परीक्षा नियंत्रण प्रकोष्ठ, जबलपुर इंजीनियरिंग महाविद्यालय, जबलपुर (म.प्र.)

क्रमांक / प.नि.प्र. / 2020 / 219 जबलपुर, दिनांक 30/12/2020

सूचना

महाविद्यालय के B.E. / B.Tech. एवं B.E. (PTDC) कोर्स के अंतर्गत विभिन्न स्कीम के समान पाठ्यक्रम के सिलेबस की समतुल्यता संलग्न सारणी अनुसार निर्धारित की गयी है। अतः CE/EE/EC/CSE/IT/IP विभाग के विद्यार्थी सारणी के तृतीय कॉलम मे दर्शित विषयों के स्थान पर उनके सम्मुख अंतिम कॉलम में दर्शित विषय एवं Mechanical विभाग के विद्यार्थी संलग्न सारणी अनुसार सरल क्रमांक (Serial No.) में दर्शित प्रथम विषय के कोड अनुसार Final Subject Code & Subject (After Equivalence) के सेलेबस द्वारा आगामी परीक्षाओं की तैयारी करना सुनिश्चित करें।

प्राचार्य / मुख्य परीक्षा नियंत्रक
जबलपुर इंजीनियरिंग महाविद्यालय,
जबलपुर (म.प्र.)

Jabalpur Engineering College, Jabalpur

Department of Mechanical Engineering

S. No./MED/2020/252 **Dated, December 10, 2020**

To,

Controller of Examination
Jabalpur Engineering College
Jabalpur

Sub : Equivalence of subjects.

This is in reference to the subject cited above, the equivalence of the subjects of different schemes of the Under Graduate Courses of Mechanical Engineering Department is as under for your necessary action.

1. Subject code ME-701 (AICTE Scheme) is having equivalence of subject codes ME-69 (Grading System) and ME-7001 (Choice Based Grading System).
2. Subject code ME-702 (AICTE Scheme) is having equivalence of subject codes ME-48 (Grading System) and ME-7002 (Choice Based Grading System).
3. Subject code ME-703 (AICTE Scheme) is having equivalence of subject codes ME-50 (Grading System) and ME-7003 (Choice Based Grading System).
4. Subject code ME-704 A (AICTE Scheme) is having equivalence of subject codes ME-53 C (Grading System) and ME-7004 A (Choice Based Grading System).
5. Subject code ME-704 B (AICTE Scheme) is having equivalence of subject code ME-8004 B (Choice Based Grading System).
6. Subject code ME-705 A (AICTE Scheme) is having equivalence of subject codes ME-52 (Grading System) and ME-7005 A (Choice Based Grading System).
7. Subject code ME-801 (AICTE Scheme) is having equivalence of subject codes ME-67 (Grading System) and ME-8001 (Choice Based Grading System).
8. Subject code ME-802 (AICTE Scheme) is having equivalence of subject codes ME-46 (Grading System) and ME-8002 (Choice Based Grading System).
9. Subject code ME-803 A (AICTE Scheme) is having equivalence of subject codes ME-71 (Grading System) and ME-8003 A (Choice Based Grading System).
10. Subject code ME-803 B (AICTE Scheme) is having equivalence of subject code ME-8003 B (Choice Based Grading System).
11. Subject code ME-803 C (AICTE Scheme) is having equivalence of subject code ME-8003 C (Choice Based Grading System).
12. Subject code ME-804 A (AICTE Scheme) is having equivalence of subject codes ME-73 A (Grading System) and ME-8004 A (Choice Based Grading System).

Original Copy

Prof. (Dr.) Veerendra Kumar
Dean (Academics) and Professor of Mechanical Engineering

Jabalpur Engineering College, Jabalpur (M.P)
PROGRAMME: B.Tech. Mechanical Engineering (VII-Semester) AICTE
w.e.f. July 2017-18 batch

Credits: 4	ME701	Refrigeration & Air Conditioning	L: 3, T: 0, P: 2

Course Objective

1. Learn the basic concepts and principles of refrigeration and air conditioning.
2. Learn the fundamental analysis methodology of refrigeration.
3. Learn the basic process and systems of air conditioning.
4. Will apply the course knowledge to do a design project of HVAC system.

Course Content

Module-I

Introduction: Principles and methods of refrigeration, freezing; mixture cooling by gas reversible expansion, throttling, evaporation, Joule Thomson effect and reverse Carnot cycle; unit of refrigeration, coefficient of performance, vortex tube & thermoelectric refrigeration, adiabatic demagnetization; air refrigeration cycles- Joule's cycle Boot-strap cycle, reduced ambient cycle and regenerative cooling cycles.

Module-II

Vapour compression system: Vapor compression cycle, p-h and t-s diagrams, deviations from theoretical cycle, sub-cooling and super heating, effects of condenser and evaporator pressure on cop; multi-pressure system: removal of flash gas, multiple expansion & compression with flash inter cooling; low temperature refrigeration: production of low temperatures, cascade system, dry ice, production of dry ice, air liquefaction system,.

Module-III

(a) **Vapour absorption system**: Theoretical and practical systems such as aqua-ammonia, Electrolux & other systems;
(b) **Steam jet refrigeration**: Principles and working, simple cycle ofoperation, description and working of simple system,
(c)**Refrigerants:** nomenclature & classification, desirable properties, common refrigeration, comparative study, leak detection methods, environment friendly refrigerants and refrigerant mixtures, brine and its properties

Module-IV

Psychometric: Calculation of psychrometric properties of air by table and charts;psychrometric processes: sensible heating and cooling, evaporative cooling, cooling and dehumidification, heating and humidification, mixing of air stream, sensible heat factor; principle of air conditioning, requirements of comfort air conditioning, ventilation standards, infiltrated air load, fresh air load human comfort, effective temperature & chart, heat production & regulation of human body,

Module-V

Air conditioning: Calculation of summer & winter air conditioning load, bypass factor ofcoil, calculation of supply air rate & its condition, room sensible heat factor, grand sensible heat factor, effective sensible heat factor, dehumidified air quantity. Problems on cooling load calculation. Air distribution and ventilation systems

Evaluation:

Evaluation will be continuous and integral part of the class as well as through external assessment.

References:

1. Arora CP; Refrigeration and Air Conditioning; TMH
2. Sapali SN; Refrigeration and Air Conditioning; PHI
3. Ananthanarayan; Basic Refrigeration and Air conditioning; TMH
4. Manohar Prasad; Refrigeration and Air Conditioning; New Age Pub
5. Ameen; Refrigeration and Air Conditioning; PHI
6. Pita; Air conditioning Principles and systems: an energy approach; PHI
7. Stoecker W.F, Jones J; Refrigeration and Air conditioning; McGH, Singapore
8. Jordan RC and Priester GB Refrigeration and Air Conditioning, PHI USA

Course Outcomes:

At the completion of this course, students should be able to

CO1	Explain the principles and methods of refrigeration.
CO2	Evaluation of VCRS and Vapor absorption systems and applications.
CO3	Analyze psychrometric properties and processes.
CO4	Elaborate the heating and cooling load for a given AC system.

Mapping of Course outcomes (COs) with Program Outcomes (POs):

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	1		2									
CO2	1	3	1									
CO3	1	2	2									
CO4	1	2	1	2								

List of Experiments:

1. General Study of vapor compression refrigeration system.
2. General Study of Ice Plant
3. General Study and working of cold storage
4. General Study Trane Air Condition (Package Type).
5. General Study of Electrolux Refrigeration
6. General Study One tone Thermax refrigeration unit.
7. General Study of Water cooler
8. General Study of Psychrometers (Absorption type)
9. General Study of Leak Detectors (Halide Torch).
10. General Study and working of Gas charging Rig.
11. General Study of window Air Conditioner.
12. General Study and working of Vapor compression Air conditioning Test rig.
13. Experimentation on Cold Storage of Calculate COP & Heat Loss.
14. Experimentation on Vapor compression Air Conditioning test rig.
15. Changing of Refrigerant by using Gas Charging Kit.

Evaluation:
Evaluation will be continuous and integral part of the class followed by the final practical examination as well as through external assessment

Course Outcomes: (Lab)
At the completion of this course, students should be able to

CO1	Evaluate the principles of ice plant and cold storage.
CO2	Analyze the Electrolux Refrigeration system and Psychrometric processes
CO3	Elaborate the working of Gas charging Rig.
CO4	Formulate the problem and solution of window AC.

Mapping of Course outcomes (COs) with Program Outcomes (POs):(Lab)

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	1		2									
CO2	1	2	1		1							
CO3	1	2	2									
CO4	1	2	1	2								

Jabalpur Engineering College, Jabalpur (M.P)
PROGRAMME: B.Tech. Mechanical Engineering (VII-Semester) AICTE
w.e.f. July 2017-18 batch

Credits: 4	ME702	Vibration & Noise Control L: 3, T: 0, P: 2

Course Objective

1. Learn the basic concepts and principles of vibration in mechanical systems.
2. Learn the fundamental damped free and undamped free vibration.
3. Learn the basic principle of noise engineering.

Course Content

Module-I:

Fundamental Aspects of Vibrations: Vibration, main causes, advantages and disadvantages; engineering applications of vibration and noise; vector method of representing harmonic motion; characteristics of vibration, harmonic analysis and beats phenomenon, work done by harmonic forces on harmonic motion; periodic, non-harmonic functions- Fourier series analysis; evaluation of coefficients of Fourier series; elements of vibratory system; lumped and distributed parameter systems. **Undamped Free Vibrations:** Derivation of differential equation of motion: the energy method, themethod based on Newton's second law of motion, and Rayleigh's method. Solution of differential equation of motion: Natural frequency of vibration. Systems involving angular oscillations: the compound pendulum.

Module-II:

Damped Free Vibrations: Viscous damping: coefficient of damping; damping ratio; underdamped, over damped and critically damped systems; logarithmic decrement; frequency of damped free vibration; Coulomb or dry friction damping; frequency, decay rate and comparison of viscous and Coulomb damping; solid and structural damping; slip or interfacial damping.

Module-III:

Harmonically excited Vibration: One degree of freedom- forced harmonic vibration; vector representation of forces; excitation due to rotating and reciprocating unbalance; vibration Isolation, force and motion transmissibility; absolute and relative motion of mass (Seismic Instruments).

Whirling Motion and Critical Speed: Whirling motion and Critical speed: Definitions and significance. Critical –speed of a vertical, light –flexible shaft with single rotor: with and without damping. Critical speed of a shaft carrying multiple discs (without damping), Secondary critical speed.

Module-IV:

Systems with Two Degrees of Freedom: Un-damped free vibration of 2 d.o.f and Principalmodes of vibration; torsion vibrations; Forced, Un-damped vibrations with harmonic excitation; Coordinate coupling; Dynamic vibration absorber; torsion Vibration Absorber; Pendulum type of dynamic vibration.

Module-V:

Noise Engineering –Subjective response of sound: Frequency and sound dependent humanresponse; the decibel scale; relationship between, sound pressure level (SPL), sound power level and sound intensity scale; relationship between addition, subtraction and averaging, sound spectra and Octave band analysis; loudness; weighting networks; equivalent sound level, auditory effects of noise; hazardous noise, exposure due to machines and equipments; hearing conservation and damage risk criteria, daily noise doze.

Noise: Sources, Isolation and Control: Major sources of noise on road and in industries, noise due toconstruction equipments and domestic appliances, industrial noise control, strategies- noise control at source (with or without sound enclosures), noise control along the path (with or without partitions and acoustic barriers); noise control at the receiver, ear defenders, earplugs, semi-insert protectors.

Evaluation:
Evaluation will be continuous and integral part of the class as well as through external assessment.

References:

1- Ambekar A.G., 'Mechanical Vibrations and Noise Engineering', PHI.
2- Meirovitch Leonard,'Element of Vibration Analysis', TMH.
3- Dukikipati RV, Srinivas J,'Text book of Mechanical Vibrations', PHI.
4- Kelly SG and kudari SK,'Mechanical Vibrations',Schaum Series, TMH.
5- Thomson , W.T., 'Theory of Vibration with Applications', C.B.S Pub & distributors .
6- Singiresu Rao, 'Mechanical Vibrations', Pearson Education.
7- G.K. Grover, 'Mechanical Vibration', Nem chand and Bross , Roorkee.

Course Outcomes:
At the completion of this course, students should be able to-

CO1	Analyze Undamped and Damped free vibration systems.
CO2	Evaluate the two Degrees of Freedom.
CO3	Explain whirling motion and critical speed in Harmonically excited Vibration.
CO4	Evaluate sound pressure level (SPL), sound power level and sound intensity.

Mapping of Course Outcomes (COs) with Program Outcomes (POs):

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	1								
CO2	1	1	2									
CO3	1	1	2									
CO4	1	1	2		1							

List of experiments:

1. To find out effect of load on natural frequency of vibrations of a lever pin supported at one end carrying adjustable load on a vertical screwed bar and spring supported at some intermediate point (i) When the dead weight of rods is neglected and (ii) when their dead weight is taken into account .
2. To find out frequency of damped free vibration and rate of decay of vibration-amplitude in the system.
3. To find out natural frequency and damped free frequency of a torsion pendulum and, hence to find out coefficient of damping of the oil;
4. To observe the phenomenon of 'whirl' in a horizontal light shaft and to determine the critical speed of the shaft.
5. To observe the mode shapes of a spring-connected, double pendulum and hence to demonstrate the phenomenon of beats.
6. To demonstrate the principle of tuned Undamped Dynamic Vibration Absorber and to determine the effect of mass-ratio (of main and auxiliary mass) on the spread of the resulting

natural frequencies;

7. To take measurements of sound Pressure Level (SPL) and to carry out octave band analysis of a machine using Noise Level Meter.

Evaluation:

Evaluation will be continuous and integral part of the class followed by the final practical examination as well as through external assessment

Course Outcomes:

At the completion of this course, students should be able to-

CO1	Analyze Undamped and Damped free vibration systems.
CO2	Evaluate the two Degrees of Freedom and
CO3	Explain whirling motion and critical speed in Harmonically excited Vibration.
CO4	Evaluate sound pressure level (SPL), sound power level and sound intensity

Mapping of Course outcomes (COs) with Program Outcomes (POs):

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	1								
CO2	1	1	2									
CO3	1	1	2									
CO4	1	1	2		1							

Jabalpur Engineering College, Jabalpur (M.P)
PROGRAMME: B.Tech. Mechanical Engineering (VII-Semester) AICTE
w.e.f. July 2017-18 batch

Credits: 4 ME703 Operations Research& Supply Chain L: 3, T: 0, P: 2

Course Objective:

The student will be made to learn.

1. To be familiar with all the OR Techniques and optimization methods.
2. To understand the role of logistics in the supply chain within a focal firm as well as between organisations linked within a given supply chain network.
3. To be familiar with various inventory control techniques.
4. Students will get a clear idea of the decision making and meta-heuristic algorithm.

Course Content:

Module-I

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 theirgraphical solution, Vogels Approximation Method (VAM) or penalty method, cell evaluation degeneracy, basics of SW Lindo, Tora, Excel.

Module-II

Supply chain (SCM): Definition, importance, expenditure and opportunities in SCM; integrationof 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 andtransportation; Bull-whip effect; customer value; IT, info-sharing and strategic partnerships; plant andwarehouse-network configuration; supply contracts and revenue sharing; outsourcing; transportation,cross docking and distribution, forecasting models in SCM; coordination and leadership issues; changeof purchasing role and vendor rating, variability from multiple suppliers.

Module-III

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.

Module-IV

(a) **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 multipleserver models (M/M/s)

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

Module-V:

(a) **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.

(b) Meta-heuristics: Definition of heuristic and meta-heuristic algorithms; introduction to Tabu search,Simulated Annealing and Genetic algorithms and solution of traveling salesman, non-linearoptimization problems.

Evaluation:

Evaluation will be continuous and integral part of the class as well as through external assessment.

References:

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. Srinivasan G; Quantitative Models In Operations and SCM; PHI Learning
4. Mohanty RP and Deshmukh SG; Supply Chain Management; Wiley India
5. Taha H; Operations research; PHI
6. Sen RP; Operations Research-Algorithms and Applications; PHI Learning
7. Sharma JK; Operations Research; Macmillan
8. Ravindran, Philips and Solberg; Operations research; Wiley India
9. Vollman, Berry et al; Manufacturing planning and control for SCM; TMH.
10. Bowersox DJ, Closs DJ, Cooper MB; Supply Chain LogistiMgt; TMH
11. Burt DN, Dobler DW, StarlingSL; World Class SCM; TMH
12. Bronson R;Theory and problems of OR; Schaum Series; TMH
13. George Hadley; Linear programming; Addison Wesley

Course Out Comes:

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

CO1	Formulate linear programming problems.
CO2	Elaborate optimum solution of transportation problems and forecasting in supply chain.
CO3	Determine average queue length and waiting time of queuing models.
CO4	Estimate optimum inventory and cost in inventory models.

Mapping of course outcomes (COs) with Program Outcomes (POs):

course outcome	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1								1
CO2	1		3									
CO3	1	1		1								1
CO4	2	1	1									

LIST OF EXPERIMENTS:

1. Use computer and software as Lindo, Tora, and Excelto solve problems contained in the syllabus.
2. Case studies on SCM.
3. Problems on ABC Analysis.
4. Problems onEconomic order quantity.
5. Problems onWaiting Line Models.
6. Problems on Game Theory.

Evaluation:

Evaluation will be continuous an integral part of the class followed by the final practical examination as well as through external assessment.

Course Out Comes:

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

CO1	Formulate linear programming problems.
CO2	Determine average queue length and waiting time of queuing models.
CO3	Estimate optimum inventory and cost in inventory models.
CO4	Discuss different decision-making processes and apply various optimization algorithms.

Mapping of course outcomes (COs) with Program Outcomes (POs):

course outcome	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1								
CO2	1	1		1								
CO3	2	1	1									
CO4	1	1	1	3								

Jabalpur Engineering College, Jabalpur (M.P)
PROGRAMME: B.Tech. Mechanical Engineering (VII-Semester) AICTE
w.e.f. July 2017-18 batch

Credits: 4 PEC–III ME704A	**Industrial Robotics**	**L: 3, T: 1, P:0**

Course Objective:

1. Introduction and need of industrial robots.
2. End Effectors and Drive systems industrial robots
3. Understanding the basic principle Sensors.
4. Understanding the basic principle robotics programming

Course Content:

Module-I Introduction: Need and importance, basic concepts, structure and classification of industrial robots, terminology of robot motion, motion characteristics, resolution, accuracy, repeatability, robot applications.

Module-II End Effectors and Drive systems: Drive systems for robots, salient features and comparison, different types of end effectors, design, applications.

Module-III Sensors: Sensor evaluation and selection Piezoelectric sensors linear position and displacement sensing, revolvers, encoders, velocity measurement, proximity, tactile, compliance and range sensing. Image Processing and object recognition.

Module-IV Robot Programming: Teaching of robots, manual, walk through, teach pendant, off line programming concepts and languages, applications.

Module-V Safety and Economy of Robots: Work cycle time analysis, economics and effectiveness of robots, safety systems and devices, concepts of testing methods and acceptance rule for industrial robot.

Evaluation:

Evaluation will be continuous an integral part of the class as well through external assessment.

References:

1. Nagrath IJ and Mittal RK; Robotics and Control; TMH
2. GrooverM.P,Weiss M, Nagel,OdreyNG; Industrial Robotics-The Appl; TMH
3. Groover M.P; CAM and Automation; PHI Learning
4. Spong Mark and Vidyasagar; Robot Modelling and control; Wiley India
5. Yoshikava; Foundations of Robotics- analysis and Control; PHI Learning;
6. Murphy; Introduction to AI Robotics; PHI Learning
7. FU KS, Gonzalez RC, Lee CSG; Robotics Control, sensing; TMH
8. Shimon, K; Handbook of Industrial Robots; John Wiley & Sons,
9. Bhupendra Gupta, A text book of Industrial Robotics: Dhanpat Rai Publishing company, New Delhi.
10. GhosalAshitava; Robotics Fundamental concepts and analysis; Oxford
11. Saha S; Introduction to Robotics; TMH 11. Yu Kozyhev; Industrial Robots Handbook; MI

Course Outcomes:

At the completion of this course, students should be able to-

CO1	Illustrate the concept of robot and its motion characteristics.
CO2	Identify different types of end effectors and drive systems required for specific applications
CO3	Explain the working of various types of sensors and their applications.
CO4	Develop programming principles and languages for a robot control system

Mapping of Course outcomes (COs) with Program Outcomes (POs):

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1				1							1
CO2	1		2	2								
CO3	1	1	2	1								
CO4	1	2	2	2								

Jabalpur Engineering College, Jabalpur (M.P)
PROGRAMME: B.Tech. Mechanical Engineering (VII-Semester) AICTE
w.e.f. July 2017-18 batch

Credits: 4 PEC–III ME704B Product Design L: 3, T: 1, P:0

Course objective:

- Confidence in your own abilities to create a new product.
- Awareness of the role of multiple functions in creating a new product (e.g. marketing, finance, industrial design, engineering, production).
- Ability to coordinate multiple, interdisciplinary tasks in order to achieve a common objective.

Module-I

Basic concepts of engineering products' drawings. Software's applications for preparation of drawings, designs and animations.

Module-II

Creativity, Concept generation – Intuitive / Rational and as per customers choice amongst alternatives. Needs and wants. Products' specifications and product architecture.

Module-III

A brief review of engineering materials and their properties. Concepts of tribology – Friction, Wear and Lubrication

Module-IV

Basic concepts of limits, fits and tolerances in individual components and assemblies. A brief review of process planning, Jigs, Fixtures, manufacturing methods and shop floor practices. Review of drawings and design from industrial and manufacturing aspects. A brief review of quality assessment and control

Module-V

Basic concepts of ergonomics and related proportions. Value Engineering and Value analysis, cost analysis, market impact and feedback data from market to designer. The product life cycle. Intellectual property rights/ Patent procedures and governments' support for export/import substitutions.

Books:

1. K.T.Ulrich and S.D.Eppinger," Product design and development".
2. G.E.Dieter, Engineering Design.
3. Product design – Otto, Wood,

Course Outcomes:

At the completion of this course, students should be able to

CO1	Create 2D & 3D drawing with the help of CAD software.
CO2	Elaborate a set of tools and methods for product design and development.
CO3	Discuss the role of multiple functions in creating a new product (e.g. marketing, finance, industrial design, ergonomics, and production).

Mapping of Course outcomes (COs) with Program Outcomes (POs):

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	3	-	-	-	-	-	-	-	-	1
CO2	-	-	3	2	1	-	-	-	-	-	-	1
CO3	-	-	-	-	-	1	2	1	-	-	2	-

Jabalpur Engineering College, Jabalpur (M.P)
PROGRAMME: B.Tech. Mechanical Engineering (VII-Semester) AICTE
w.e.f. July 2017-18 batch

Credits: 4 OEC –III ME705A Renewable Energy Systems	**L: 3, T: 1, P:0**

Course Objective:

1. Understanding the solar thermal conversion techniques and photovoltaic conversion of solar energy.
2. Understanding thewind energy conversion systems and wind characteristics curves.
3. Understanding the Biomass conversion systems: biochemical, chemical and thermochemical
4. Understanding the Principle of ocean, Geothermal, Hydrogen energy conversion system and Fuel Cells.

Course Content:

Module-I: SOLAR ENERGY CONVERSION SYSTEMS

Solar Radiation: Introduction to solar energy, Extra-terrestrial and terrestrial, solar constant, radiation measuring instruments.Solar collector, Types of solar collector. Working principle of flat plate solar collectorand concentrating solar collector. Modifications in solar collector.Construction and working principle of solar water heater, solar dryer, solar still, Solar cooling and solar refrigeration. Solar photovoltaic: Principle of photovoltaic conversion system, Construction of PV Cell, Module, Penal, Array,Applications of PVC system.

Module-II : WIND ENERGY CONVERSION SYSTEMS

Metrology of wind: wind and its potential, wind speed distribution, windspeed statistics. Weibull, Rayleigh and Normal distributionof wind. Measurement of wind data, Principle of wind energy conversion system; Classification of WECS, advantages and disadvantages of wind energy conversion system. Discuss thedesign parameters of wind mill. Characteristics curves of wind turbine, Application of wind energy.

Module-III :BIOMASS CONVERSION SYSTEMS

Biomass and its production, Classificationsofbiomass and its potential,Physicochemical characteristics of biomass,Biomass conversion techniques:anaerobic digestion, fermentation, chemical reduction, etc. Biogas production mechanism,Types of digesters, biogas plantparameters,manure-utilization and manure values. Thermal gasification of biomass. Biomass Gasification: working principle and its types, Construction and working principle of gasification.

Module-IV:HYDRO POWERCONVERSION SYSTEMS: Overview of micro, mini and small hydro-power system, potential of hydropower system, Site selection criteria of hydro power systems, working principle of hydro power conversion system, advantages and limitations of hydro-power system. **Ocean thermalEnergy:** Principle of ocean thermal energy conversion system,Ocean wave energyand ocean wave energy conversion system. Tidal energy and its conversion system.

Module-V GEOTHERMAL, HYDROGEN & FUEL CELLS ENERGY: Origin of geothermal resources, Type of geothermal energy deposits, advantages and disadvantages of geothermal energy system.**Hydrogen Energy**: Hydrogenproduction methods, storage, transportation& utilization. **Fuel Cells**: Principle of operation of a fuel cell, classifications, advantages and disadvantages of fuel cell.

Evaluation:

Evaluation will be continuous and integral part of the class as well as through external assessment.

References:

1. Kothari, Singal&Rajan; Renewable Energy Sources and Emerging Technologies, PHI Learn
2. Khan, B H, Non Conventional Energy, TMH.
3. Sukhatme S.P. and Nayak, Solar Energy, Principles of Thermal Collection and Storage, TMH.
4. Tiwari and Ghosal, Renewable Energy Resources: basic principle & application, NarosaPubl
5. Koteswara Rao, Energy Resources, Conventional & Non-Conventional, BSP Publication.
6. Chetan Singh Solanki, Solar Photovoltaics: Fundamental, technologies and Application, PHI L
7. AbbasiTanseem and Abbasi SA; Renewable Energy Sources; PHI Learning
8. Ravindranath NH and Hall DO, Biomass, Energy and Environment, Oxford University Press.
9. Duffie and Beckman, Solar Engineering of Thermal Process, Wiley
10. Nikolai, Khartchenko; Green Power; Tech Book International
11. Tester, Sustainable Energy-Choosing Among Options, PHI Learning.
12. Godfrey Boyle, Renewable Energy: Power for a sustainable future, Oxford OUP.

Course Outcomes:

At the completion of this course, students should be able to

CO1	Able to develop the concept of energy conversion systems.
CO2	Develop the models of energy conversion systems.
CO3	Estimation of the energy potential at the site.
CO4	Modify the energy conversion systems for better performance.

Mapping of Course outcomes (COs) with Program Outcomes (POs):

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	3	1								
CO2	1	2	2									
CO3	1	2	2									
CO4	1	1	1									

Jabalpur Engineering College, Jabalpur (M.P)
PROGRAMME: B.Tech. Mechanical Engineering (VIII-Semester) AICTE
w.e.f. July 2017-18 batch

Credits: 4	ME801	Advance Machine Design	L: 3, T: 0, P: 2

Course Objective

- Understand the design concepts of belt, rope and chain drives.
- Able to design different types of gears.
- Able to design I.C. Engine components, different types of couplings and power screw.

Course Contents:

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

Module-II: Spur and Helical Gears: Force analysis of gear tooth, AGMA Bending stress equation and AGMA Contact stress equation, modes of failure, beam strength, Lewisequation, 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 gear and Helical Gears.

Module-III: Bevel Gears: Application of bevel gear, formative gear and virtual number of teeth; Force analysis; Lewisequation for bevel gears; Strength against wear; Design of bevel gear.

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

Module-V: Design of Miscellaneous Components: Design of Flanged coupling; Rigid coupling and Flexible coupling, Design of Pressure vessels subjected to internal pressure, Design of power screw.

References:

1. Shigley J.E.; Machine Design; TMH
2. BhandariVB; Design of Machine Elments; TMH
3. Sharma CS and Purohit K; Design of Machine Elements; PHI Learning.
4. Hall and Somani; Machine Design; Schaum Series; TMH
5. Wentzell TH; Machine Design; Cegage Learning
6. Sharma & Agrawal; Machine Design; Katson
7. Kulkarni SG; Machine Design; TMH
8. Abdul Mubeen; Machine Design; Khanna Publishers
9. Juvinall RC, Marshek KM; Fundamentals of Machine Component Design; Wiley
10. Norton R; Design Of Machinery; TMH
11. P.C.Gope- Machine Design

Note: PSG Design data book and/ or Mahadevan and Reddy's Mechanical design data book are to be provided/ permitted in exam hall (duly verified by authority)

Course Outcomes:

At the completion of this course, students should be able to-

CO1	Analyze belt, rope and chain drives.
CO2	Select different types oftransmission elements.
CO3	Examine I.C.Engine Components (cylinder,piston, piston-rings, connecting rod and crankshaft.)

Mapping of Course outcomes (COs) with Program Outcomes (POs):

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	-	-	-	-	-	-	-	-	-
CO2	1	2	1	1	-	-	-	-	-	-	-	-
CO3	1	2	3	3	1	-	-	-	-	-	-	-

List of Experiments:

1. Design of belt, chain and rope drive.
2. Design of spur and helical gear.
3. Design of bevel gears.
4. Design of I.C. engine components.
5. Design of miscellaneous components.

Course Outcome:

At the completion of this course, students should be able to-

CO1	Design the various different machine components.
CO2	Select the various machine components for desired output.

Mapping of Course outcomes (COs) with Program Outcomes (POs):

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	-	-	-	-	-	-	-	-	-
CO2	1	2	1	1	-	-	-	-	-	-	-	-

Jabalpur Engineering College, Jabalpur (M.P)
PROGRAMME: B.Tech. Mechanical Engineering (VIII-Semester) AICTE
w.e.f. July 2017-18 batch

Credits: 4	ME802	AUTOMOBILE ENGINEERING	L: 3, T: 0, P: 2

COURSE OBJECTIVE:

The students will be made to learn.

- The anatomy of the automobile in general.
- The location and importance of each part of automobile.
- The functioning of the engine and its accessories, gear box, clutch, brakes, steering, axles and wheels, suspension, frame, springs and other connections.
- The effect of automobile emissions on environment and how to control pollution.

Course Contents:

Module-I: Chassis & Body Engineering: Types, Technical details of commercial vehicles, types of chassis, layout, types of frames, testing of frames for bending & torsion on unutilized body frame, vehicle body and their construction, driver's visibility and methods for improvement, safety aspects of vehicles, vehicle aerodynamics, optimization of body shape, driver's cab design, body materials, location of engine, front wheel and rear wheel drive, four wheel drive.

Module-II: Steering System: front axle beam, stub axle, front wheel assembly, Wheel Alignment, principles of types of wheel alignment, front wheel geometry viz. camber, Kingpin inclination, castor, toe-in and toe-out, condition for true rolling motion, centre point steering, directional stability of vehicles, steering gear, power steering, slip angle, cornering power, over steer & under steer, gyroscopic effect on steering gears.

Module-III: Transmission System: Function and types of clutches, single plate, multi-plate clutch, roller &spring clutch, clutch lining and bonding, double declutching, types of gear boxes, synchronizer, gear materials, determination of gear ratio for vehicles, gear box performance at different vehicle speed, automatic transmission, torque converters, fluid coupling, principle of hydrostatic drive, propeller shaft, constant velocity universal joints, differential gear box, rear axle construction, Introduction to Electric and Hybrid Power train.

Module-IV: Suspension system : Basic suspension movements, Dependent and Independent Suspension, Independent front & rear suspension, shock absorber, type of springs: leaf spring, coil spring, air spring, torsion bar, location of shackles, power calculations, resistance to vehicle motion during acceleration and breaking, power & torque curve, torque & mechanical efficiency at different vehicle speeds, weight transfer, braking systems, disc theory, mechanical, hydraulic & pneumatic power brake systems, performance, self-energization, air-bleeding of hydraulic brakes, types of wheels and tyres, tyre specifications, construction and material properties of tyres& tubes.

Module-V: Electrical and Control Systems: Storage battery, construction and operation of lead acid battery, testing of battery, principle of operation of starting mechanism, different drive systems, starter relay switch, regulator electric fuel gauge, fuel pump, horn, wiper, lighting system, head light dazzling, signaling devices, battery operated vehicles, choppers, importance of maintenance, scheduled and unscheduled maintenance, wheel alignment, trouble Shooting probable causes & remedies of various systems, microprocessor based control system for automobile, intelligent automobile control systems. Emission standards and pollution control: Indian standards for automotive vehicles-Bharat I, II, III, IV, Euro I to Euro VI norms, fuel quality standards, environmental management systems for automotive vehicles, catalytic converters, fuel additives, and modern trends in automotive engine efficiency and emission control.

References:

1. Crouse, Automotive Mechanics TMH.
2. Srinivasan S; Automotive engines; TMH
3. Gupta HN; Internal Combustion Engines; PHI;
4. Joseph Heitner, Automotive Mechanics, Principles and Practices, CBS Pub.
5. Kripal Singh, Automotive Engineering Khanna Pub.
6. Newton &Steeds, Automotive Engineering
7. Emission standards from BIS and Euro –I to Euro-VI

At the completion of this course, students should be able to

CO1	Enlist the major parts of an automobile
CO2	Analyze the steering, transmission, suspension, electrical and control systems of an automobile.
CO3	Explain the environmental implications of automobile emissions.

Mapping of Course outcomes (COs) with Program Outcomes (POs):

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	-	-	-	-	-	-	-	-	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-
CO3	2	-	1	-	-	-	1	-	-	-	-	-

List of Experiments:

1. Study of frame and chassis.
2. Study of clutches – single plate, multi plate and centrifugal
3. Study of gear boxes – sliding mesh, constant mesh, synchro-mesh.
4. Study of differential, universal joints, axles and slip joints.
5. Study of brakes – mechanical, hydraulic, air brake and disc brake.
6. Study of steering system used with rigid axle suspension and independent suspension system, powersteering
7. Study of rigid axle suspension system.
8. Study of independent suspension system.
9. Study of battery, starting and generating system and battery charging system.

Course Outcomes: At the complition of the course student will be able to:

1. Differentiate between different part of an automobile.
2. Investigate the different parts of the automobile.

Mapping of Course Outcomes with Program Educational Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1					2	1	1		2		
CO2					1	1	1		2		

Jabalpur Engineering College, Jabalpur (M.P)
PROGRAMME: B.Tech. Mechanical Engineering (VIII-Semester)AICTE
w.e.f. July 2017-18 batch

Credits: 3 PEC-IV ME803A CAD /CAM/ CIM L: 3, T: 0, P: 0

Course Objective

- Understand the concepts of product design in CIM environment.
- Able to Create mathematical models to characterize curves and surfaces.
- Understand the Concepts ofNumeric control and part programming.
- Able to show the elements of an automated manufacturing environment.

Course Contents:

Module-I : Introduction: Information requirements of mfg. organizations; business forecasting and aggregate production plan; MPS, MRP and shop floor/ Production Activity Control (PAC); Mfg. as a system, productivity and wealth creation; production processes on volume-variety axes; importance of batch and job shop production; CIM definition and CIM wheel, evolution and benefits; CIM as a subset of Product Life Cycle (PLC) mgt; design for mfg. (DFM) and concurrent engg; product design in conventional and CIM environment; terms like CAD, CAE, CAM, CAP, CAPP, CATD and CAQ.

Module-II: Graphics and standards: Raster scan, coordinate systems for model (M/ WCS) user and display; database for graphic modelling; PDM, PIM, EDM; define EDM, features of EDM; basic transformations of geometry- translation, scaling, rotation and mirror; introduction to modelling software; need for CAD data standardization; developments in drawing data exchange formats; GKS, PHIGS,
CORE, IGES, DXF, STEP, DMIS AND VDI; ISO standard for exchange of Product Model data-STEP and major area application protocols.

Module-III: Geometric Modelling: Its use in analysis and mfg.; 2D and 3D line, surface and volume models; linear extrusion and rotational sweep; Constructive Solid Geometry (CSG); basics of boundary presentation- spline, Bezier, b-spline, and NURBS; sculpture surfaces, classification, basics of coons,
Bezier, b-spline and ruled surfaces; tweaking, constraint based parametric modelling; wire-frame Modelling, definition of point, line and circle; polynomial curve fitting; introduction to rapid prototyping.

Module-IV: Numeric control and part programming: Principles of NC machines, CNC, DNC; NC modes of point to point, -line and 2D, 3D contouring; NC part programming; ISO standard for coding, preparatory functions(G)- motion, dwell, unit, pre-set, cutter compensation, coordinate and plane selection groups; miscellaneous (M) codes; CLDATA and tool path simulation; ISO codes for turning tools and holders; ATC, modular work holding and pallets;

time and power estimation in milling, drilling and turning; adaptive control, sequence control and PLC; simple part programming examples.

Module-V: Group Technology: Importance of batch and job shop production; merits of converting zigzag process layout flow to smooth flow in cellular layout, Production Flow Analysis (PFA) and clustering methods; concept of part families and coding; hierarchical, attribute and hybrid coding; OPITZ, MICLASS and DCLASS coding; FMS; material handling; robots, AGV and their programming; agile mfg; Computer Aided Process Planning (CAPP), variant/ retrieval and generative approach

References:

1. S.KantVajpay; Principles of CIM; PHI
2. Rao PN; CAD/CAM; TMH
3. Groover MP; Automation, Production Systems & CIM; P.H.I.
4. Rao PN, Tiwari NK, Kundra TK; Computer Aided Manufacturing; TMH
5. Alavudeen A, Venkteshwarn N; Computer Integrated Mfg; PHI
6. Radhakrishnan P, Subramanian S and Raju V; CAD/CAM/CIM; New age Pub

Course Outcomes:

At the completion of this course, students should be able to-

CO1	Analyze geometric transformations and CAD models.
CO2	Develop and validate CNC programs to manufacture engineering components.
CO3	Illustrate the elements of group technology in an automated manufacturing environment.

Mapping of Course outcomes (COs) with Program Outcomes (POs):

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	3		1							
CO2	1	2	2		2							
CO3	1	1	2								1	

Jabalpur Engineering College, Jabalpur (M.P)
PROGRAMME: B.Tech. Mechanical Engineering (VIII-Semester) AICTE
w.e.f. July 2017-18 batch

Credits: 3 PEC-IV ME803B Tribology L: 3, T: 0, P: 0

Course Objective:
To study the basic principles governing the tribology and apply them to reduce friction and wear in mechanical machines and structures.

Module-I: Introduction, history of tribology, early scientific studies of - friction, wearand lubrication. Tribo-Surface preparations and characteristics. Surface contacts, Hertz contact stresses, residual stress, surface fatigue, creep, stress relaxation, fracture mechanics, elastic, viscoelastic and plastic behavior of materials. Choice of materials.

Module-II: Friction, laws of friction, rolling/sliding friction, theory of adhesion and abrasion, different mechanisms of friction, stick slip characteristics, interface temperature, thermal analysis, Molecular mechanical theory of friction, operating conditions and system parameters, calculations of coefficient of friction, design of friction devices.

Module-III: Wear, different types of wear mechanisms, adhesive, abrasive impact,percussion erosion, fretting wear calculations of wear rate, two body/ three body wear, wear prevention, wear of metal cutting and metal forming tools, wear mapping of materials, cavitation, surface fatigue, corrosion, performance levels classifications and specifications of lubricants

Module-IV: Lubrication, lubricants and additives, composition and properties of lubricants, maintenance of oil and emulsions, industrial hygiene aspects, technical regulations for lubricants. boundary/ mixed and fluid film lubrication, industrial methods of lubrications, SAE,BIS, ASTM, IP, DIN Standards, oil testing's, wear and chemistry of lubricants.

Module-V: Nano tribology, Instrumental tests, Bearings, clutches and brakes, Commonly used bearing materials, and properties of typical bearing materials, slide units, dynamic seals, Automobile applications, machine tools/ press machines applications. Other applications and case studies.

Evaluation:

Evaluation will be continuous an integral part of the class as well through external assessment.

References:

1. Principles and applications of tribology, Bharat Bhushan, John Wiley& sons, ISBN 0471
   594075.
2. Tribology,, - lubrication ,friction and wear, I V Kragelsky and V VAlisin, Mir publication,
   ISBN 1860582885.
3. Applied Tribology,M MKhonsari and E. R. Booser, John Wiley, ISBN 0471283029.

Tutorial topics:

1. Testing equipments of tribology.
2. Various industrial applications of tribology.
3. NEMS and MEMS applications
4. Solid, liquid and mist/ gas lubricants.
5. Surface coatings.
6. Chemical analysis of materials
7. Various simulations
8. AFM/ FFM , SFA, STM, studies.

Course Outcomes:

At the completion of this course, students should be able to-

CO1	Infer thebasic principles governing the wear, friction and lubrication..
CO2	Examine the different mechanisms of friction and develop friction devices.
CO3	Illustrate the various modes of lubrication.
CO4	Analyze various mechanical machines and structures against wear and friction.

Mapping of Course outcomes (COs) with Program Outcomes (POs):

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	-	-	-	-	-	-	-	-	-
CO2	1	2	2	1	-	-	-	-	-	-	-	-
CO3	2	-	1	-	-	-	-	-	-	-	-	-
CO4	1	2	2	2	-	-	-	-	-	-	-	-

Jabalpur Engineering College, Jabalpur (M.P)
PROGRAMME: B.Tech. Mechanical Engineering (VIII-Semester) AICTE
w.e.f. July 2017-18 batch

Credits: 3 PEC-IV ME803C Advance Machining Processes L: 3, T: 0, P: 0

Course Objectives:

- Understand the fundamentals and technologies used in different advance machining processes.
- Apply the characteristics and applications of the product obtained using advanced manufacturing processes.
- Compare different advance machining processes.

Course Contents:

Module-I: Mechanical processes: Process selection, mechanics of cutting, metal removal rate, cuttingtool system design, ultrasonic machining, abrasive jet machining, water jet machining, effect of parameters and variables, applications and limitations, recent developments inmechanical processes.

Module-II: 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, materialremoval and surface finish, electrochemical grinding, electrochemical deburring,electrochemical honing, chemical machining.

Module-III:Thermal metal removal processes: Electric discharge machining[EDM], spark erosion,mechanism of metal removal, spark erosion generator, electrod feed control, vibratingelectrode system, dielectric fluid, flushing, accuracy, plasma arc machining[PAM], nonthermal generation of plasma, mechanisms and parameters, equipments, electron beammachining[EBM],generation and control of electron beam, theory and process capabilities, neutral particle etching, laser beam machining, hot machining, methods of local heating,toollie and production rate.

Module-IV: Rapid prototyping fabrication methods: Fundamentals, Technologies, Applications, Principlesand working of 3D printing, subtractive v/s additive manufacturing process, VAT photopolymerization, material and binder jetting, continuous liquid inter phase production, directmetal laser sintering.

Module-v: 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 fabricationprocesses.

Books:

1. Mikell P. Groover, Fundamentals of Modern Manufacturing, Wiley India, ISBN 9788126523016
2. Pandey P.C, Shan H.S., Modern Machining Processes, Tata McGraw Hill,ISBN 0070965188
3. Lal G.K,Gupta V, Reddy N.V., Narosa Publishing House,ISBN 8173197091
4. CMTI Handbook

At the completion of this course, students should be able to:

CO1	Explain the fundamentals and technologies used in different advance machining processes.
CO2	Predict the characteristics and applicationsof the product obtained using advanced manufacturing processes.
CO3	Compare different advance machining processes.

Mapping of Course outcomes (COs) with Program Outcomes (POs):

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	-	-	-	-	-	-	-	-	2
CO2	2	-	2	1	3	-	-	-	-	-	-	1
CO3	3	2	-	1	1	-	-	-	-	-	-	1

Jabalpur Engineering College, Jabalpur (M.P)
PROGRAMME: B.Tech. Mechanical Engineering (VIII-Semester) AICTE
w.e.f. July 2017-18 batch

Credits: 3 OEC-IV ME804A Energy Conservation & Audit L: 3, T: 0, P: 0

Course Objective

- Understand the concepts of energy management and conservation.
- Able to conduct energy audit and report.
- Concepts of Energy policy its purpose and formation.
- Able to do Electrical Energy Management in different electrical systems.

Module-I Energy Management: Concept of energy management, energy demand and supply, economic analysis; Duties and responsibilities of energy managers.
Energy Conservation: Basic concept, energy conservation in Household, Transportation, Agricultural, service and Industrial sectors, Lighting, HAVC.

Module-II Energy Audit: Definition, need and types of energy audit; Energy management (Audit) approach: Understanding energy cost, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirement; Fuel & energy substitution; Energy audit instruments; Energy conservation Act; Duties and responsibilities of energy manager and auditors.

Module-III Material Energy Balance: Facility as an energy system; Method for preparing process flow; material and energy balance diagrams.
Energy Action Planning: Key elements, force field analysis; Energy policy purpose, perspective, content, formulation, rectification

Module-IV Monitoring and Targeting: Definition monitoring & targeting; Data and information analysis.
Electrical Energy Management: energy conservation in motors, pumps and fan systems; energy efficient motors.

Module-V Thermal Energy Management: Energy conservation in boilers, steam turbine and industrial heating system; Application of FBC; Cogeneration and waste heat recovery; Thermal insulation; Heat exchangers and heat pump; Building Energy Management.

References:

1. Murphy &Mckay, Energy Management, BSP Books Pvt. Ltd.
2. Smith CB; Energy Management Principle, Pergamon Press, New York.
3. Rajan GG, Optimising Energy Efficiency in Industry, TMH.
4. Callaghan P O, Energy Management, McGraw-Hill Book Company.
5. Amit Kumar Tyagi, Handbook on Energy Audit and Management, Tata Energy Research Institute.
6. Bureau of Energy Efficiency, Study material for energy Managers and Auditors: Paper I to V.
7. Hamies; Energy Auditing and Conservation: Method, Measurement…, Hemisphere, Washington.
8. Witty, Larry C, Industrial Enegy Management Utilisation, Hemisphere Publishers, Washington

9. Kreith&Goswami, Energy Management and Conservation Handbook, CRC Press.

Course Outcomes:
At the completion of this course, students should be able to

CO1	Understand the concepts of energy conservation, management and energy efficiency.
CO2	Explain energy audit and preparation of report.
CO3	Examine Energy Management in different electrical/thermal systems.
CO4	Built Material and energy balance diagram and its significance.

Mapping of Course outcomes (COs) with Program Outcomes (POs):

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	2	1	-	-	-	-	1	-	-	-	-	-
CO2	-	2	3	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	1	-	-	-	-	-	2	-
CO4	-	2	3	-	-	-	-	-	-	-	-	-