DR. A. P. J. ABDUL KALAM TECHNICAL UNIVERSITY

LUCKNOW, UTTAR PRADESH

STUDY & EVALUATION SCHEME WITH SYLLABUS

FOR

B. TECH. 4th YEAR

MECHANICAL ENGINEERING

[Effective from Session: 2021-22]

B. Tech Mechanical Engineering
Evaluation Scheme
Effective in Session 2021-22

SEMESTER- VII													
Sl. No.	Code	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1		HSMC-1/HSMC-2	3	0	0	30	20	50		100		150	3
2		Departmental Elective-IV	3	0	0	30	20	50		100		150	3
3		Departmental Elective-V	3	0	0	30	20	50		100		150	3
4		Open Elective-II	3	0	0	30	20	50		100		150	3
5	KME 751	Measurement & Metrology Lab	0	0	2				25		25	50	1
6	KME 752	Mini Project or Internship Assessment*	0	0	2				50			50	1
7	KME 753	Project	0	0	8				150			150	4
8		MOOCs (Essential for Hons. Degree)											
		Total	**9**	**0**	**12**	**21**						**850**	**18**

***The Mini Project or internship (5 - 6 weeks) conducted during summer break after VI semester and will be assessed during VII semester.

SEMESTER- VIII													
Sl. No	Code	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1		HSMC-2/HSMC-1	3	0	0	30	20	50		100		150	3
2		Open Elective-III	3	0	0	30	20	50		100		150	3
3		Open Elective-IV	3	0	0	30	20	50		100		150	3
4	KME 851	Project	0	0	18				100		300	400	9
5		MOOCs (Essential for Hons. Degree)											
		Total	**9**	**0**	**18**	**27**						**850**	**18**

It is suggested that the students should choose Departmental Electives Specialization wise that will support them to gain enough learning of the chosen Specialization.

Department Electives

	Specialization-1	**Specialization-2**	**Specialization-3**	**Specialization-4**	**Specialization-5**
Specialization	**Manufacturing and Automation**	**Automation and Industry 4.0**	**Design and Analysis**	**Thermal Engineering**	**Automobile Engineering**
Sem VII Code	KME 071			KME 072	KAU 072
Departmental Elective-IV	Additive manufacturing (Common to all Three Specializations)			HVAC systems	Hybrid Vehicle Propulsion
Sem VII Code	KME 073	KME 074	KME 075	KME 076	KAU 073
Departmental Elective-V	Mathematical Modeling of Manufacturing Processes	Machine Learning	Computer Graphics and product modeling	Power Plant Engineering	Vehicle Body Engineering & safety

Subject Code: KME 751	Measurement & Metrology Lab	L T P : 0 0 2	Credits: 1

Course Outcome (CO): The Students will be able to		Bloom Taxonomy
CO-1	Understand the basic principles of instrumentation for measurement of surface finish, strain, temperature, pressure and flow.	K2
CO-2	Understand the principle and operation of Coordinate Measuring Machine (CMM).	K2
CO-3	Apply Sine Bar, Slip Gauges, Bevel Protractor, Stroboscope, Dial Indicator etc. for measurement of different attributes.	K3
CO-4	Apply the basic concepts of limits, fits & tolerances for selective assembly.	K3

List of Experiments

Minimum 08 experiments out of following (or such experiment) are to be performed:

1. Measurement of effective diameter of a screw thread using 3 wire method.
2. Measurement of angle using sine bar & slip gauges.
3. Study of limit gauges.
4. Study & angular measurement using Bevel protector.
5. Study of different types of Comparators.
6. Study of important parameters of surface finish.
7. Study of principle and operation of coordinate-measuring machine (CMM).
8. Use of dial indicator and V Block to check the circularity and plot the polar Graph.
9. Study and understanding of limits, fits & tolerances in assembly of machine components.
10. Study and understanding of different methods of measurement of pressure.
11. Study and understanding of different methods of measurement of temperature.
12. Study and understanding of measurement of strain using strain gauges.
13. Study and understanding of different methods of measurement of flow.
14. Study and understanding of different methods of measurement of vibration/power.
15. Study and understanding of measurement of displacement using LVDT.

Semester – VII: Departmental Elective – IV
Specialization – Manufacturing and Automation
Automation and Industry 4.0
Design and Analysis

Subject Code: KME 071	Additive manufacturing	L T P : 3 0 0	Credits: 3

Course Outcome: Student will be able to		Bloom Taxonomy
CO 1	Understanding the basics of additive manufacturing/rapid prototyping and its advantages and disadvantages	K2
CO 2	Understanding the role of additive manufacturing in the design process and the implications for design.	K2
CO 3	Understanding the processes used in additive manufacturing for a range of materials and applications	K2
CO 4	Understand the various software tools, processes and techniques that enable advanced/additive manufacturing and personal fabrication.	K2
CO 5	Apply knowledge of additive manufacturing for various real-life applications	K3

UNIT I
Introduction
History and Advantages of Additive Manufacturing, Distinction Between Additive Manufacturing and CNC Machining, Types of Additive Manufacturing Technologies, Nomenclature of AM Machines, Direct and Indirect Processes; Prototyping, Manufacturing and Tooling.

Layer Manufacturing Processes: Polymerization, Sintering and Melting, Extrusion, Powder Binder Bonding, Layer Laminate Manufacturing, Other Processes; Aerosol printing and Bio plotter.

UNIT II
Development of Additive Manufacturing Technology
Computer Aided Design Technology, Other Associated Technology, Metal and Hybrid Systems.

Generalized Additive Manufacturing Process Chain; The Eight Steps in Additive Manufacturing, Variation from one AM Machine to Another, Metal System, Maintenance of Equipment, Material Handling Issue, Design of AM.

UNIT III
Additive Manufacturing Processes
Vat Photo polymerization; Materials, Reaction Rates, Photo polymerization Process Modelling, Scan Patterns

Powder Bed Fusion Processes; Material, Powder Fusion Mechanism, Process Parameters and Modeling, powder Handling

Extrusion Based System; Basic principles, plotting and Path Control, Other Systems

Material Jetting; Materials, Material Processing Fundamentals, Material Jetting Machines
Directed Energy Deposition Processes; General DED Process Description, Material Delivery, DED systems, Process Parameters, Processing-Structure-Properties Relationships

UNIT IV: Design & Software Issues
Additive Manufacturing Design and Strategies; Potentials and Resulting Perspectives, AM based New Strategies, Material Design and Quality Aspects for Additive Manufacturing; Material for AM, Engineering Design Rules for AM.

Software Issue for Additive Manufacturing; Introduction, Preparation of CAD Models: The STL file, Problem with STL file, STL files Manipulation, Beyond the STL file, Additional Software to Assist AM

UNIT V
Material Design & Quality Aspects
Machines for Additive Manufacturing, Printers, Secondary Rapid Prototyping processes, Intellectual Property, Product Development, Commercialization, Trends and Future Directions in Additive Manufacturing, Business Opportunities

Applications
Aerospace, Automotive, Manufacturing, Architectural Engineering, Art, Jewellery, Toys, Medical, Biomedical, Dental, Bio-printing, Tissue & Organ Engineering and many others.

Books and References:

1. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, by- Ian Gibson , DSavid W. Rosen , Brent Stucker, Springer.
2. Understanding Additive Manufacturing, by- Andreas Gebhardt, Hanser.
3. Additive Manufacturing, by- AmitBandyopadhyay, Susmita Bose, CRC Press.
4. Rapid Prototyping: Principles and Applications, by -Chee Kai Chua, Kah Fai Leong, Chu Sing Lim.

Semester – VII: Departmental Elective – IV: Specialization – Thermal Engineering

Subject Code: KME 072	HVAC systems	L T P : 3 0 0	Credits: 3

The students will be able to		Bloom Taxonomy
CO1	Understand the basics concepts of HVAC and various HVAC systems.	K2
CO2	Understand the use of refrigerants with their respective applications and its future trends.	K2
CO3	Understand the use of different auxiliary systems used in HVAC systems.	K2
CO4	Apply the basic laws for thermodynamic analysis of different processes involved in HVAC systems.	K3
CO5	Apply the basic concepts to calculate the HVAC loads for different applications.	K3
CO6	Apply the concepts of psychrometry to design HVAC systems for different applications	K3

Unit-I (8 Hours)

Advanced Vapour Compression Cycles: Review of vapour compression cycle, Effect of superheating, subcooling, condenser pressure and evaporator pressure on COP, Transcritical cycle, Ejector refrigeration cycle. Presentation of cycle on P-h and T-s chart.

Refrigerants: Classification of Refrigerants, CFC, HFC, HCFC, Azeotropic, Zeotropic, Natural refrigerant, Secondary Refrigerant, Anti-freeze solution, Phase Changing Materials. Desired properties of refrigerants, Requirements for refrigerant, Classification based on safety, Refrigerant oils and applications, Properties and uses of commonly used refrigerant, Greenhouse effect, Global warming, Future Refrigerants like Hydrofluoro-Olefines

Unit-II (7 Hours)

Review of Psychrometry: Psychrometric properties, Psychrometric chart and Psychrometric processes, Psychrometric process in Air conditioning equipment: By pass factor, cooling and dehumidifying coils, Apparatus dew point (ADP), Heating coils, air washer, use of hygroscopic solution in Air Washer, adiabatic dehumidifier, water injection, stream injection, Summer Air conditioning, Winter Air conditioning, Sensible heat factor (SHF), Grand Sensible heat factor (GSHF)

Design Condition:

Choice of inside design condition- cold storage, Industrial air conditioning, comfort air conditioning, Human comfort, Outside design condition

Unit-III (7 Hours)

Heat Pump: Introduction, package heat pump with reversible cycle, decentralized heat pump, heat pump with a double bundle condenser, industrial heat pump

Ventilation: Introduction, purpose of ventilation, Natural ventilation, mechanical ventilation, tunnels ventilation, mine ventilation, Natural ventilation, and mechanical ventilation.

Air Conditioning system: Introduction, Unitary system, central air conditioning system, directs expansion system, all water system, all air system, air water system.

Unit-IV: (11 Hours)

Load Calculation: Solar radiation, Heat gain through glass- Calculation of solar heat gain through ordinary glass tables-shading devices- effect of shading devices. Fabric heat gain, over all heat transfer coefficient, Periodic heat transfer through walls and roofs. Empirical methods to calculate heat transfer through walls and roofs using decrement factor and time lag method. Infiltration - stack effect, wind effect, infiltration load.

Internal heat loads, System heat gains, Break-up of ventilation and effective sensible heat factor, Cooling and heating load estimation, Psychrometric calculation for cooling, selection of air conditioning apparatus, Evaporative cooling, Building requirements and energy conservation in air conditioning buildings.

Unit-V (7 Hours)

Air Distribution: Room air distribution - types of supply air outlets, mechanism of flow through outlets, selection and location of outlets, Distribution patterns of outlets - ducts- Definition and types - materials for ducts and its specification, friction loss in ducts - grills, diffusers, registers, rectangular equivalent of circular duct. Air duct designs, duct construction, duct design procedures. Equal friction method, static regain method, velocity reduction method.

Air Conditioning Apparatus: Fans and blowers, types of fans, fan characteristic, centrifugal fans, axial fans, fan arrangements, Suction Line, Discharge Line (Hot-Gas Line), Liquid Line, location and arrangement of piping, vibration and noise in piping, basic elements of the control system

Text Books

1. Refrigeration and Air conditioning by C.P Arora, McGraw-Hill

Reference Books

2. Refrigeration and Air conditioning by stoecker& Jones. McGraw-Hill
3. Refrigeration and Air conditioning, by Manohar Prasad, New Age International (P) Ltd.Pub.
4. ASHRAE Handbook (HVAC Equipments)
5. Refrigeration and Air conditioning by R. C. Arora, PHI
6. Refrigeration and Air conditioning by Arora & Domkundwar. DhanpatRai
7. Air Conditioning System Design Manual, IInd edition, ASHRAE.

Semester – VII: Departmental Elective – IV: Specialization – Automobile Engineering

Subject Code: KAU 072	Hybrid Vehicle Propulsion	L T P : 3 0 0	Credits: 3

The students will be able to		Blooms Taxonomy
CO-1	Understand the basics of the hybrid electric vehicles and it's types.	K2
CO-2	Understand the types of drive trains used in hybrid vehicles	K2
CO-3	Understand the propulsion units used in Hybrid Vehicles and their efficiency.	K2
CO-4	Understand the requirements and devices of energy storage used in hybrid vehicles.	K2
CO-5	Understand the concept of downsizing of IC engines in case of hybrid vehicles.	K2
CO-6	Understand the principles of energy management and issues related to these strategies.	K2

UNIT I

Introduction to Hybrid Electric Vehicles: (4 Hours)

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: (4 Hours)

Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance.

UNIT II

Hybrid Electric Drive-trains: (4 Hours)

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: (4 Hours)

Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

UNIT III

Electric Propulsion unit: (10 Hours)

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

UNIT IV

Energy Storage: (5 Hours)

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: (4 Hours)

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

UNIT V

Energy Management Strategies: (8 Hours)

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.

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.

Semester – VII: Departmental Elective – V: Specialization – Manufacturing and Automation

Subject Code: KME 073	Mathematical Modeling of Manufacturing Processes	L T P : 3 0 0	Credits: 3

Course Outcome: Student will be able to		Bloom Taxonomy
CO1	Understand the fundamentals of manufacturing processes, mathematical models and their solutions	K2
CO2	Understand unconventional and conventional machining, their discrete-time linear, non-linear models and solutions	K2
CO3	Analyze the mechanism of forming and heat transfer in welding	K4
CO4	Apply the principles of casting, powder metallurgy, coating and additive Manufacturing	K3
CO5	Understand the fundamental of heat treatment, micro / nano manufacturing and processing of non-metallic materials.	K2

Unit-1:

Introduction to Manufacturing processes; Materials Processing; Types and Properties of Engineered Materials; Evaluation of Properties of Manufactured Products; Statistical and data-driven modelling approach; Overview of mathematical modeling, types of mathematical models and methods to solve the same. Physics of manufacturing processes; Solid-state deformation (Elasticity and Plasticity) and residual stresses; solid-state phase transformation and recrystallization; melting and solidification; Coupled Systems

Unit-2:

Conventional machining; Orthogonal cutting; Tool geometry; chip formation; force components; heat generation; tool life; mathematical modelling approach; solution of problems; Introduction to discrete-time linear and non-linear models. Non-conventional machining; Principal and mechanism of different processes; Parametric analysis of heat transfer, material removal, and surface finish.

Unit-3:

Metal forming; Mechanics of bulk metal forming; mechanics of sheet metal forming; heat transfer and deformation; Welding; Fusion welding; Welding-heat source modeling, temperature distribution, effect of surface- active elements, modes of metal transfer in welding; Solid-state welding; Solidification and microstructure; Residual stress and distortion.

Unit-4:

Casting and powder metallurgy; Cooling and Solidification; principle of powder metallurgy; Coating and additive manufacturing; Principle of surface and coating technology; Principle and development of additive manufacturing technologies

Unit-5:

Heat treatment; Fundamentals of heat treatment; Evaluation of microstructure properties and residual stress of different manufacturing processes. Micro/nanoscale manufacturing; Down-scaling of conventional manufacturing processes, Change of properties, Micro-to-nano manufacturing; Packaging, finishing, micro joining and nano joining, micro casting, micro forming, micromachining. Processing of non-metallic materials; Principle of plastic processing and shaping of plastics, processing of non-metallic bio-materials; Principle of glass and ceramics processing and shaping of glass and ceramics.

Books and References

1. A Ghosh and A K Mallik: Manufacturing Science, East-West Press Pvt Ltd, 2nd Ed., 2010.
2. D A Brandt, J C Warner: Metallurgy Fundamentals, Goodheart- Willcox, 2009.
3. C Lakshmana Rao and Abhijit P Deshpande: Modelling of Engineering Materials, Ane Books Pvt. Ltd., New Delhi, India, 2010.
4. J. Chakrabarty: Theory of plasticity, 3rd Eds, Elsevier India, 2009.
5. Norman Y Zhou: Microjoining and Nanoioining, Woodhead publishing, 2008
6. R W Messler: Principles of Welding John Wiley and Sons, 1999.
7. J T Black and Ronald A Kohser: DeGarmo's Materials & processes in Manufacturing Wiley-India, 2010.
8. V K Jain: Advanced Machining Processes, Allied Publishers, Mumbai, 2002.
9. Yi Qin: Micromanufacturing Engineering and Technology, Elsevier, 2015.
10. J Zhang and Yeon-Gil Jung: Additive Manufacturing: Materials, Processes, Quantifications and Applications, Elsevier, 2018.
11. J A Dantzig and M Rappaz: Solidification, CRS press, 2009.
12. J.N. Kapur, Mathematical Models in Biology and Medicine, East-West Press Private limited.
13. Leah, Edelstein, Keshet, Mathematical Models in Biology, SIAM publications.
14. J.D. Murray, Mathematical Biology Vol. I, II, 3rd edition, Springer publications.

Related Course's / Useful Links

1. https://www.digimat.in/nptel/courses/video/112103273/L01.html
2. https://swayam.gov.in/nd1_noc20_ma47/preview

Semester – VII: Departmental Elective – V: Specialization – Automation and Industry 4.0

Subject Code: KME 074	Machine Learning	L T P : 3 0 0	Credits: 3

Course Outcomes: Students are able to		**Bloom's Taxonomy**
CO 1	Understand the need of machine learning concepts	K2
CO 2	To Understand a wide variety of ML Algorithms and how to evaluate models generated from data	K3
CO 3	Solve prediction based problems	K3
CO 4	Analyze machine learning algorithms	K4
CO 5	Apply the Algorithms to real-world problems	K4

Unit 1: Introduction to Machine Learning (6Hours)

An Introduction to Machine Learning, Types of Machine Learning, and Applications of ML in Mechanical Engineering, Designing a Learning System, Performance Measures for ML Model, Issues in Machine Learning, AI vs. ML, and Essential Math for ML and AI, Data Science Vs Machine Learning

Unit 2: Supervised Learning (9Hours)

Supervised Learning: Introduction to Supervised Learning, Classification, Regression Analysis and its Types , Model Selection Procedures, Bayesian Decision Theory, Naïve Bayes Classifier, Bayes Optimal Classifier, Evaluating an Estimator: Bias and Variance , Support Vector Machines, Types of Support Vector Kernel(Linear Kernel, Polynomial Kernel, Gaussian Kernel, Issues in SVM, Case Study on House Price Prediction using Machine Learning.

Unit 3: Unsupervised Learning (9Hours)

Unsupervised Learning: Introduction to Unsupervised Learning, Cluster Analysis, K-Means Clustering, Expectation-Maximization Algorithm, Dimensionality Reduction: Principal Components Analysis, Independent Component Analysis, Multidimensional Scaling, Linear Discriminant Analysis.

Unit 4: Decision Tree & Neural Networks (9Hours)

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.)

Unit 5: Genetic Algorithms & Reinforcement Learning (7Hours)

Genetic Algorithm: Introduction, Components of Genetic Algorithm, CrossOver, 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,

Text Book:

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.

Semester – VII: Departmental Elective – V: Specialization – Design and Analysis

Subject Code: KME 075	Computer Graphics and Product Modeling	L T P : 3 0 0	Credits: 3

Course Outcome: Student will be able to		Bloom Taxonomy
CO 1	Understand the components of a computer graphics with object representation and to develop algorithm for graphics system components.	K2
CO 2	Understand the basic principles of 3- dimensional computer graphics and express the 3D model with illumination and shading effects.	K2
CO 3	Develop a 3D solid model using 3D Solid Modeling Software	K4
CO 4	Identify the customer needs in order to develop a business model for new product.	K3
CO 5	Develop strategy for designing and development of a new product	K4

Unit-1:

Introduction to computer graphics – historical evolution, issues and challenges, graphics pipeline, hardware and software basics; line and circle drawing algorithms, , Object representation – boundary representation, splines- cubic, Bezier, B-spline and NURBS, space partitioning

Unit-2:

Modeling transformations – matrix representation, homogeneous coordinate system, composition, 3D transformations; Illumination and shading – background, simple lighting model, shading models, intensity representation, color models, texture synthesis.

Unit-3:

3D Graphics: Polygon surfaces-Polygon mesh representations, Quadric and Superquadric surfaces and blobby objects; Solid modeling-Solid entities, Fundamentals of Solid modeling-Set theory, regularized set operations; Half spaces, Boundary representation, Constructive solid geometry, Sweep representation, Color models. Application Commands for3D Solid Modeling Software like Solidworks /Autodesk Inventor / PTC Creo / Catia (Any one) etc.

Unit-4:

Managing Product Development- Introduction; Business Models for New Products; Managing Product Development; Understanding Customer Needs- Identifying New Product Opportunities, Market Research for New Product Development. Introduction to Product Life Cycle Management and related software

Unit-5:

Organizing Product Development-Product Architecture, Design for manufacturing and Prototyping; Organizing for Product Development; Developing Services and Product Service Systems; New Product Strategy- Building Markets and Creating Demand for New Products; Intellectual Property Issues in Product Development; New Product Business Plans – Strategy Consulting for New Products; Design Thinking for New Products- Designing Products for Emerging Markets; Design Thinking for New Products

Books and References

1. Samit Bhattacharya. (2015). Computer Graphics. Oxford University Press.
2. Hearn, D. & Baker, M. P. (2003). Computer Graphics with OpenGL, (3rd ed), Pearson.
3. Drew Boyd & Jacob Goldenberg (2013) Inside the Box: The Creative Method that Works for Everyone
4. Joseph V. Sinfield, Edward Calder, Bernard McConnell, and Steve Colson (2012) How to Identify New Business Models, MIT Sloan Management Review Vol. 53, No.2.
5. Chun-Che Huang (2000) Overview of Modular Product Development, Proc. National Science Council ROC(A) Vol. 24, No. 3, pp. 149-165
6. Marc H. Meyer and Arthur DeTore (1999) Product Development for Services, The Academy of Management Executive, Vol. 13, No. 3, Themes: Teams and New Product Development (Aug., 1999), pp. 64-76

Related Course's / Useful Link

1. https://swayam.gov.in/nd1_noc20_cs90/preview
2. https://nptel.ac.in/courses/106/106/106106090/
3. https://nptel.ac.in/courses/112/102/112102101/
4. https://swayam.gov.in/nd1_noc20_me12/preview
5. https://swayam.gov.in/nd1_noc20_de05/preview

Semester – VII: Departmental Elective – V: Specialization – Thermal Engineering

Subject Code: KME 076	Power Plant Engineering	L T P : 3 0 0	Credits: 3

Course Outcome: The student will be able to		Bloom Taxonomy
CO-1	Understand the different sources of power generation and their impact on environment.	K2
CO-2	Understand the elements of power generation using conventional and non-conventional energy sources.	K2
CO-3	Understand the concepts of electrical systems used in power plants.	K2
CO-4	Apply the basic concepts of thermodynamics to measure the performance of different power plants.	K3
CO-5	Determine the performance of power plants based on load variations.	K3

Unit I

Introduction to Power Plants

Introduction to the sources of energy: conventional and non-conventional; Principal types of power plants; Present status and future trends; Carbon credits.

Thermal Power Plant

General layout of modern thermal power plant, Review of Rankine and modified Rankine cycles, Power plant boilers including critical and super critical boilers. Fluidized bed boilers, boilers mountings and accessories. Feed water treatment and condenser and cooling towers and cooling ponds, Turbine auxiliary systems such as governing, feed heating, reheating, flange heating and gland leakage. Operation and maintenance of steam power plant, heat balance and efficiency, Site selection of a steam power plant.

Unit II

Hydroelectric Power Plant

Hydro-electric plant, General arrangement of hydroelectric power plant, Plant layout, Penstock and water hammer, Specific speed and capacity calculations, Classification of hydro-plant, Low-, medium- and high-head plants, Pumped storage plant, Run-off river power plant, Surge tanks.

Gas turbine power plant:

Layout of gas turbine power plant, Elements of gas turbine power plants, Gas turbine fuels, cogeneration, auxiliary systems such as fuel, controls and lubrication, operation and maintenance, combined cycle power plants, Site selection of gas turbine power plant, Integrated Gas fire based Combined Cycle (IGCC) systems. Controlling of air fuel ratio (AFR) in power plant.

Unit 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, Reactor control, Radiation hazards, Radioactive waste disposal, Nuclear power generation in India.

Solar Power Plant

Solar energy collectors, Photovoltaic power system, Solar central receiver system, Solar thermal energy, types of solar thermal plant, typical layout and components, solar parabolic trough plants, solar tower power plants, and solar dish power plants. Working principle of concentrating solar thermal power plant and their applications.

Unit IV

Non-Conventional Power Plants

Geothermal energy: Hydrothermal systems, Petro thermal systems, Hybrid geothermal fossil systems, Problems associated with geothermal conversion,

Wind energy: Components of a wind generator, Horizontal and vertical axis wind mills, Aerodynamic considerations of wind mill design, Coefficient of performance of wind mill rotor, Availability of wind energy in India, Wind power by country.

Tidal energy: The simple single pool tidal system, The modulated single pool tidal system, The two-pool tidal system, Ocean thermal energy conversion, Principle of working, Ocean temperature differences, The open or Claude cycle, The closed or Anderson OTEC cycle,
Electricity generation from Fuel cells and city garbage.

Unit V

Electrical system:

Introduction to generator and exciters, Earthing of power systems, Power and unit transformer, Circuit breakers, Protective equipment, Switch gear.

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

Environmental Aspects of Power Station

Environmental aspects, Different pollutants due to thermal power plant and their effect on human health, Thermal pollution of water and its control, Effluents from power plants and impact on environment, Radiation from nuclear power plant effluents, Methods of pollution mitigation and control.

Books and References:

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.

Semester – VII: Departmental Elective – V: Specialization – Automobile Engineering

Subject Code: KAU 073	Vehicle Body Engineering & safety	L T P : 3 0 0	Credits: 3

The students will be able to		Blooms Taxonomy
CO-1	Understand the classification of the vehicles on the basis of body.	K2
CO-2	Understand the importance of material selection in designing automotive bodies.	K2
CO-3	Understand the concepts of aerodynamics used in designing automobiles.	K2
CO-4	Understand the importance of interior and exterior ergonomics while designing the vehicle.	K2
CO-5	Identify various sources of noise and methods of noise separation and various safety aspects in a given vehicle.	K2
CO-6	Calculate various aerodynamic forces and moments acting on vehicle, load distribution in vehicle body and stability of vehicle.	K3

UNIT-I:

Classification of Coachwork: [L-9 Hours]

Styling forms, coach and bus body style, layout of cars, buses and coach with different seating and loading capacity, types of commercial vehicles, vans and pickups, etc. Terms used in body building construction, angle of approach, Angle of departure, ground clearance, Cross bearers, floor longitudes, posts, seat rail, waist rail, cant rail, Roof stick, Roof longitude, Rub rail, skirt rail, truss panel, wheel arch structure, wheel arch, post diagonals, gussets.

UNIT-II:

Vehicle Body Materials: [L-9 Hours]

Aluminum alloys, Steel, alloy steels, plastics, Metal matrix composites, structural timbers - properties, glass reinforced plastics and high strength composites, thermoplastics, ABS and styrenes, load bearing plastics, semi rigid PUR foams and sandwich panel construction. Paints adhesives and their properties, corrosion and their prevention.

UNIT-II:

Aerodynamics: [L-5 Hours]

Basics, Vehicle drag and types, Various types of forces and moments, effects of forces and moments, various body optimization techniques for minimum drag, Principle of wind tunnel technology, flow visualization techniques, tests with scale models, aerodynamic study for heavy vehicles.

Load Distribution: [L-5 Hours]

Type of body structures, Vehicle body stress analysis, vehicle weight distribution, Calculation of loading for static loading, symmetrical, longitudinal loads, side loads, stress analysis of bus body structure under bending and torsion.

UNIT-IV:

Interior Ergonomics: [L-4 Hours]

Introduction, Seating dimensions, Interior ergonomics, ergonomics system design, seat comfort, suspension seats, split frame seating, back passion reducers, dash board instruments, electronic displays, commercial vehicle cabin ergonomics, mechanical package layout, goods vehicle layout. Visibility, regulations, drivers visibility, methods of improving visibility, Window winding and seat adjustment mechanisms.

Vehicle Stability: [L-4 Hours]

Introduction, Longitudinal, lateral stability, vehicle on a curvilinear path, critical speed for toppling and skidding.Effect of operating factors on lateral stability, steering geometry and stabilization of steerable wheels, mass distribution and engine location on stability.

UNIT-V:

Noise and Vibration: [L-5 Hours]

Noise characteristics, Sources of noise, noise level measurement techniques, Body structural vibrations, chassis bearing vibration, designing against fatigue, methods of noise suppression.

Impact protection: [L-5 Hours]

Basics, physics of impact between deformable bodies, design for crash worthiness, occupant and cargo restraint, passive restraint systems, side impact analysis, bumper system, energy absorbent foams, laws of mechanisms applied to safety**.**

Books &Reference:

1. Bosch, “Automotive Handbook”, 8th Edition, SAE publication, 2011.
2. Powloski J., “Vehicle Body Engineering”, Business books limited, London, 1969.
3. Ronald K. Jurgen, “Automotive Electronics Handbook”, Second Edition, McGraw-Hill Inc., 1999.
4. Vehicle body engineering Giles J Pawlowsky Business books limited 1989
5. Vehicle body layout and analysis John Fenton Mechanical Engg. Publication ltd, London. 1990
6. Vehicle Safety 2002 Cornwell press Town bridge, UK ISBN 1356 – 1448
7. Aerodynamics of Road Vehicles W.H. Hucho Butter worth’s 1987 4th Edition