relations between force and moment resultants and mid-plane strains and curvatures, Physical significance of extensional stiffness matrix, coupling matrix and bending stiffness matrix, Lamination sequence (standard laminate code), Simplification of Stiffness Matrice, Quasi-Isotropic Laminates, Failure of Composite Laminates.	8

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

COs	Statements
CO1	Explain and classify composite materials, their fibers, and matrices, while analyzing their properties, advantages, and limitations for engineering applications
CO2	Compare and apply different fabrication methods for thermoset, thermoplastic, metal, and

	ceramic matrix composites
CO3	Model and evaluate the mechanical properties of unidirectional composites, including modulus, strength, Poisson's ratio, and failure modes using analytical relations.
CO4	Analyze the elastic constants, stress–strain relations, and anisotropic behavior of orthotropic lamina with varying fiber orientations using stiffness and compliance matrices.
CO5	Examine and design laminated composite structures by applying strain–displacement and stress–strain relations, stiffness matrices, lamination sequences, and failure theories

IME 076	Energy Conversion and Waste Heat Recovery	3L:0T:0P	3 Credits

Unit	Topics	No. of Hours
I	Introduction to waste heat recovery, Introduction to Waste Heat, Importance of Waste Heat Recovery, Introduction to First and Second Laws, Thermodynamic principles of waste heat recovery, Reversible Cycles, Entropy, Exergy, Second Law efficiency, Recapitulation of common power cycles	9
II	Power Plant Cycles - Energy Cascading, Rankine Cycle, modification of Rankine cycle, examples, Gas Turbine cycle, Combined cycle, Heat recovery steam generator, Thermodynamic cycles for low temperature application, Heat exchanger, Heat Exchanger Network (HEN)	9
III	Thermodynamic cycles for low temperature application, Cogenerations, Introduction to Heat Exchangers, Analysis – LMTD and ε-NTU method, Analysis of Heat Exchanger – continued, Problem solving, Special Heat Exchangers for Waste Heat Recovery, Synthesis of Heat Exchanger Network	9
IV	Heat pipes & Vapor Chambers, Direct conversion technologies –Thermoelectric Generators, Direct conversion technologies – Thermoelectric Generators (contd.), Thermoionic conversion, Thermo-PV, MHD	7
V	Heat Pumps, Waste Heat Recovery from Incinerator Plants, Energy Storage Techniques – Pumped hydro, Compressed Air, Flywheel, Superconducting Magnetic storage, Thermal storage (Sensible & Latent), Battery, Chemical Energy Storage, Fuel cells, Hydrogen Economy, Fuel Cells, Energy Economics	7

Course Outcomes:

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

COs	Statements
CO1	Explain and analyze the principles of waste heat recovery using first and second laws of thermodynamics, exergy, entropy, and reversible cycles.
CO2	Evaluate energy cascading and thermodynamic performance of Rankine, gas turbine, and combined cycles with heat recovery steam generators for waste heat utilization
CO3	Apply and analyze methods for heat exchanger design and synthesis (LMTD, ε-NTU), and assess cogeneration and special heat exchangers for low-temperature waste heat recovery.
CO4	Examine direct conversion technologies such as thermoelectric, thermionic, thermo-photovoltaic, and magneto-hydrodynamic systems for waste heat to power conversion.
CO5	Assess and recommend suitable energy storage systems (thermal, mechanical, electrochemical, hydrogen-based) and waste heat recovery strategies in terms of energy economics and sustainability.