

**Bachelor of Technology (Mechanical Engineering), KUK
Credit-Based (2023-24 Onwards)**

MODIFIED SCHEME OF STUDIES/EXAMINATIONS (Semester - VII) w.e.f. session 2026-27

S. No.	Course No./ Code	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of exam (Hours)
						End Semester Exam	Internal Assessment	Practical Exam	Total	
1		*Program Elective-III	3:0:0	3	3	70	30	--	100	3
2		**Open Elective-I	3:0:0	3	3	70	30	--	100	3
3	B23-MEC-401	Automobile Engineering	3:0:0	3	3	70	30	--	100	3
4	B23-MEC-403	Python for Mechanical Engineering	3:0:0	3	3	70	30	--	100	3
5	B23-MEC-405	Project-II	0:0:8	8	4	--	100	100	200	3
6	B23-MEC-407	Python for Mechanical Engineering Lab	0:0:2	2	1	--	40	60	100	3
7	#B23-MEC-409	Industrial Training-II	2:0:0	2	2	--	100	--	100	
8	B23-VAC-401/403/405/407/409/411	NCC/NSS/Sports/Yoga/ Technical or Cultural Club/Society activities	2:0:0	2	1	--	100	--	100	
		Total		26	20	280	460	160	900	

*Program Elective-III		**Open Elective-I	
Course No.	Course Name	Course No.	Course Name
B23-MEP-401	Manufacturing Automation	B23-MEO-401	Internet of Things
B23-MEP-403	Finite Element Analysis	B23-MEO-403	Basics of Electric Vehicle
B23-MEP-405	Air-conditioning System Design	B23-MEO-405	Management Information System
B23-MEP-407	Non-destructive Testing	B23-MEO-407	Waste to Energy
B23-MEP-409	Computational Fluid Dynamics	B23-MEO-409	Consumer Electronics
B23-MEP-411	Heating, Ventilation and Air-conditioning systems	B23-MEO-411	Bioinformatics

Note: The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.

- #B23-MEC-409 is a mandatory credit course in which the students will be evaluated for the industrial training undergone after 6th semester. Students will be required to get passing marks to qualify.
- *B23-VAC-401/403/405/407/409/411 are single credit value added courses in which NCC/NSS/Sports/Yoga/Technical or Cultural Club/Society activities will be joined by students in first year and will be evaluated in 7th semester by the institute based upon continuous evaluation model as per guidelines.

**Bachelor of Technology (Mechanical Engineering), KUK
Credit-Based (2023-24 Onwards)**

MODIFIED SCHEME OF STUDIES/EXAMINATIONS (Semester - VIII) w.e.f. session 2026-27

S. No	Course No./ Code	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of exam (Hours)
						End Semester Exam	Internal Assessment	Practical Exam	Total	
1		*Program Elective-IV	3:0:0	3	3	70	30	--	100	3
2		**Open Elective-II	3:0:0	3	3	70	30	--	100	3
3.	B23-MEC-402/404 /406/408	Project-IV/ Industrial Training/ Entrepreneurship/ Start-up	0:0:10	10	5		100	100	200	3
Total				16	11	140	160	100	400	

*Program Elective-IV		**Open Elective-II	
Course No.	Course Name	Course No.	Course Name
B23-MEP-402	Quality and Reliability Engineering	B23-MEO-402	Intellectual Property Rights (IPR) and Regulatory Framework
B23-MEP-404	Composite Materials	B23-MEO-404	Digital Marketing
B23-MEP-406	Lubricants and Lubrication	B23-MEO-406	Supply Chain Management
B23-MEP-408	Tool Design	B23-MEO-408	Biomechanics
B23-MEP-410	Total Quality Management	B23-MEO-410	Artificial Intelligence
B23-MEP-412	Concurrent Engineering	B23-MEO-412	Energy Management
B23-MEP-414	Foundry Engineering	B23-MEO-414	Block Chain Technology
B23-MEP-416	Ergonomics	B23-MEO-416	Gender Sensitivity

Note:

- **The Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.**
- **In case of semester-long project work/training done in industry, the Program Elective- IV and Open Elective-II may be offered in online mode through MOOC courses from SWAYAM/NPTEL.**

B. Tech (7th Semester) Mechanical Engineering

B. Tech (7th Semester) Mechanical Engineering							
B23-MEP-401	Manufacturing Automation						
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	0	0	3	70	30	100	3
Purpose	The purpose is to equip students with the knowledge and technical skills to design, operate, and manage automated production systems						
Course Outcomes							
CO 1	Students will be able to know automation in manufacturing and production system, and role of robotics in industry.						
CO 2	Students will be able to apply the group technology and flexible manufacturing technique in automated production line and manufacturing system.						
CO 3	Students will be able to generate computer aided process planning and control the shop floor manufacturing activity by computer.						
CO 4	Students will be able to generate CNC programming and understand the concept automated guided vehicle in material handling.						

UNIT-I

Introduction: Production system, Automation in production system, Manual labour in production system, Automation principle and strategies, Manufacturing industries and products, Manufacturing operations, Product facilities, Product/ Production relationship, Basic elements of an automation system, Advance automation function, Level of automation.

Industrial robotics: Robot anatomy and related attributes, joint and links, common robot configuration, joint drive system, sensors in robotics, robot control system, end effectors, grippers and tools, applications of industrial robots, material handling, processing operation, assembly and inspection, Robot programming.

UNIT-II

Group Technology and Cellular Manufacturing: Part families, parts classifications and coding, Production flow Analysis, cellular Manufacturing- composite part concept, machine cell design, applications of group technology, grouping parts and machines by Rank order clustering technique, Arranging machines in a G.T. cell.

Flexible Manufacturing: Introduction, FMS components, Flexibility in Manufacturing – machine, Product, Routing, Operation, types of FMS, FMS layouts, FMS planning and control issues, deadlock in FMS, FMS benefits and applications.

UNIT-III

Process Planning: Introduction, Manual process planning, Computer aided process planning – variant, generative, Decision logic decision tables, decision trees, Introduction to Artificial intelligence.

Shop Floor Control: Introduction, Shop floor control features, Major displays, Major reports, Phases of SFC Order Release, Order Scheduling, Order Progress, Manufacturing control, Methodology, Applications, Shop floor data collections, Types of data collection system, Data input techniques, Automatic data, Collection system.

UNIT-IV

CNC Basics and Part Programming: Introduction, Historical Background, Basic Components of an NC, Steps in NC, Verifications of Numerical control machine tool programs, Classification of NC Machine tool, Basics of motion control and feedback for NC M/C, NC part programming, Part programming methods, Modern Machining system, automatically programmed tools, DNC, Adaptive control.

Automated Guided Vehicle: Introduction, History, Features, Functions of AGV, Types of AGV, Safety consideration for AGV, Design of AGV.

Text Books:

1. Chris McMahon and Jimmie Browne, CAD/CAM – Principle Practice and Manufacturing Management, Addison Wesley England, Second Edition, 2000.
2. Ibrahim Zeid, CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
3. Ibrahim Zeid, Mastering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.

Reference Books:

1. Rogers, D.F. and Adams, A., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY, 1989
5. P. Radhakrishnan, S. Subramanayan and V.Raju, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.
2. Groover M.P. and Zimmers E. W., CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall International, New Delhi, 1992.
3. Automation, production system and computer integrated manufacturing- Mikell P. Groover, Pearson fourth edition.

Note: The paper setter will set the paper as per the question paper template provided.

B. Tech. (7th Semester) Mechanical Engineering							
B23-MEP-403	Finite Element Analysis						
Lecture	Tutorial	Practical	Credit	End Semester Exam	Internal Assessment	Total	Time (Hrs)
3	0	0	3	70	30	100	3
Purpose	The purpose is to acquaint the students with theoretical foundations, mathematical formulations, and computational techniques required to simulate and analyze complex engineering problems.						
Course Outcomes							
CO1	Students will be able to understand the basic steps in FEM formulation. Also to study various concepts associated and assembly along with the boundary conditions in FEM formulation.						
CO2	Students will be able to understand how FEM problem is formulated in 1-D elements. Also to discuss shape functions, h and p approximations; and various solvers associated in FEM.						
CO3	Students will study FEM formulation of 2-D element using various methods like Galerkin approach, Weighted Residual etc. Also to understand the natural co-ordinates, numerical integration and various other concepts related to 2-D FEM formulation.						
CO4	Students will be able to understand the axi-symmetric problems along with plane stress and plane strain problems with regards to solid mechanics. Also to discuss various elements of FEM, FEM with C1 continuity and FDM problems.						

UNIT-I

Basic Steps in FEM Formulation, General Applicability of the Method; Variational Functional, Ritz Method.

Variational FEM: Derivation of Elemental Equations, Assembly, Imposition of Boundary Conditions, Solution of the Equations.

UNIT-II

1-D Elements, Basis Functions and Shape Functions, Convergence Criteria, h and p Approximations.

Natural Coordinates, Numerical Integration, Gauss Elimination based Solvers. Computer implementation: Pre-processor, Processor, Post-processor.

UNIT-III

Alternate Formulation: Weighted Residual Method, Galerkin Method; Problems with C1 Continuity: Beam Bending, Connectivity and Assembly of C1 Continuity Elements.

Variational Functional, 2-D Elements (Triangles and Quadrilaterals) and Shape Functions. Natural Coordinates, Numerical Integration, Elemental Equations, .Connectivity and Assembly, Imposition of Boundary Conditions.

UNIT-IV

Axisymmetric (Heat Conduction) Problem, Plane Strain and Plane Stress Solid Mechanics Problems.

Sub-parametric, Iso-parametric and Super-parametric Elements; Elements with C1 Continuity. Free Vibration Problems, Formulation of Eigen Value Problem, FEM Formulation. Time-dependent Problems, Combination of Galerkin FEM and FDM (Finite Difference Method), Convergence and Stability of FD Scheme.

Text Books:

1. R. Dhanraj & K. Prabhakaran Nair, Finite Element Method, Oxford University Press
2. C. S. Krishnamoorthy, Finite element analysis, Tata McGraw Hill
3. J. N Reddy, An introduction to Finite element method, Tata Mc. Graw Hill

4. Y. M. Desai, Finite Element Method with applications in engineering, Pearson Education India

Reference Books:

1. Nonlinear Finite Elements for Continua and Structures (Paperback) by Belytschko (shelved 1 time as *finite-elements*).
2. The Finite Element Method for Three-Dimensional Thermomechanical Applications (Hardcover) by Guido Dhondt (shelved 1 time as *finite-elements*).
3. Numerical Solution of Partial Differential Equations by the Finite Element Method (Paperback) by Claes Johnson (shelved 1 time as *finite-elements*).

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B. Tech (7th Semester) Mechanical Engineering							
B23-MEP-405	AIR CONDITIONING SYSTEM DESIGN						
Lecture	Tutorial	Practical	Credit	End Semester Exam	Internal Assessment	Total	Time (Hrs)
3	0	0	3	70	30	100	3
Purpose	To acquaint the students with fundamentals of heating, ventilation and air-conditioning.						
Course Outcomes							
CO 1	Student should be able to understand construction and design features of Air-conditioning system.						
CO 2	Student should be able to understand various types and its adoptability in the various environment and application areas.						
CO 3	Student should be able to understand various health issues.						
CO 4	Student should be able to design seasonal energy efficient system.						

UNIT-I

Air conditioning systems: the complete system, System selection and arrangement, HVAC components and distribution system, All-air, Air-water and All-water systems, decentralized cooling and heating.

Various air-conditioning processes: Moist air and standard atmosphere, Adiabatic saturation, classic moist air processes, Space air conditioning: design conditions, off-design conditions.

UNIT-II

Comfort and health-Indoor air quality: Enthalpy deviation curve, Psychrometry, SHF, dehumidified air quantity, human comfort, indoor air quality.

Heat transmission in building structures: Basic heat transfer modes, Tabulated overall heat-transfer coefficient.

UNIT-III

Design conditions and load calculations: Space heating load: outdoor and indoor design conditions, transmission heat losses, infiltration, heat losses from air duct. Solar radiation

The cooling load: Design conditions, Internal heat gain, Transient conduction heat transfer, Fenestration: Transmitted solar radiations.

UNIT-IV

Fan and Building air distribution: fan performance and selection, Fans and variable-air-volume systems, Air flow in ducts and fittings, pressure drop, duct design, & blowers, Performance & selection, noise control.

Reference/Text Books:

1. ASHRAE Handbook.
2. "Handbook of air-conditioning system design", Carrier Incorporation, McGraw Hill Book Co., U.S.A, 1965.
3. Norman C. Harris, "Modern Air Conditioning", McGraw-Hill, 1974.
4. Jones W.P., "Air Conditioning Engineering", Edward Arnold Publishers Ltd., London, 1984.
5. Hainer R.W., "Control Systems for Heating, Ventilation and Air-Conditioning", Van Nostrand

6. Reinhold Co., New York, 1984.
7. Arora C.P., “Refrigeration & Air Conditioning”, Tata Mc Graw Hill, 1985.
7. Manohar Prasad, “Refrigeration & Air Conditioning”, New Age Publishers.
8. Stoecker, “Refrigeration & Air Conditioning”, Mc Graw Hill, 1992.
9. Stoecker, “Design of Thermal Systems”, Mc Graw Hill, 1992.
10. F. C. McQuiston, J. D Parker, J. D. Spitler “Heating, Ventilation and Air-conditioning”, Wiley publications.

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B. Tech (7th Semester) Mechanical Engineering							
B23-MEP-407	NON-DESTRUCTIVE TESTING						
Lecture	Tutorial	Practical	Credit	End Semester Exam	Internal Assessment	Total	Time (Hrs)
3	0	0	3	70	30	100	3
Purpose	The purpose of this course is to impart comprehensive knowledge of techniques to inspect, detect, and evaluate material flaws without damaging components						
Course Outcomes							
CO 1	Students will be able to learn the fundamental concepts of NDT.						
CO 2	Students will be able to describe the different methods of surface NDE.						
CO 3	Students will be able to describe the concept of thermography and eddy current testing.						
CO 4	Students will be able to explain the ultrasonic testing and acoustic emissions.						

UNIT-I

Introduction to NDT: Introduction to NDT, Importance of the non-destructive Testing methods, Historical Developments in NDT, Various types of Discontinuities and Defects, Applications of NDT, relative merits and limitations of Destructive vs NDT Technique, Comparison of NDT vs destructive testing.

Visual inspection : Introduction to Visual Inspection, Physics of Vision, Unaided visual inspection, Aided Visual Inspection: Direct visual aids, Remote(Indirect) Visual aids; Categories of Visual Inspection, Advantages of Visual Testing, Limitations of Visual testing, Applications of Visual testing.

UNIT-II

Surface NDE methods: Liquid penetrant testing – History, advantages of LPT over VT, principle, Testing procedure for LPT, Materials Used in Penetrant Testing, Different Types of Penetrants, penetrants sensitivity, properties of liquid penetrants, Methods of Penetrant removal; Developers , mechanism of developer action, various types of developers, advantages and limitations of various methods, interpretation of results,

Magnetic Particle Testing-Introduction, theory of magnetism, Circular and Longitudinal direction of magnetization, magnetization methods, Magnetic particles, interpretation and evaluation of test indications, principles and methods of demagnetization, residual magnetism.

UNIT-III

Thermography and eddy current testing (ET): Thermography- principles, contact and non-contact inspection methods, advantages and limitations various types of infrared detectors, instrumentation and methods, applications.

Eddy current testing: Principles of Eddy current testing, Generation of eddy currents, properties of eddy currents, Factors affecting eddy current response, eddy current sensing elements, various types of eddy current probes, instrumentation, interpretation/evaluation, advantages, limitations, applications.

UNIT-IV

Ultrasonic testing (UT): Ultrasonic testing-principle, Transducers, ultrasonic generation, Ultrasonic wave propagation, classification of transducers Ultrasonic test techniques, Ultrasonic Data Presentation formats, Applications, advantages and limitations.

Acoustic emission Testing: Introduction, History of AET, Basic Principle, Comparison of AET with other NDT techniques, Acoustic Emission Instrumentation, Characteristics of Acoustic emission waves, AE wave propagation, AE Signal parameters, AE Source mechanism, Advantages and limitation, applications.

Text books:

1. Non-Destructive Testing - Baldev Raj, T. Jayakumar, M. Thavasimuthu Narosa Publishing House.
2. Non-Destructive Testing Techniques - Ravi Prakash, 1st revised edition, New Age International Publishers.

Reference books:

1. ASM Metals Handbook, Non-Destructive Evaluation and Quality Control, American Society of Metals, Metals Park, Ohio.
2. ASNT, American Society for Non Destructive Testing, Columbus, Ohio, NDT Handbook, Vol. 1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing, Vol. 5, Electromagnetic Testing, Vol. 6, Acoustic Emission Testing, Vol. 7, Ultrasonic Testing.
3. Handbook of Nondestructive evaluation by Charles, J. Hellier, McGraw Hill, New York 2001.
4. Introduction to Non-destructive testing: a training guide by Paul E Mix, Wiley, 2nd Edition New Jersey, 2005.
5. Nondestructive Testing, Louis Cartz, ASM International.
6. Theory and Practice of Non Destructive Testing by Prof. Ranjit Bauri NPTEL course from IIT Madras (Theory and Practice of Non Destructive Testing - Course).

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B. Tech (7th Semester) Mechanical Engineering							
B23-MEP-409	COMPUTATIONAL FLUID DYNAMICS						
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	0	0	3	70	30	100	3
Purpose	To familiarize the students with the basic concepts of Computational Fluid Dynamics.						
Course Outcomes							
CO 1	Students will be able to develop and classify the basic equations which govern the fluid flow and heat transfer phenomena, and analyze their mathematical behavior.						
CO 2	The students will be able to understand the basic concepts of discretization and apply finite difference technique for the solution of heat transfer and fluid flow problems.						
CO 3	The students will be to understand the basic concepts of finite volume method and apply the same to solve problems of heat transfer.						
CO 4	The students will be able to analyze the combined heat conduction diffusion problems and develop knowledge about the different techniques of CFD.						

UNIT-I

Introduction: Introduction to computational fluid dynamics, its importance, comparison of the three basic approaches in engineering problem solving- analytical, experimental and computational; applications of CFD, three main elements of a CFD code; models of the flow, substantial derivative, governing equations – continuity equation, Navier-Stokes equation, energy equation; physical boundary conditions.

Mathematical behavior of governing equations: classification of quasi linear partial differential equations, general method of determining the classification of partial differential equations, general behavior of hyperbolic, parabolic, elliptic equations.

UNIT-II

Finite difference method: The concept of discretization; finite differences; Taylor series formulation; finite difference discretization of ordinary and partial derivatives; difference equations; explicit and implicit approaches, truncation error, round-off error, discretization error; consistency and stability of numerical schemes; error and stability analysis, Thomas algorithm, solution of one and two dimensional unsteady heat equations by explicit and implicit methods, solution of steady two dimensional heat equation by iterative procedure, Couette flow solution; problems.

UNIT-III

Finite volume method: Heat Conduction: Control volume formulation, basic rules, guiding principles; Steady one-dimensional conduction, inter-face conductivity, non-linearity, source-term linearization, boundary conditions. Unsteady one-dimensional conduction: explicit, Crank-Nicolson and fully implicit schemes, discretization of two and three dimensional problems, over relaxation and under relaxation, problems.

UNIT-IV

Heat Convection & Diffusion: Steady one-dimensional convection and diffusion, central differencing scheme, upwind differencing scheme, exact solution, exponential, hybrid, and power law schemes, discretization equations for two dimensions & three dimensions.

Simple CFD Techniques: Lax-Wendroff technique, Mac Cormack's technique, space marching, relaxation technique, pressure correction technique, SIMPLE algorithm.

Text Books:

1. Numerical Heat Transfer and Fluid Flow by Suhas V. Patankar, Taylor & Francis.
2. Computational fluid dynamics by John D. Anderson, Jr, McGraw Hill.

Reference Books:

1. An Introduction to Computational Fluid Dynamics, H. Versteeg & W. Malalasekera, Pearson.
2. Introduction to Computational Fluid Dynamics: Development, Application & Analysis, Atul Sharma, Athena Academics, Wiley Publications.
3. Computational Fluid Flow & Heat Transfer, K. Muralidhar & T. Sundararajan.
4. Introduction to Computational fluid dynamics by Anil W. Date
5. Computational Techniques for Fluid Dynamics Volume I & II, C.A.J. Fletcher, Springer.

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B. Tech (7th Semester) Mechanical Engineering							
B23-MEP-411	HEATING, VENTILATION AND AIR-CONDITIONING SYSTEMS						
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	0	0	3	70	30	100	3
Objective	To acquaint the students with fundamentals of heating, ventilation and air-conditioning.						
Course Outcomes							
CO 1	Student will be able to understand comfort, health and Indoor air Quality.						
CO 2	Student will be able to understand heat transmission due to building structure and analyze space heating load.						
CO 3	Student will be able to analyze ventilation, duct design and air distribution system.						
CO 4	Student will be able to understand and design advanced air conditioning systems.						

UNIT-1

Comfort and Health

Comfort: Physiological Considerations, environmental comfort indices, comfort conditions, Basic concern of IAQ, Common Contaminants, Methods to control Humidity, Methods to control Contaminants.

UNIT-II

Heat Transmission in Building Structures:

Basic Heat Transfer Modes, Tabulated Overall Heat transfer coefficients, Moisture transmission.

Space Heating Load: Outdoor and Indoor Design conditions, Transmission heat losses, infiltration, heat losses from air ducts, Auxillary heat sources, Supply air for heating space, Source media for space heating.

UNIT-III

Ventilation, Infiltration & Air Distribution Systems (Ducts)

Ventilation and infiltration: Natural ventilation, Mechanical ventilation

Duct Design: Definition of duct and types of ducts, Economic factors influencing duct layout, Materials for ducts and its specification, Flow through duct, Pressure in ducts, Friction loss in ducts, Equivalent diameter of a circular duct for rectangular sections, Methods of duct designs. (Numerical treatment on duct design)

Air Distribution System: Factors considered in air distribution system, (simple numerical). Types of air distribution devices. Fan coil unit, Fan laws, Types of fans used air conditioning applications, Types of supply air outlets, Selection and location of outlets, Filters, Diffusers, Grillers, and Dampers

UNIT-IV

Advanced Air Conditioning Systems

Advanced AC Systems: Working of summer, winter and all year round AC systems, all air system, all water system, air water system, variable refrigerant flow and variable air volume systems, unitary and central air conditioning

Desiccant: Based Air Conditioning Systems: Introduction, Sorbents & Desiccants.

Dehumidification: Liquid spray tower, Solid packed tower, Rotary desiccant dehumidifiers, Hybrid cycles, Solid desiccant Air-Conditioning (Theoretical treatment)

Evaporative Cooling Air Conditioning Systems, Thermal storage air-conditioning systems, Clean room Air Conditioning systems, Radiant cooling. (No numerical),

Text Books:

1. Arora C. P., Refrigeration and Air Conditioning, Tata McGraw-Hill.
2. Manohar Prasad, Refrigeration and Air Conditioning, Willey Eastern Ltd, 1983.
3. McQuiston, - Heating Ventilating and air Conditioning: Analysis and Design 6th Edition, Wiley

India.

4. Arora and Domkundwar, Refrigeration & Air Conditioning, Dhanpatrai & Company, New Delhi.

References Books:

1. Dossat Ray J, Principles of refrigeration, S.I. version, Willey Eastern Ltd, 2000.

2. Stockers W.F and Jones J.W., Refrigeration and Air conditioning, McGraw Hill International editions 1982.

3. Threlkeld J.L, Thermal Environmental Engineering, Prentice Hall Inc., New Delhi.

4. Aanatnarayan, Basics of refrigeration and Air Conditioning, Tata McGraw Hill Publications.

5. Roger Legg, Air Conditioning System Design, Commissioning and Maintenance.

6. ASHRAE Handbook (HVAC Equipments) & ISHRAE handbook.

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B. Tech (7th Semester) Mechanical Engineering							
B23-MEO-401	Internet of Things						
Lecture	Tutorial	Practical	Credit	End Semester Exam	Internal Assessment	Total	Time (Hours)
3	0	0	3	70	30	100	3
Purpose	To introduces the principles of IoT and the basic architecture concepts. The course emphasizes implementation of various logic related to IoT and understanding the concept of data communication among IoT device, data storage, data analytics and data security.						
Course Outcomes							
CO1	Students will get familiarize with IoT architecture and Communication services related to computer architecture.						
CO2	Students will get familiarize with the design of IoT microcontroller and understanding the concept of applying different logics.						
CO3	Students will be understanding the concept of data communication through various IoT devices						
CO4	Students will be acquainted with the basic knowledge of data storage, data analytics and security in IoT						

UNIT-I

Introduction to IoT: Part I, Part II, Sensing, Actuation, Basics of Networking: Part-I, Basics of Networking: Part-II, Part III, Part IV, Communication Protocols: Part I, Part II, Part III, Part IV, Part V.

UNIT-II

Sensor Networks: Part I, Part II, Part III, Part IV, Part V, Part VI, Machine-to-Machine Communications, Interoperability in IoT, Introduction to Arduino Programming: Part I, Part II, Integration of Sensors and Actuators with Arduino: Part I, Part II.

UNIT-III

Introduction to Python programming, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi, Introduction to SDN, SDN for IoT, Data Handling and Analytics, Cloud Computing, Sensor-Cloud.

UNIT-IV

Fog Computing, Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Industrial IoT, Case Study: Agriculture, Healthcare, Activity Monitoring.

Text Books

1. S. Misra, A. Mukherjee, and A. Roy, 2020. Introduction to IoT. Cambridge University Press.
- 2) S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press

Reference Books:

1. Programming Arduino: Getting started with sketches, 2ndEdition,Simon Monk, ISBN: 978-1259641633, Tata McGraw Hill Publication.
2. Exploring Raspberry Pi: Interfacing to the real world with Embedded Linux, Derex Molly, 1st Edition, ISBN: 978-1119188681, Wiley Publication,2016
3. Arduino Programming in 24 hours, Richard Blum, 1st Edition, ISBN: 978-0672337123, Sams

Teach Yourself Publishing.2014

4. Aditya Gupta, “The IoT Hacker’s Handbook: A Practical Guide to Hacking the Internet of Things”, ISBN: 1484242998, Apress publisher, 2019

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B. Tech (7th Semester) Mechanical Engineering							
B23-MEO-403		BASICS OF ELECTRIC VEHICLE					
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	0	0	3	70	30	100	3
Purpose	To provide students with the essential knowledge and skills to understand, test, and work with EV systems.						
Course Outcomes							
CO 1	Students will be able to identify components and subsystems used in electric vehicles.						
CO 2	Students will be able to select electrical drives for particular EV application.						
CO 3	Students will be able to test the performance of batteries and energy storage systems used for EV applications.						
CO 4	Students will be able to apply the concept of converters and charging system in EV and to know Indian EV policies for EV applications.						

UNIT-I

Basics of Electric Vehicles: History and evolution of electric vehicles (EV), need of EV, Electric vehicles and internal combustion engine vehicles: Comparison on the basis of environmental impact, power source, maintenance, gear change, noise level, vibrations level, capital cost, and running cost. Electric vehicle architecture, Types of EV: Battery Electric Vehicle (BEV), Hybrid Electric Vehicle (HEV), Plug-in Hybrid Electric Vehicle (PHEV), Fuel Cell Electric Vehicle (FCEV). Comparison of different electric vehicle types on the basis of Driving Component, Energy Source used, Features, Problems and models available in market, Block diagram of EV subsystems, energy source subsystem, propulsion subsystem and auxiliary subsystem.

UNIT-II

Electric Vehicle Drives: Classification of electric drives used in EV: DC Motor drives, AC Motor drives. Brushed DC Motor, Brushless DC Motor (BLDC), Permanent Magnet Synchronous Motor (PMSM), Induction Motor (IM), Synchronous Reluctance Motor (SynRM), PM Assisted Synchronous Reluctance Motor, Axial Flux Ironless Permanent Magnet Motor: Salient features, characteristics, advantages, limitations, and usage of different motor types in EV models. Comparison of EV motors based on power-weight ratio, torque-speed characteristic, cost of controllers required and cost of motors. Physical location of motor in EV, Rating of motors, Connections (Mechanical and Electrical), and Selection criteria of various types of EV motors.

UNIT-III

Batteries and Energy Storage Systems: Energy storage technology: EV Batteries, Super capacitors, flywheel energy storage. Battery Parameters: Cell and Battery Voltages, Charge (or Amphour) Capacity, Energy Stored, Specific Energy, Energy Density, Specific Power, Amphour (or Charge) Efficiency, Energy Efficiency, Self-discharge Rates, Battery Geometry, Battery Temperature, Heating and Cooling Needs, Battery Life and Number of Deep Cycles. **Batteries:** Lead-acid, NiMH (Nickel-Metal Hydride), Li-Ion (Lithium-Ion), Ni-Zn (Nickel-Zinc), Ni-Cd (Nickel-Cadmium), Aluminium-Ion batteries (Al-Ion batteries), Aluminium-air batteries (Al-air batteries) - their basic construction components, life time (cycles), efficiency, advantages and disadvantages. Comparison of various batteries. Factors influencing the operation of battery, and selection of battery. Series and Parallel connection of Batteries, Calculation of battery capacity. **Battery Management Systems (BMS):** Need of BMS, Block diagram of BMS, function of each block, Battery Condition Monitoring, “3R” (Reduce, Reuse, Recycle) process for battery.

UNIT-IV

Converters and EV Chargers: Introduction to power electronics used in EV, Block diagram of typical EV: Description and Functions of DC to DC Converter, DC to AC Converter, AC to DC Converter (Rectifier) and filters. **Charging methods:** Home charging, Trickle charging, Household AC charging, Public charging (DC Fast charging). Charging System: Classification- Wireless, On

board and Off board charging, V1G (Uni-directional smart charging), V2B/V2H (Vehicle-to-Building/ Vehicle-to-Home), V2X (Vehicle-to-Everything), V2G (Vehicle-to-Grid, Bi-directional smart charging).

Electric Vehicle (EV) Policies: Goal of EV30@30 campaign, Goals of electric vehicles initiative in India. National Electric Mobility Mission Plan 2020 (NEMMP): Objectives, Steps taken by Indian Government for faster adoption of electric vehicles, Barriers to adoption of electric mobility, E-mobility strategy.

Text Books:

- 1 Mehrdad Ehsani, Yimin Gao, Stefano Longo, and Kambiz Ebrahimi. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles. CRC Press, 2019, ISBN 13: 9780367137465.
- 2 James Larminie, John Lowry. Electric Vehicle Technology Explained. Wiley-Blackwell, 2012, ISBN 13: 978-1119942733
- 3 Dr. Nitesh Tiwari, Dr. Shekhar Yadav. Electric Vehicle (Green and Sustainable Transportation). S.K. Kataria & Sons, 2023, ISBN 13: 987-81-963589-0-7.
- 4 Ali Emadi, Mehrdad Ehsani, John M. Miller. Vehicular Electric Power Systems: Land, Sea, Air, and Space Vehicles. CRC Press, 2003, ISBN 13: 9780824747510. 5 Sunil R. Pawar. Electrical Vehicle Technology: The Future towards Eco-Friendly Technology. Notion Press Publication, 2021, ISBN 10:1685545610.

Reference Books:

1. Build Your Own Electric Vehicle by Seth Leitman and Bob Brant.
2. Handbook on Battery Energy Storage System, ASIAN DEVELOPMENT BANK, 2018
3. Iqbal Hussein, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, 2nd Edition, 2003.

Note: The paper setter will set the paper as per the question paper template provided.

B. Tech (7th Semester) Mechanical Engineering							
B23-MEO-405	MANAGEMENT INFORMATION SYSTEM						
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	0	0	3	70	30	100	3
Purpose	The purpose of this course is to provide students with an in-depth knowledge of management information system. The course addresses the various emerging technologies used in MIS.						
Course Outcomes							
CO 1	Students will be able to understand the concept of Management Information systems. The student will also be able to understand key components of Database management systems.						
CO 2	Students will be able to understand various Strategic Enterprise Systems and Operational Support Systems						
CO 3	Students will be able to understand about IT Strategy and concepts of E-commerce						
CO 4	Students will be able to understand about various Emerging Technologies used in MIS and concepts in Knowledge Management system.						

UNIT-I

Introduction to Management Information systems: Types of MIS, Capabilities, Complements, CCR Framework; Role of manager with respect to IT in an organization, Database management systems, Data Warehousing, Foundations of business intelligence, Data and Text Mining.

UNIT-II

Strategic Enterprise Systems - ERP, SCM, CRM, SRM
Operational Support Systems - Manufacturing Systems, Sales and Marketing Systems, HRIS, Finance and Accounting Systems

UNIT-III

IT Strategy and Balanced Scorecard – IT strategies, IT- business alignment, balanced scorecard, cloud and vendor strategies.
Mobile and E-commerce – B2C, B2B and e-procurement, C2C and mobile commerce

UNIT-IV

Emerging Technologies – Cloud computing, Big Data Technologies, Internet of Things, Bring Your Own Device (BYoD,) Virtual Reality, Augmented Reality, Block chain, Artificial Intelligence.
Knowledge Management – Decision Support Systems, Expert Systems, Learning Management Systems, Executive Information Systems, Social, ethical and security Issues in MIS.

Text books:

1. Book Name: Management information system by Girdhar Joshi, Oxford.
2. Kenneth C. Laudon & Jane P. Laudon. "Management Information Systems". Pearson Publishing.

Reference books:

1. Management Information Systems, James A. Obrein, Tata McGraw-Hill.
2. Management Information Systems, Gordon B. Davis & Margrethe H.Olson, Tata McGrawHill.
3. Management Information Systems Text & Cases, W S Jawadekar, Tata McGraw-Hill.

Note: The paper setter will set the paper as per the question paper template provided.

B. Tech (7 th Semester) Mechanical Engineering							
B23-MEO-407	Waste to Energy						
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	0	0	3	70	30	100	3
Purpose	The purpose of this course is to introduce Mechanical Engineering students to waste-to-energy technologies and sustainable energy recovery methods. The course emphasizes thermo-chemical and bio-chemical conversion of wastes, waste-derived fuels, and practical energy recovery systems, enabling students to understand the role of waste-to-energy in addressing energy demand and environmental challenges.						
Course Outcomes							
After successful completion of this course, the students will be able to:							
CO 1	Explain the principles of waste management, waste characterization, and the role of waste as an alternative energy resource.						
CO 2	Describe thermo-chemical and bio-chemical waste-to-energy conversion technologies suitable for mechanical engineering applications.						
CO 3	Analyze energy recovery options from solid, liquid, and gaseous wastes, including plastics and organic wastes.						
CO 4	Evaluate waste-to-energy systems with respect to efficiency, environmental impact, and practical implementation in Indian conditions.						

UNIT – I

Introduction to Waste and Energy Recovery

Fundamentals of Waste Management and Waste as Energy Resource: Introduction to waste management principles, waste management hierarchy, and the 3R concept of reduce, reuse, and recycle. Concept of waste as a resource and waste-to-energy as an alternative energy pathway. Role of waste-to-energy in sustainable development and energy security.

Waste Sources and Characterization for Energy Utilization: Sources of waste from domestic, industrial, agricultural, municipal, and post-consumer sectors. Classification of wastes, including agro-based residues, forest residues, municipal solid waste, plastic waste, and industrial wastes (hazardous and non-hazardous). Physical and chemical characterization of waste, proximate and ultimate analysis, and calorific value determination for energy recovery.

UNIT – II

Thermo-Chemical Waste-to-Energy Technologies

Combustion, Incineration, and Heat Recovery Systems: Energy production from wastes through combustion and incineration processes. Incinerator types and heat recovery mechanisms. Power generation from waste heat, efficiency improvement of waste-to-energy power plants, and basic environmental considerations.

Pyrolysis, Gasification, and Plastic Waste Conversion: Principles of pyrolysis and gasification of solid wastes. Syngas generation, composition, and utilization. Densification of solid wastes through briquetting and pelletization. Energy recovery from non-recyclable plastic wastes. Introduction to gas cleanup and emission control systems.

UNIT – III

Bio-Chemical and Biological Energy Conversion

Anaerobic Digestion and Fermentation Technologies: Energy production from organic wastes through anaerobic digestion. Biogas generation, composition, and applications. Fermentation processes for bio-energy production from biomass and organic wastes. Utilization of digestate and process limitations.

Advanced Biological Energy Systems: Energy recovery from wastewater using anaerobic processes. Introduction to microbial fuel cells and their working principles. Cultivation of algal biomass using wastewater. Energy production pathways from algae and challenges in algal bioenergy systems.

UNIT – IV

Waste-Derived Fuels and Specialized Waste Streams

Waste-Derived Fuels and Energy Recovery Options: Landfill gas generation, collection, and recovery systems. Refuse Derived Fuel (RDF), including fluff, briquettes, and pellets. Alternate Fuel Resources (AFR) derived from wastes and their utilization in cement plants, thermal power plants, and industrial boilers. Optimization and benchmarking of waste-to-energy systems.

E-Waste and Environmental Considerations: Introduction to e-waste and its global and Indian context. Growth of electrical and electronic waste, environmental and health hazards. Overview of e-waste recycling practices and challenges. Basic e-waste management strategies, government regulations, and the need for environmental and health safeguards in India.

Text Books:

1. Rogoff, M.J. and Screve, F., *Waste-to-Energy: Technologies and Project Implementation*, Elsevier.
2. Young, G.C., *Municipal Solid Waste to Energy Conversion Processes*, John Wiley & Sons.
3. Harker, J.H. and Backhurst, J.R., *Fuel and Energy*, Academic Press Inc.

Reference Books

1. El-Halwagi, M.M., *Biogas Technology – Transfer and Diffusion*, Elsevier Applied Science.
2. Hall, D.O. and Overend, R.P., *Biomass – Renewable Energy*, John Wiley & Sons.
3. Mondal, P. and Dalai, A.K. (Eds.), *Sustainable Utilization of Natural Resources*, CRC Press, 2017.
4. Nicholas P. Cheremisinoff, *Handbook of Solid Waste Management and Waste Minimization Technologies*, Elsevier, New Delhi, 2003.
5. M. Dutta, B.P. Parida, B.K. Guha and T.R. Surkrishnan, *Industrial Solid Waste Management and Landfilling Practice*, Narosa Publishing House, New Delhi, 1999.
6. *Waste-to-Energy in Austria – White Book – Figures, Data Facts*, 2nd edition, May 2010.
7. Hagerty, D. Joseph; Pavoni, Joseph L; Heer, John E., *Solid Waste Management*, Van Nostrand, New York.

Note: The paper setter will set the paper as per the question paper template provided.

B. Tech (7th Semester) Mechanical Engineering							
B23-MEO-409	Consumer Electronics						
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	0	0	3	70	30	100	3 Hrs
Purpose	This purpose of this course is to provide in-depth knowledge of audio, video, and home appliances, aiming to teach students how to operate, troubleshoot, repair, and maintain these devices.						
Course Outcomes							
CO 1	Students will be able to explain the working principles of microphones, speakers, amplifiers, and recording systems.						
CO 2	Students will be able to describe the operation of LCD, LED, Smart TV, and DTH systems, including signal transmission.						
CO 3	Students will be able to understand the, repair, and maintain products such as ACs, washing machines, refrigerators, and microwave ovens.						
CO 4	Students will be able to identify key components and troubleshoot mobile handsets, EPABX, and communication systems.						

UNIT I

Audio Systems PA Systems: Microphones, Loudspeakers, Amplifiers. Audio recording and reproduction: Magnetic recording, Digital audio recording, CD/DVD players, MP3 players.

UNIT II

Video Systems Monochrome and Color TV basics: Scanning, Composite Video Signal. TV Standards (NTSC, PAL, SECAM). Digital TV: HDTV, LCD, LED, Plasma displays, Set-top boxes, and DTH.

UNIT III

Domestic Appliances Microwave ovens, Washing Machines (Electronic control, Fuzzy logic), Air Conditioners, Refrigerators, Digital Clocks, and Home Security Systems.

UNIT IV

Digital Access Devices Calculators, Digital Cameras, Camcorders. Communication devices: Fax machines, Smart phones, Tablets, and Barcode scanners.

Text Books:

1. **Consumer Electronics** by S.P. Bali (Pearson Education)
2. **Consumer Electronics for Engineers** by Philip Hoff (Cambridge University Press)

Reference Books:

1. **Audio Video Systems: Principles, Practices, and Troubleshooting** by Bali & Bali (Khanna Publishing)
2. **Modern Television Practice** by R.R. Gulati (New Age International) - *The standard text for understanding monochrome and color TV systems, including HDTV.*

B. Tech (7 th Semester) Mechanical Engineering							
B23-MEO-411	Bioinformatics						
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	0	0	3	70	30	100	3 Hrs
Purpose	This purpose of this course is to make the students understand about the principles of analysing biological data, building models and testing hypotheses using computer science algorithms. It will also introduce information technology practices in the field of biotechnology.						
Course Outcomes							
CO 1	Students will know the overview of various information repositories widely used in biological sciences; and tools for searching or querying those databases						
CO 2	Students will learn about the foundation of sequence alignment techniques.						
CO 3	Students will learn about the foundation for how to find evolutionary connections						
CO 4	Students will know about analyzing mRNA expression data and gene annotations.						

UNIT-I

General Introduction: Bioinformatics and its applications. Biological databases and tools: Sequence Databases: introduction of Databases, primary and secondary databases, nucleotide and protein sequence databases: Genbank, EMBL, DDBJ, Swissprot, pfam. Structure Databases: Introduction to structures. PDB (Protein Data bank) Molecular Modeling database at NCBI, database structure viewers. c) Sequence and Structure File Formats: The gene bank Flat file- a dissection.

UNIT- II

Entrez system: Integrated information axis, Information retrieval from biological database, retrieving database entries, integrated information retrieval, and sequence database beyond NCBI. Medical databases. Sequence Alignment and Database Searching: Pair-wise Alignment, Dot matrix, Dynamic programming and gap penalties, Database similarity searching: BLAST and its types, low-complexity regions, Tool of multiple sequence alignment: CLUSTAL W/X.

UNIT- III

Phylogenetic Analysis: Elements of phylogenetic models, phylogenetic data analysis: alignment, substitution model building, tree building and tree evaluation, phylogenetic software (PHYLIP). phylogenetics online tool and Applications.

UNIT- IV

Computational Epigenetic: Epigenetic and its role in transcription regulation, development, and diseases. Transcription factor regulation and motif finding. Molecular modeling and validation, docking.

Text Books:

- Jonathan Pevsner. Bioinformatics and Functional Genomics, 2nd Edition. ISBN: 978-0- 470-08585
- Greg Gibson and Spencer V. Muse. A Primer of Genome Science, Third Edition. ISBN: 978-0-87893-309-9.

Reference Books:

- Essential Bioinformatics, Jin Xiong, Cambridge University Press; 1st edition 2006.
- Bioinformatics: methods and applications, S. C. Rastogi, PHI learning; 4th edition, 2013.
- The Dictionary of Genomics, Transcriptomics and Proteomics, Günter Kahl, Willey VCH, 2015.

Note: The paper setter will set the paper as per the question paper template provided.

B. Tech (7th Semester) Mechanical Engineering							
B23-MEC-401	AUTOMOBILE ENGINEERING						
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	0	0	3	70	30	100	3
Purpose	The objective of this course is to enable the students to understand various automotive systems.						
Course Outcomes							
CO 1	Students will be able to understand the automobile chassis and frames construction, failure reasons and the front xl end the steering systems.						
CO 2	Students will be able to explain the working of the gearbox, transmission system, and drive line.						
CO 3	Students will be able to understand the suspension system, steering geometry and wheels of vehicles.						
CO 4	Students will be able to know about different braking systems operation, safety features and the vehicle safety system.						

UNIT-I

Chassis and frames: Types of Chassis Layout With Reference to Power Plant Locations and Drives, Vehicle Frames, Various Types of Frames, Constructional Details, Materials, Testing of Vehicle Frames, Unitized Frame Body Construction, Articulated Vehicle, Manufacturing processes for chassis, causes of chassis failure.

Front Axle and Steering System: Functions of front axle, Types of front axle, Construction, Stub axle and Wheel bearing, Front wheel steering Geometry – castor, Camber, King pin inclination, toe-in, toe-out, Centre point Steering, Self-returning property, Adjusting and checking of front wheel geometry, Ackerman and Davis steering linkages, Steering system layout, Steering gear boxes.

UNIT-II

Transmission - I: Function of transmission, necessary of transmission, types of transmission, manual transmission, sliding mesh gear box, constant mesh gear box, synchromesh gear box, selector mechanism, lubrication of gear box, transfer box, all-wheel drive,

Transmission - II: Automatic transmission, epicyclic gear box, free wheel unit, torque converter, automatic transmission, overdrives, continuous variable transmission, toroidal CVTs, automated manual transmission, modern shift control; techniques, hybrid power transmission, zero shift transmission technology, comparison of various types of transmissions, trends in transmission design for electric/hybrid vehicles.

Drive line: Drive line, propeller shaft, half shafts, universal joints, analysis of hook's joints, propeller shaft overhauling, final drive, differential, real axle, rear axle drive, rear axle shaft supporting, rear axle casing, and improvements in 4-wheel drive.

UNIT-III

Suspension system: objectives of suspension, basic consideration, functions of suspension springs, types of suspension springs, leaf springs, coil springs, torsion bars, dampers, independent suspension, anti-roll device, roll centre moment sensor, swing arma angh, delphi active stabilizer bar system, interconnected suspension system, air suspension, hydrolastic suspension, Daimler Benz vehicle suspension, hydra gas interconnected suspension system, magneride, continental electronic air suspension, Bose suspension system, modern suspension trends.

Front axle and steering: front axle, wheel alignment, factors of wheel alignment, factors pertaining to wheels, steering geometry, correct steering angle, steering mechanism, cornering force, self-righting torque, understeer and oversteer, lift of oversteer, torque steering, vehicle handling, steering linkages, steering gears, steering ratio, reversibility, special steering columns, power steering, adaptive steering, Nissan's steer by wire, four wheel steering, steering adjustments, checking of wheel alignments and steering geometry.

Wheel and tyres: Types of wheels, carbon fibre wheels, wheel dimensions, tyres, desirable tyres properties, carcass types, comparison of radial and bias ply tyres, tyre materials, consideration tread design, structural consideration in PCR tyres, tyre selection, tyre designations, matching tyres to wheels, tyre wear indicator, nitrogen in tyres, wider vs narrower tyres, ageing of tyres, tyre colour, effect of air pressure on tyre performance, effect of temperature on tyre pressure, factors affecting tyres life, tyre manufacture, tyre retreading, Dunlop Denovo tyre, tyre pressure monitoring system, self-inflating tyres, tyre reliability solutions, precaution regarding the tyres.

UNIT-IV

Brake- I: Principle, braking requirements, brake efficiency and stopping distance, fading of brakes, weight transfer, wheel skidding, type of brakes, drum brakes, disc brakes, mechanical brakes, Girling mechanical brake, hydraulic brakes, brake fluid, brake system for Maruti 800 car.

Brake II: Electric brakes, servo brake systems, power brakes, vacuum servo brakes, brakes with hydraulic booster, engine exhaust brakes, air brake, hand brake, hill holding device, electric parking brake, brake drums, brake shoes, brake linings, disc brake pads, anti-brake system, adjustment of brake, replacing brake lining, brake maintenance, regenerative brake system, electric-hydraulic combi brake, Sensotronic brake control, siemens VDO's electronic wedge brake, carbon ceramic brakes, brake system selection criterion.

Safety features: ABS, GPS vehicle tracking, autonomous emergency braking (AEB), automatic transmission, electronic stability control (ESC), forward collision warning.

Vehicle Safety Systems: Introduction, Electronic stability program system operation, overview, rollover mitigation system overview, active safety and passive safety, latest trends in traffic system for improved road safety, head restraints, introduction to the type of safety glass and their requirements, types of different mirrors and their location.

Text Books:

1. Automobile Engineering -By K.M. Gupta, Umesh Publications.
2. Automobile Engineering- Sudheer Kumar, University Science Press.
3. Automobile Engineering- K.K Jain, Tata McGraw-Hill Publishing Company Limited.

Reference Books:

1. The Motor Vehicle - By Newton, Steeds and Garrett Basic.
2. Automobile Engineering - By Kirpal Singh, Standard Publication.

Note: The paper setter will set the paper as per the question paper template provided.

B. Tech. (7th semester) Mechanical Engineering							
B23-MEC-403	PYTHON FOR MECHANICAL ENGINEERING						
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	0	0	3	70	30	100	3
Purpose	To make student proficient in applying python programming for analyzing and solving engineering problems.						
Course Outcomes							
CO1	Students will learn the basics of Python programs from an engineering point of view.						
CO 2	Students will learn about the applications of various modules and packages used with Python.						
CO 3	Use of Python to solve engineering problems in Mechanics and Machine design.						
CO 4	Use of Python to solve engineering problems in Thermal sciences and Fluid mechanics.						

UNIT-I

Basics of Python Programming:

Introduction to Python, History, Advantages of Python programming language Need of Learning Python, Overview of Different Text editors for python, Installation of Python shell, Installation of Anaconda, Installation of Sublime text, Running a Hello world program, Running Python from a Terminal.

Basics of Programming with Python:

Various variables and data types available in Python, Types of Operations in Python, Data type conversion, Strings, List and tuples, Dictionary and sets, Loops in python, Functions, File input and output. Object Oriented Programming in Python

UNIT-II

Modules, Packages and Library used in Python

Introduction to Numpy, creation of Arrays, functions for generating sequences, aggregate functions.

Introduction to Matplotlib

Plotting in Python, Figures and axes, Subplots, scatter plot, Line plot, Bar plot, Contour plot, Surface plot, Multiple plot

UNIT-III

Applications of Python in Mechanics and Machine Design

Analysing projectile motion using Python, Analysis of Shear Force and Bending moment diagrams, Use of Python Script in Design and Simulation Softwares.

UNIT-IV

Application of Python in Mechanical Engineering

Applications of Python to solve one dimensional equation, Application of python to visualise flow streamlines, Applications of Python to analyse Diesel cycle, Application of python to supercharger in engine. Flow over an airfoil.

Text Books:

1. Python Basics by H. Bhasin, Mercury Learning and Information LLC, New Delhi.
2. Head First Programming by O'Reilly, O'Reilly Media, Inc., CA, USA.
3. UDEMY online course on Pthon for mechanical engineers.
4. Python Basics by H. Bhasin, Mercury Learning and Information LLC, New Delhi.
5. Head First Programming by O'Reilly, O'Reilly Media, Inc., CA, USA.

Reference Books:

1. Automate the Boring Stuff with Python by Al Sweigart No Starch Press, Inc., San Francisco, USA.
2. Decibel lab online course on Python for mechanical engineers.

Note: The paper setter will set the paper as per the question paper template provided.

B. Tech. (7th Semester) Mechanical Engineering							
B23- MEC-405	PROJECT-II						
Lecture	Tutorial	Practical	Credits	Internal Assessment	Practical Exam	Total	Time (Hrs.)
0	0	8	4	100	100	200	3
Purpose:	To implement the engineering principles and theories into innovative practical projects for solving real world problems.						
Course Outcomes							
CO1	The students will be able to apply the theoretical knowledge into practical work.						
CO2	The students will be able to learn new things related to latest technologies with the help of practical work.						

The project work could be done for the problem statement of an industry or practical project in the institute. The students may also opt for the analysis based software projects with proper validation. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.

Note: The maximum number of students in a group should not exceed four.

B. Tech. (7th semester) Mechanical Engineering							
B23-MEC-407	Python for Mechanical Engineering Lab						
Lecture	Tutorial	Practical	Credits	Internal Assessment	Practical Exam	Total	Time (Hrs.)
0	0	2	1	40	60	100	3
Purpose	The purpose of the Python for Mechanical Engineering Lab course is to provide students with practical skills in applying Python programming to analyze, simulate, and solve problems across mechanics, machine design, thermal sciences, and fluid mechanics.						
Course Outcomes							
CO1	Students will be able to write and execute basic Python programs, demonstrating proficiency in variables, data types, loops, functions, and object-oriented concepts.						
CO 2	Students will be able to apply Python libraries such as NumPy and Matplotlib to perform numerical computations and visualize engineering data effectively.						
CO 3	Students will be able to use Python scripts to analyze mechanical problems such as projectile motion, shear force, and bending moment diagrams, and integrate Python with design and simulation tools.						
CO 4	Students will be able to apply Python programming to solve thermal and fluid mechanics problems, including Diesel cycle analysis, supercharger performance, and flow visualization over an airfoil.						

List of Experiments

1. Basics of Python Programming- Hello World & Basic I/O- Write a Python program to display “Hello Mechanical Engineering” and take user input for name and roll number.
2. Data Types & Operations- Create a program to demonstrate variables, type conversion, lists, tuples, dictionaries, and sets with mechanical examples (e.g., material properties).
3. Loops & Functions- Write a program using loops and functions to calculate factorial of a number and generate a multiplication table.
4. NumPy Arrays- Create arrays for stress values, perform aggregate functions (mean, max, min), and generate a sequence of values.
5. Matplotlib Basics- Plot a line graph showing stress vs. strain using Matplotlib.
6. Multiple Plots- Generate subplots: (a) bar chart of material strength, (b) scatter plot of load vs. deflection.
7. Projectile Motion Simulation-Write a Python script to simulate projectile motion and plot trajectory.
8. Shear Force & Bending Moment Diagram- Develop a program to calculate and plot shear force and bending moment for a simply supported beam with point load.
9. Diesel Cycle Analysis- Write a Python program to plot a diesel cycle and finding efficiency of otto cycle.
10. Flow Visualization over Airfoil- Use Python (Matplotlib/NumPy) to visualize streamlines of airflow over a simple airfoil shape.

B. Tech (8th Semester)
Mechanical Engineering

B. Tech (8th Semester) Mechanical Engineering							
B23-MEP-402	QUALITY AND RELIABILITY ENGINEERING						
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	0	0	3	70	30	100	3
Purpose	The purpose of this course is to provide students with an in-depth knowledge of quality and reliability. The course addresses the techniques of Statistical Quality Control and their practical uses as well as give insight to modern reliability engineering tools.						
Course Outcomes							
CO 1	Students will be able to understand the concept of quality system and engineering in design. The student will also be able to solve the statistical problems.						
CO 2	Students will be able to identify various control charts and sampling plans						
CO 3	Students will be able to understand reliability, availability and maintainability concepts						
CO 4	Students will be able to solve the reliability problems related to complex system as well as able to identify various failure modes and create fault tree diagram.						

UNIT-I

Quality system and Engineering: Quality systems, quality engineering in product design and production process, system design, parameter design, tolerance design.

Statistical Methods: Statistical methods for quality control and improvement, mean, median, mode, standard deviation, calculating area, Normal distribution tables, finding the Z score, Central limit theorem

UNIT-II

Variation in process: Control charts for variables: X-bar and R charts, Control charts for attributes P, C and U-Chart, Establishing and interpreting control charts, process capability.

Acceptance sampling: Acceptance sampling by variables and attributes, single, double, sequential and continuous sampling plans, design of various sampling plan.

UNIT-III

Reliability Concepts: Basics of Reliability engineering; Failure data analysis; Failure rate and Bath-Tub curve; Concept of burn in period; Useful life and wear out phase of a system.

RAM Concepts: Overview of reliability, availability and maintainability (RAM); Concepts of Mean time to failure (MTTF); Mean time between failure, (MTBF) and mean time to repair (MTTR)

UNIT-IV

Reliability evaluation: Reliability of series, parallel and standby systems (complex systems), reliability prediction and system effectiveness, reliability testing

Reliability techniques- Failure mode, effects analysis (FMEA), Failure mode, effects and criticality analysis (FMECA)-Case Studies, RPN, Basic symbols, Ishikawa diagram for failure representation, Fault Tree construction and analysis - case studies.

Text books:

1. Reliability Engineering, (3rd Edition) - LS Srinath, Affiliated East West Pvt Ltd, 1991..
2. Reliability Engineering- E.Bala Guruswamy, Tata McGraw Hill, 1994.
3. Statistical Quality Control- M. Mahajan, Dhanpat Rai & Co., 2018.
4. Statistical Process Control- Eugene Grant, Richard Leavenworth, McGraw Hill.

Reference books:

1. Introduction to Reliability Engineering- Lewis E. E., John Wiley & Sons - 1987
2. Reliability Based Design-Rao S. S., McGraw Hill - 1992
3. Practical Reliability Engineering- O'coner P. D. T., John Wiley & Sons Ltd. - 2003
4. Statistical Quality Control-Eugene G. L., McGraw-Hill – 1996

Note: The paper setter will set the paper as per the question paper template provided.

B. Tech (8th Semester) Mechanical Engineering							
B23-MEP-404		COMPOSITE MATERIALS					
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	0	0	3	70	30	100	3
Purpose	To acquaint the student with the knowledge of different composite materials manufacturing techniques, behavior of composites under loading and performance analysis under fatigue, impact and environmental conditions.						
Course Outcomes							
CO 1	Students will be able to know and explain different types of composite materials, fibers and fabrication techniques.						
CO 2	Students will be able to understand the behaviour of unidirectional composites and short fiber composites.						
CO 3	Students will be able to determine the stresses and strains in the laminated composites and analyze the performance of fiber composites under fatigue.						
CO 4	Students will be able to analyze the performance of fiber composites under fatigue under impact and environmental effects.						

UNIT-I

Introduction: Introduction to composites, Characteristics, Classification, Particulate Composites, Fiber-Reinforced Composites, Applications of Fiber Composites, Introduction to fibers: Glass Fibers, Graphite Fibers, Aramid, Metallic and Other Fibers, Matrix materials and Polymers, Polymer Matrix Materials, Metals and Fillers.

Fabrication of Composites: Fabrication of Thermosetting Resin Matrix Composites, Hand Lay-up Technique, Bag Molding Processes, Resin Transfer Molding, Filament Winding, Pultrusion, Preformed Molding Compounds, Fabrication of Thermoplastic-Resin Matrix Composites (Short-Fiber Composites), Fabrication of Metal Matrix Composites, Fabrication of Ceramic Matrix Composites

UNIT-II

Behavior of unidirectional composites: Nomenclature, volume and void fraction, longitudinal behavior of unidirectional composites, transverse stiffness and strength, failure modes, expansion co-efficient and transport properties.

Short-fiber composites: Introduction, theories of stress transfer: approximate analysis of stress transfer, stress distribution from finite-element analysis, average fiber stress. Modulus and strength of short-fiber composites: prediction of modulus, prediction of strength, effect of matrix ductility.

UNIT-III

Analysis of laminated composites: Introduction, laminate strains, variation of stresses in laminates, resultant forces and moments, laminate description system, determination of laminate stresses and strains, analysis of laminates after initial failure, Hygrothermal Stresses in Laminates, Laminate Analysis through Computers

Performance of Fiber Composites (Fatigue): Introduction to Fatigue Damage, Damage/Crack Initiation, Crack Arrest and Crack Branching, Final Fracture, Schematic Representation, Damage Characterization, Influence of Damage on Properties, Factors Influencing Fatigue Behavior of Composites Empirical Relations for Fatigue Damage and Fatigue Life, Fatigue of High-Modulus Fiber-Reinforced Composites, Fatigue of Short-Fiber Composites

UNIT-IV

Performance of Fiber Composites (Impact): Introduction and Fracture Process, Energy-Absorbing Mechanisms and Failure Models, Fiber Breakage, Matrix Deformation and Cracking, Fiber Debonding, Fiber Pullout, Delamination Cracks, Effect of Materials and Testing Variables on Impact Properties

Environmental-Interaction Effects: Fiber Strength, Features of Stress Corrosion, Static Fatigue

and Stress-Rupture of Fibers, Stress Corrosion of Glass Fibers and GRP, Matrix Effects, Effect of Temperature and Moisture, Degradation at Elevated Temperatures, Stress-Rupture Characteristics at Modest temperatures.

Text Books:

1. Analysis and performance of Fiber Composites by Bhagwan D. Agarwal, Lawrence J. Broutman, K. Chandrashekhara, Wiley India Pvt. Ltd., India.
2. Fiber Reinforced Composites: Materials Manufacturing and Design by P.K. Mallick, 3rd Edition, CRC Press.
3. Mechanics of Composite Materials by Autar K. Kaw, 2nd Edition, CRC Taylor and Francis Group.
4. Composite Materials, Design and Applications by Daniel Gay, Suong V. Hoa, 2nd Edition, CRC Taylor and Francis Group.

Reference Books:

1. Mechanics of Composite Materials by R. M. Jones, CRC Press.
2. Fibrous Materials by K. K. Chawla, Cambridge University Press.

Note: The paper setter will set the paper as per the question paper template provided.

B. Tech. (8 th Semester) Mechanical Engineering							
B23-MEP-406	LUBRICANTS AND LUBRICATION						
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	0	0	3	70	30	100	3
Purpose	The purpose of the course is to make the students aware of the different properties and composition of lubricants and make them understand the fundamental concepts of hydrodynamic, hydrostatic and extreme pressure lubrication.						
Course Outcomes							
CO1	Students will be able to explain and describe properties and composition of lubricants.						
CO2	Students will be able to understand the basics of hydrodynamic lubrication and analyse the thermal and non-Newtonian effects in hydrodynamic lubrication.						
CO3	Students will be able to explain and analyze the hydrostatic lubrication, and extreme pressure lubrication at different temperature-load combinations.						
CO4	Students will be able to understand and analyze the elasto-hydrodynamic lubrication.						

UNIT-I

Physical properties of lubricants: Introduction, relationship of viscosity with temperature, pressure and shear rate, viscosity index, viscosity measurement, viscosity of mixtures; Viscosity classification, thermal properties of lubricants, temperature characteristics of lubricants, neutralization number, carbon residue, optical properties, additive compatibility and solubility, lubricant impurities and contaminants.

Lubricants and their composition: Mineral oil-based liquid lubricants – sources, types, synthetic oils – manufacturing of synthetic oils, hydrocarbon synthetic lubricants, silicon analogues of hydrocarbons, organohalogens; new developments in synthetic lubricants, emulsions and aqueous lubricants, greases, grease characteristics, lubricant additives.

UNIT-II

Hydrodynamic lubrication: Introduction, Reynolds equation, pressure distribution, load capacity, coefficient of friction, lubricant flow; converging diverging wedges, journal bearings, thermal effects in bearings, isoviscous and non-isoviscous thermal analysis, hydrodynamic lubrication with non-Newtonian fluids, squeeze films.

UNIT-III

Hydrostatic lubrication: Introduction, hydrostatic bearing analysis, general approach, optimization of bearing design, aerostatic bearings, stability.

Extreme pressure lubrication: Lubrication mechanisms for low temperature-low load, low temperature -high load, high temperature – medium load and high temperature – high load, boundary and EP lubrication of non-metallic surfaces.

UNIT-IV

Elasto-hydrodynamic lubrication: Introduction, contact stresses, geometry of contacting bodies, contact area, pressure, maximum deflection and position of maximum shear stress, EHL of lubricating films, pressure distribution, film thickness formulae, effect of non-dimensional

parameters, lubrication regimes, partial EHL, surface temperature at conjunction.

Text books:

1. Engineering Tribology - Gwidon W. Stachowiak, Andrew W. Batchelor, Butter worth, Heinemann.
2. Introduction to Tribology of Bearings - B.C. Majumdar, S. Chand Co.

Reference books:

1. Friction and Lubrication - E.P. Bowden and Tabor. D., Heinemann Educational Books Ltd.
2. Engineering Tribology - Ross Beckett, Larsen and Keller Education
3. Fundamentals of Fluid Film Lubrication - Bernard Hamrock, Bo Jacobson, and Steven R. Schmid, Taylor and Francis.

Note: The paper setter will set the paper as per the question paper template provided.

B. Tech. (8th Semester) Mechanical Engineering							
B23-MEP-408	TOOL DESIGN						
Lecture	Tutorial	Practical	Credit	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	0	0	3.0	70	30	100	3
Purpose	The present course focus on to equip students with the knowledge and skills to design, analyze, and develop various tools, dies, and moulds essential for efficient manufacturing and production processes.						
Course Outcomes: After learning the course the students should be able to:							
CO 1	Students will be able to design and analyze guide plate tools and blanking dies, ensuring accuracy and efficiency in sheet metal operations.						
CO 2	Students will be able to develop progressive tool designs for multi-stage operations, incorporating elements like strippers, cut-off punches, and stock lifters.						
CO 3	Students will be able to design compound, bending, and drawing tools, and perform calculations for drawing force, blank holding force, and press capacity.						
CO 4	Students will be able to design injection moulds, compression moulds, transfer moulds, and die casting dies for industrial applications.						

UNIT- I

Guide Plate Tools & Blanking Dies

Design of guide plate tools (single stage, progressive), Design of blanking tool with die set, Design of fine blanking die.

UNIT- II

Progressive Tools

Single stage progressive tool incorporating fixed stop, Multi-stage progressive tools with: Travelling stripper, Cut-off punches & parting-off punches, Side cutter & stock lifters.

UNIT- III

Compound, Bending & Drawing Tools

Compound tools (direct knockout, indirect knockout), Bending tools: V-bending, U-bending, L-bending, Curling tool, forming tool, Drawing tools: Deep draw tool, inverted draw tool, Calculations: drawing force, blank holding force, press capacity.

UNIT-IV

Moulds & Die Casting

Injection moulds: Single cavity, multi cavity, two-plate moulds, Different ejection systems & feed arrangements, Compression moulds (horizontal flash, vertical flash), Transfer moulds (pot transfer, plunger transfer), Die casting dies (cold chamber, hot chamber systems)

Text Books

1. Jigs and Fixtures by Hiran E. Grant, Tata McGraw-Hill
2. Jigs and Fixtures by K. Venkata Reddy and Joshi, Tata McGraw-Hill
3. Introduction to Injection Mould Design by Pye, Longman Scientific & Technical Engineers

Reference Books

1. Tool Design by Donaldson, Tata McGraw-Hill
2. Production Engineering by P.C. Sharma, S. Chand & Company
3. Press Tools: Design and Construction P.H. Joshi, S. Chand & Company
4. Machine Tools and Tool Design P.C. Sharma, S. Chand & Company

B. Tech (8thSemester) Mechanical Engineering							
B23-MEP-410	TOTAL QUALITY MANAGEMENT						
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	0	0	3	70	30	100	3
Purpose	The purpose of this course is to develop an understanding of quality management framework, philosophies, in-depth knowledge of various tools and techniques with their application in the manufacturing and service industry.						
Course Outcomes							
CO 1	Students will be able to understand quality management philosophies and frameworks.						
CO 2	Students will be able to describe various tools and techniques of quality management.						
CO 3	Students will be able to explain the applications of quality tools and techniques in both manufacturing and service industry						
CO 4	Students will be able to describe various quality systems like ISO and its standards.						

UNIT-I

Introduction and philosophies of quality management: introduction, need for quality ,evolution of quality, definitions of quality, dimensions of product and service quality, basic concepts of TQM, TQM framework, benefits, awareness and obstacles, quality, vision, mission and policy statements, contributions of Deming, Juran and Crosby , barriers to TQM, quality statements, customer focus, customer orientation, customer satisfaction, customer complaints, and customer retention, costs of quality.

UNIT-II

Principles of quality management: Leadership, strategic quality planning, quality councils, employee involvement, motivation, empowerment, team and teamwork, quality circles recognition and reward, performance appraisal, continuous process improvement , PDCA cycle, 5S, Kaizen , supplier partnership, partnering, supplier selection, supplier rating.

Process capability: Meaning, significance and measurement, six sigma concepts of process capability.

UNIT-III

Tools and techniques for quality management: Quality functions development (QFD), benefits, voice of customer, information organization, house of quality (HOQ), building a HOQ, QFD process.

Failure mode effect analysis (FMEA): Requirements of reliability, failure rate, FMEA stages, design, process and documentation, seven old (statistical) tools, seven new management tools, bench marking and POKAYOKE.

UNIT-IV

Quality systems organizing and implementation: Need for ISO: 9000, ISO: 9001-2008 quality system, elements, documentation, quality auditing, QS: 9000, ISO: 14000, concepts, requirements and benefits, TQM implementation in manufacturing and service sectors, quality audits, TQM culture.

Text Books:

1. Total Quality Management-Dale H. Besterfield, Pearson Education (First Indian Reprints 2004).
2. Total Quality Management-Shridhara Bhat K, Himalaya Publishing House, First Edition 2002.

Reference Books:

1. Competitive Manufacturing Management – John M. Nicholas, TMH.
2. Total Quality Management- R Kesavan, C Elanchezhian, B Vijaya Ramnath, IK International.

3. Total Quality Management: Principles, Methods, and Applications-Sunil Luthra, Dixit Garg, Ashish Agarwal, Sachin K. Mangla, CRC Press.
4. Total Quality Management-Poornima M. Charantimath, Pearson Pub. Note: The paper setter will set the paper as per the question paper template provided

Note: The paper setter will set the paper as per the question paper template provided.

B. Tech. 8 TH Semester Mechanical Engineering							
B23-MEP-412	CONCURRENT ENGINEERING						
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs)
3	0	0	3	70	30	100	3
Purpose	The objective of this course is to familiarize students with the concepts, approaches and implementation techniques related to concurrent engineering.						
Course Outcomes							
CO1	Students will be able to describe the basic concepts of concurrent engineering and implement concurrent engineering techniques.						
CO2	Students will be able to identify the concept of life cycle management.						
CO3	Students will be able to analyze reengineering and system engineering approaches and processes.						
CO4	Students will be able to appraise different information modeling systems and product realization taxonomy.						

UNIT – I

Concurrent engineering concept: Concurrent engineering definitions, basic principles of CE, components of CE, concurrency and simultaneity, modes of concurrency, modes of cooperation, CE design methodologies, benefits of concurrent engineering,

Review of CE technique: Design for manufacture (DFM), design for assembly (DFA), quality function deployment (QFD), rapid prototyping (RP), total design (TD), organizing for CE, CE tool box.

UNIT – II

Life-cycle management: Introduction, shrinking life-cycle, product development cycle, product-life cycle, life-cycle management, new product introduction, strategic technology insertions, managing continuity, managing revision changes, life-cycle cost drivers, life-cycle management tools, sequential versus concurrent engineering.

UNIT – III

Process-reengineering: Introduction, understanding and managing change, reengineering approaches work-flow mapping, information flow-charting, process improvement methodology, change management methodology, concurrent process reengineering.

System engineering: System engineering process, systems thinking, approaches to system complexity, sharing and collaboration in CE, system integration, management and reporting structure.

UNIT – IV

Information modeling systems: Information modeling, modeling methodology, foundation of information modeling, concurrent engineering process invariant, enterprise model-class, specification model-class, product model-class, process model-class, cognitive models, merits and demerits.

Product realization taxonomy: Development methodology for CPRT, concurrent product realization taxonomy, pull system of product realization, description of parallel tracks, description of 2-T loops, description of 3-T loop.

Text Books:-

1. Concurrent Engineering Fundamental, (Vol 1) integrated Product and Process Organization - Biren Prasad.
2. Concurrent Engineering - G.S. SAWHNEYUNIVERSITY SCIENCE PRESS (An Imprint of Laxmi Publications Pvt. Ltd.) An ISO 9001:2008 Company.
3. Concurrent Engineering Fundamentals: Integrated Product Development - Prasad, Prentice hall India

Reference Books:

1. Design for Concurrent Engineering - J. Cleetus, CE Research Centre, Morgantown
2. Concurrent Engineering in Product Design and Development - I. Moustapha, New Age International
3. Concurrent Engineering: Automation Tools and Technology - Andrew Kusiak - , Wiley Eastern

Note: The paper setter will set the paper as per the question paper templates provided.

B. Tech. (8th Semester) Mechanical Engineering							
B23-MEP-414	FOUNDRY ENGINEERING						
Lecture	Tutorial	Practical	Credit	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	0	0	3.0	70	30	100	3
Purpose	The present course focus on giving the exposure of various Foundry processes for a product whose scale ranges from miniature to extra-large, Moulding-Coring practice, Melting inoculations practices, Quality Control of the casting.						
Course Outcomes: After learning the course the students should be able to:							
CO 1	Express knowledge about the fundamentals of the casting, basic terminology related to casting process and pattern making.						
CO 2	Demonstrate the ability to select the proper molding material and cores Materials.						
CO 3	Develop ability to understand various types of Moulding processes.						
CO 4	Demonstrate the ability to understand various aspects in gating system design and riser design for the casting.						
CO 5	Select the methods of the casting and Decide correct melting practice of different cast alloy & different melt-treatments.						
CO 6	To understand various types of casting processes to obtain quality cast products and select the right casting process for a particular application.						
CO 7	Minimize the defects generated during casting.						

UNIT-I

Introduction: Introduction to metal casting and foundry industry in modern industrial scenario. Advantages and limitations of casting methods. Classification of foundries. Different sections in a foundry and their functions. Important cast metals and alloys-their composition, properties and uses.

Patterns: Types of patterns, brief classification of pattern making materials, consideration in selection of pattern materials, color coding, pattern allowances, core boxes, types of core boxes.

UNIT-II

Moulding and core making: Ingredients of common type of moulding and core making sands, their properties and behavior, testing of sands and clay.

Moulding processes: Classification of molding processes and casting processes, brief description of all processes such as green sand, dry sand, loam sand, floor, pit and machine molding.

UNIT-III

Elements of Gating system: Classification, basic consideration in gating design, gating ratio, gating practice for ferrous and nonferrous alloys, pouring equipment.

Risening Practice: Function of riser, directional and progressive solidification, centerline feeding resistance, riser efficiency, riser design consideration, risering curves, Cain's, N.R.L and modulus method, feeding distance, feeding aids, blind and atmospheric risers.

UNIT-IV

Melting Practice: Melting of cast iron, Mechanical features of cupola, operational steps and principles of cupola operation, Advanced practices in the cupola operation.

Casting processes: Shell molding, CO₂ silicate process, Investment casting process, permanent moulding process, Gravity and pressure die casting, centrifugal casting process

Defects in Casting: Classification of defects during casting, gas porosity, shrinkage defects, metallurgical defects, pouring metal defects, mold material defects, and casting shape defects.

Reference Books:

1. Manufacturing Technology: Foundry, Forming and Welding by P.N.Rao, Tata McGraw Hill Education Private Limited
2. Principles of Metal Casting, R. W. Heine, C. R. Loper and P. C. Rosenthal, (Tata McGraw Hill)
3. Principles of foundry Technology, P. L. Jain, (Tata McGraw Hill).
4. Fundamentals of Metal Casting Technology, P. C. Mukherjee, (Oxford & IBH)
5. Foundry Technology, P. R. Beeley
6. Foundry Engineering, H. f. Taylor, M. C. Flemings,(Wiley Eastern)
7. Foundry Technology, D. Kumar & S. K. Jain, (CBS Pub.)

Note: The paper setter will set the paper as per the question paper templates provided.

B. Tech. (8 th Semester) Mechanical Engineering							
B23-MEP-416		ERGONOMICS					
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	0	0	3	70	30	100	3
Purpose	The purpose of this course is to make the students aware of the human factor engineering principles and its application to different disciplines.						
Course Outcomes							
CO1	Students will be able to explain the ergonomics fundamentals and anthropometry.						
CO 2	Students will be able to analyse the human posture, relative movements and human behaviour and perception.						
CO 3	Students will be able to apply the ergonomics principles in visuals display and product designing.						
CO 4	Students will be able to describe the workstation design and occupational safety.						

UNIT-I

Discipline approach: ergonomics/ human factors: Introduction to ergonomics, Fitting task to man their contractual structure, domain, philosophy and objective, mutual task comfort: two way dialogue, communication model, ergonomics/ human factors fundamentals, physiology (work physiology) and stress.

Human physical dimension concern: Human body- structure and function, anthropometrics, Anthropometry: body growth and somatotypes, static and dynamic anthropometry, stand posture-erect, Anthropometry landmark: sitting postures, Anthropometry: squatting and cross-legged postures, anthropometric measuring techniques, statistical treatment of data and percentile calculations.

UNIT-II

Posture and movement: Human body- structure and function, posture and job relation, posture and body supportive devices, chair characteristics, vertical work surface, horizontal work surface, movement, work counter

Behaviour and perception: Communication and cognitive issues, psycho-social behaviour aspects, behaviour and stereotype, information processing and perception, cognitive aspects and mental workload, human error and risk perception

UNIT-III

Visual Issues: Visual performance, visual displays, environments factors, environmental factors influencing human performance

Ergonomic design process: Ergonomics design methodology, Ergonomics criteria/check while designing, Design process involving ergonomics check, some checklists for task easiness.

UNIT-IV

Performance support and design intervention: Occupational safety and stress at workplace in view to reduce the potential fatigue, errors, discomforts and unsafe acts workstation design, furniture support, vertical arm reach and design application possibility.

Humanising design: Design and human compatibility, comfort and adaptability aspects, Design Ergonomics in India: scope for exploration.

Text Books:

1. Introduction to Ergonomics - R. Bridger-CRC Press, Taylor & Francis Group.

2. Human Factors in Engineering and Design-M. Sanders, E. McCormick, McGraw-Hill International Editions: Psychology Series.
3. An Introduction to Human Factors Engineering-C. Wicknes, S. Gordon, Y. Liu and S. Gordon-Becker, New York.
4. Indian Anthropometric Dimensions for Ergonomic Design Practice-D. Chakrabarti, National Institute of Design, Ahmedabad.

Reference Books:

1. Handbook of Human Factors and Ergonomics-G. Salvendy, John Wiley & Sons, Inc.
2. Ergonomics for Beginners, A Quick Reference Guide, J. Dul and B. Weerdmeester, CRC Press, Taylor & Francis Group.

Note: The paper setter will set the paper as per the question paper templates provided.

B. Tech (8 th Semester) Mechanical Engineering							
B23-MEO-402	Intellectual Property Rights (IPR) and Regulatory Framework						
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	0	0	3	70	30	100	3
Course Outcomes							
Purpose	To understand the concepts IPR, Trademarks, Trade Secretes and GI of goods, Copyrights, Patents and Industrial Designs, managing IP rights and legal aspects and the concepts of Cyber laws in IPR.						
Course Outcomes							
CO 1	Students will be able to demonstrate understanding of basic concepts of IPR.						
CO 2	Students will be able to differentiate between Trademarks, Trade secrets and GI of goods and will understand about the copyrights, patents and industrial design.						
CO 3	Students will be able to manage and protect IP.						
CO 4	Students will gain knowledge on Cyber law.						

UNIT – I

Introduction: Introduction to Intellectual Property Rights, types of intellectual property, importance of intellectual property rights, Evolution of IP acts and treaties, Agencies responsible for IPR registrations, Role and value of IP in international commerce, Issues affecting IP internationally.

UNIT – II

Trade Marks: Purpose and function of trademarks, Acquisition of trade mark rights, transfer of rights, Selecting and evaluating trademark, registration of trademarks, claims. **Trade Secrets:** Trade secret law, determination of trade secret status, liability for misappropriation of trade secrets, trade secret litigation.

Geographical Indication of Goods: Basic aspects and need for the registration.

Copyrights: Fundamentals of copyright law, originality of material, right of reproduction, right to perform the work publicly, copyright ownership issues, notice of copyright. **Patents:** Foundation of patent law, patent searching process, Basic Criteria of Patentability **Industrial Designs:** Kind of protection provided in Industrial design.

UNIT – III

Managing IP Rights: Acquiring IP Rights: letters of instruction, joint collaboration agreement, Protecting IP Rights: non-disclosure agreement, cease and desist letter, settlement memorandum.

Transferring IP Rights: Assignment contract, license agreement, deed of assignment.

UNIT- IV

Introduction to Cyber law: Information Technology Act, cybercrime and e-commerce, data security, confidentiality, privacy, international aspects of computer and online crime.

Text Books:

1. Intellectual property right by Deborah E Bouchoux
2. Cyber law, Text and cases South western special topics collection.
3. Intellectual property rights by N.K Acharya
4. Fundamentals of IPR for engineers, BY komal bansal

Reference Books:

1. Intellectual property rights by P. Radhakrishnan.

Note: The paper setter will set the paper as per the question paper templates provided.

B. Tech (8 th Semester) Mechanical Engineering							
B23-MEO-404	Digital Marketing						
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	0	0	3	70	30	100	3
Course Outcomes							
Purpose	This course equips students with practical knowledge of digital marketing, builds understanding of the digital ecosystem, and enables them to design and evaluate data-driven campaigns in a dynamic business environment.						
Course Outcomes							
CO 1	Students will be able to develop a conceptual understanding of digital marketing and its role in the contemporary business environment.						
CO 2	Students will be able to design and implement effective content and email marketing strategies.						
CO 3	Students will be able to provide practical and strategic insights into social media marketing and display advertising mechanisms.						
CO 4	Students will be able to develop analytical and technical competencies in search engine optimization and paid search advertising.						

UNIT-I

Marketing in the Digital Ecosystem: Concept, scope, and characteristics of digital marketing, Comparison between traditional and digital marketing approaches, Transformation from offline to online marketing models

Digital marketing channels: Search Engine Optimization (SEO) and Search Advertising; Brand based Display Advertising and Social Media Marketing, Affiliate Marketing, Email Marketing and Content Marketing. Customer Value Journey, including the 5A's Framework, Ozone O3 Concept, Understanding online consumer behavior and decision-making patterns.

UNIT-II

Content Marketing: Concept and importance of content marketing, Step-by-step process for developing a content marketing strategy. Content planning, creation, distribution, and performance evaluation.

Email Marketing: Role and significance of email marketing in digital strategy. Types of emails used in marketing campaigns.

UNIT-III

Social Media Marketing: Developing a successful social media strategy.

Major social media platforms: Facebook, LinkedIn, and YouTube — concepts and strategic use. Content planning, engagement techniques, and performance analysis.

Display Advertising: Working and fundamentals of display advertising. Benefits and challenges of display campaigns. Overview of the display advertising process.

UNIT-IV

Search Engine Marketing: Introduction to Search Engine Marketing (SEM), Working of search engines and SERP positioning. Online search behavior and consumer decision journey. DMI's 5P Customer Search Insights Model. Search Engine Optimization (SEO), Overview of the SEO process. On-page optimization and Off-page optimization, Search Advertising (PPC), Overview of the PPC process and benefits of paid search. Basis of ad ranking and campaign objectives. Google Ads campaign creation: campaign structure, targeting, bid strategy, ad delivery, scheduling, ad rotation, keyword selection, ad copywriting, and ad extensions.

Text Books:

1. Chaffey, D., & Ellis-Chadwick, F. (2019). Digital marketing (7th ed.). Pearson Education.
2. Dodson, I. (2016). The art of digital marketing: The definitive guide to creating strategic, targeted, and measurable online campaigns. John Wiley & Sons.
3. Kartajaya, H., Kotler, P., & Setiawan, I. (2016). Marketing 4.0: Moving from traditional to digital. John Wiley & Sons.
4. Ryan, D. (2016). Understanding digital marketing: Marketing strategies for engaging the digital generation (4th ed.). Kogan Page.
5. Kotler, P., Kartajaya, H., & Setiawan, I. (2016). Marketing 4.0: Moving from traditional to digital. John Wiley & Sons.

Reference Books:

1. Deiss, R., & Henneberry, R. (2017). Digital marketing for dummies. John Wiley & Sons.
2. Gupta, S. (2018). Digital marketing. McGraw Hill Education.
3. Maity, M. (2017). Internet marketing: A practical approach in the Indian context. Oxford University Press.

Note: The paper setter will set the paper as per the question paper template provided.

B. Tech (8th Semester) Mechanical Engineering							
B23-MEO-406	Supply Chain Management						
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	0	0	3	70	30	100	3
Purpose	The main objective of the course is to impart students with the knowledge of the performance, driver and metrics, network design, economies and uncertainties in Supply chain management.						
Course Outcomes							
CO 1	Students will be able to explain the basics of Supply chain management and its performance.						
CO 2	Students will be able to discuss supply chain metrics and the process of designing the supply chain networks.						
CO 3	Students will be able to analyze and design supply chain networks, evaluate global supply chain decisions, and assess the role of information technology in improving supply chain performance.						
CO 4	Students will be able to evaluate inventory decisions, economies of scale benefits, and determine optimal product availability levels to improve overall supply chain profitability.						

UNIT – I

Understanding the Supply Chain: Introduction, definition, the objective of a supply chain, the importance of supply chain decisions, decision phases in a supply chain, process views of a supply chain, examples of supply chains.

Supply Chain Performance: Achieving strategic fit and scope: Competitive and supply chain strategies, achieving strategic fit, expanding strategic scope, challenges to achieving and maintaining strategic fit.

UNIT – II

Supply Chain Drivers and Metrics: Financial measures of performance, drivers of supply chain performance, framework for structuring drivers, facilities, inventory, transportation, information, sourcing, pricing.

Designing the Supply Chain Network: Designing distribution networks and applications to online sales: the role of distribution in the supply chain, factors influencing distribution network design, design options for a distribution network, online sales and the distribution network, distribution networks in practice.

UNIT – III

Network Design in Supply Chain: Role of network design in supply chain, factors influencing network design decisions, network design decision framework, and practical implementation of network design decisions. Information Technology in Supply Chain: IT role in supply chain, framework, customer and supplier relationship management, future of IT in supply chain.

Global Supply Chain Network Design: Globalization impact on supply chain structure, total cost approach for offshoring decisions, risk management in global supply chains, discounted cash flow analysis for supply chain decisions, evaluating network design decision, evaluation of on shoring vs offshoring decisions under uncertain conditions, practical aspects of global supply chain network decision making.

UNIT – IV

Managing Economies of Scale in Supply Chain: Cycle inventory and its role in supply chain, estimation of cycle inventory related costs, economies of scale using fixed cost leverage, quantity discount models in supply chain purchasing, trade promotions and short-term discounting strategies, multi-echelon cycle inventory management.

Level of Product Availability: Importance of the level of product availability, factors affecting optimal level of product availability, managerial levers to improve supply chain profitability, setting product availability for multiple products under capacity constraints, setting optimal levels of product availability in practice, summary of learning objectives.

Text Books

1. Chopra S., and Meindl, P., *Supply chain Management: Strategy, Planning and Operations*, Fifth Edition, Pearson Education (Singapore) Pte. Ltd, 2004.
2. Simchi-Levi, P., Kaminsky, Ravi Shankar, E., *Designing & Managing the Supply Chain: Concepts, Strategies & Case studies*, Third Edition, Tata McGraw-Hill Edition, 2003.

Reference Books

1. *Purchasing and Supply Chain Management: Text and Cases* - Doebler, D.W. and Burt, D.N., McGraw-Hill Publishing Company Limited, New Delhi, 1996.
2. *Supply Chain Management for Competitive Advantage* - Rangaraj, TMH.

Note: The paper setter will set the paper as per the question paper template provided.

B. Tech (8 th Semester) Mechanical Engineering							
B23-MEO-408	Biomechanics						
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	0	0	3	70	30	100	3
Purpose	The aim of this course is to familiarize students with the biological system biomechanics so they can fully understand its applications in creating mathematical simulations and mechanical elements of implant and biological assistive device design.						
Course Outcomes							
CO 1	It will help students to improve on a foundational knowledge of mechanics to gain greater insight that will allow for the engineering research.						
CO 2	The student will know about physiological and anatomical function into an engineering model by analysing a biological system.						
CO 3	The student will learn about biological systems' mechanical components.						
CO 4	To know how to use mechanical engineering concepts for giving solution to biological issues.						

UNIT I

Introduction of Mechanics: Review of the principles of mechanics, Vector mechanics- Resultant forces of Coplaner & Noncoplaner and Concurrent & non-concurrent forces, parallel force in space, Newton's laws of motion, Work and energy, Moment of inertia.

Biomechanics of Joints: Skeletal joints, forces and stresses in human joints, Analysis of rigid bodies in equilibrium, free body diagrams, types of joint, biomechanical analysis of elbow, shoulder, spinal column, hip knee and ankle.

UNIT-II

Biofluid Mechanics: Introduction, viscosity and capillary viscometer, Rheological properties of blood, laminar flow, Couette flow and Hagen- poiseuille equation, turbulent flow

Hard Tissues: Bone structure & composition mechanical properties of bone, cortical and cancellous bones; **Soft Tissues:** Structure and functions of Soft Tissues: Cartilage, Tendon, Ligament, and Muscle; Modeling of soft tissues: Cartilage, Tendon, Ligament, and Muscle.

UNIT-III

Cardiovascular Mechanics: Cardiovascular system, artificial heart valves, biological and mechanical valves development, testing of valves, Blood Flow Models, Blood Vessel Mechanics, Heart Valve Dynamics, Prosthetic Valve Dynamics.

Respiratory Mechanics: Mechanism of air flow, respiratory cycle, lung ventilation model, methods of determining pressure, flow rate and volume; spirometry.

UNIT-IV

Applied Biomechanics: Engineering approaches to standing, sitting and lying, Biomechanics of gait, application of gait and locomotion analysis, Fluid mechanics and energetics: Forms of energy and energy transfer.

Biomechanics of Implants: Design of orthopaedic implant, specifications for a prosthetic joint, biocompatibility, requirement of a biomaterial, characteristics of different types of biomaterials, manufacturing process of implants, fixation of implants.

Text Books/Reference Books:

1. Y C Fung, Biomechanics: Mechanical Properties of Living Tissues, springer, 2nd edition, 1993.

2. N. Ozkaya and M. Nordin, Fundamentals of Biomechanics-Equilibrium, Motion and Deformation, springer-verlag, 2nd edition 1999
3. Duane knudson, Fundamental of biomechanics, springer, 2nd edition 2007
4. D. J. Schneck and J. D. Bronzino, Biomechanics- Principles and Applications, CRC Press, 2nd Edition, 2000

Reference Books:

1. Joseph D, Bronzino, "The Biomedical Engineering Handbook", CRC Press, 3rd edition, 2006.
2. Roger Bartlett, Introduction to Sports Biomechanics 1997, Roger Bartlett, Taylor & Francis Group
3. Mow, Van C.; Huijkes, Rik, Basic Orthopaedic Biomechanics and Mechano-Biology, 3rd Edition, 2005, Lippincott Williams & Wilkins
4. Hiroshi Wada, Biomechanics at Micro and Nano scale Levels, volume 1, 2005, World Scientific Publishing Co. Pt. Ltd.

Note: The paper setter will set the paper as per the question paper template provided.

B23-MEO-410	Artificial Intelligence						
Lecture	Tutorial	Practical	Credit	End Semester Exam	Internal Assessment	Total	Time (Hrs)
3	0	0	3	70	30	100	3
Purpose	To obtain thorough understanding of the discipline of Artificial Intelligence and its scope in various emerging areas.						
Course Outcomes (CO)							
CO1	Students will be able to determine a fundamental understanding of Artificial Intelligence (AI) and its core principles.						
CO2	Students will be able to demonstrate fundamental concepts of problem solving, searching, inference, and perception.						
CO3	Students will be able to demonstrate proficiency in applying AI techniques in various domains.						
CO4	Students will be able to examine role of AI in various application areas.						

UNIT – I

Scope of AI: Introduction to Artificial Intelligence, History of Artificial Intelligence, Artificial Intelligence Languages, Multi Agent Systems, natural language processing, vision and speech processing, robotics, expert systems.

UNIT – II

Problem Solving, Searching and Planning: Problem spaces and search, Heuristic and Informed search strategies, Minmax search, Alpha-beta pruning. Search and optimization (gradient descent), Adversarial search, Planning and scheduling, Case study: Health Care System.

UNIT – III

Knowledge Engineering, Representation, Reasoning and finding Optimal Paths: Knowledge and Knowledge based system, Knowledge and rationality, Logic and inference, Propositional and predicate logic, Ontologies, Bayesian Reasoning, Temporal reasoning, Knowledge Discovery: Data and Web Mining.

UNIT – IV

Applications of AI in Various domains: AI in Marketing, AI in Banking, AI in Finance, AI in Agriculture, AI in Health Care, AI in Gaming, AI in Space Exploration, AI in Autonomous vehicles, AI in Chatbots, AI in Creativity.

Text books:

1. E. Rich and K. Knight, “Artificial Intelligence”, TMH, 2nd Ed.,1992.
2. N. J. Nilsson, “Principles of AI”, Narosa Publ. House,1990.

Reference Books:

1. M. N. Hoda, “Foundation Course in Artificial Intelligence”, Vikas Pub.,2004.
2. Artificial Intelligence” RB Mishra, PHI

Note: The paper setter will set the paper as per the question paper template provided.

B. Tech (8th Semester) Mechanical Engineering							
B23-MEO-412	Energy Management						
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	0	0	3	70	30	100	3
Purpose	The purpose of this course is to provide Mechanical Engineering students with essential knowledge of energy management, energy efficiency, and sustainable energy utilization in industrial and building systems.						
Course Outcomes							
CO 1	Students will be able to explain the principles of energy management, energy auditing, and the role of renewable energy systems in sustainable mechanical engineering applications.						
CO 2	Students will be able to analyse energy efficiency in HVAC systems, building services, and electrical energy utilization relevant to mechanical engineering practice.						
CO 3	Students will be able to apply energy analysis techniques and process energy management concepts to identify opportunities for energy conservation in industrial systems.						
CO 4	Evaluate waste heat recovery options, low-energy building strategies, and perform techno-economic analysis of energy management projects.						

UNIT – I

Energy Resources and HVAC Systems

Renewable Energy Systems: Introduction to renewable energy; solar energy systems; wind energy systems; energy from water (small hydro); geothermal energy (energy from earth); biomass energy systems.

Heating, Ventilation, and Air Conditioning (HVAC) Systems: General principles of HVAC systems; human comfort requirements; description of typical HVAC systems including dual duct systems and multi-zone systems; variable air volume (VAV) systems and terminal reheat systems; evaporative cooling systems and packaged HVAC systems; basic principles governing HVAC systems; energy management opportunities in HVAC systems; modeling of heating and cooling loads in buildings; numerical problems on HVAC energy analysis.

UNIT – II

Energy Auditing and Site & Building Surveys

Energy Audit Methodologies and Survey Planning: Phases of energy audit, including initiation phase, audit and analysis phase, and implementation phase; general methodology for building and site energy audits; planning and execution of energy surveys.

Site and Building Energy Surveys: Site survey methodology; energy surveys of electrical systems, steam systems, and water systems; building survey methodology; energy audit instrumentation; measurements for building energy surveys.

UNIT – III

Energy Analysis Techniques and Process Energy Management

Energy Analysis and Performance Evaluation Techniques: Annual energy consumption analysis; normalized performance indicators; time-dependent energy analysis; linear regression analysis; single independent variable analysis; correlation coefficients; multivariable analysis; cumulative sum (CUSUM) technique.

Process Energy and Industrial Energy Conservation: General principles of process energy; process heat requirements; energy savings in condensate return systems; steam generation and distribution

systems; automotive fuel control; hot water systems and water pumping; direct and indirect fired furnaces; process electricity; other process energy forms, including compressed air systems and manufacturing processes; numerical problems on process energy.

UNIT – IV

Waste Heat Recovery and Low Energy Building Design

Waste Heat Recovery and Energy-Efficient Heating Systems: Introduction to waste heat recovery; recuperative heat exchangers; heat exchanger theory; number of transfer units (NTU) concept; run-around coils; regenerative heat exchangers; heat pumps; thermal comfort and building heat loss; overall heat transfer coefficient (U-value); heat loss calculations; heating energy calculations; intermittent heating; radiant heating systems; low-emissivity glazing.

Passive Solar and Low Energy Building Design: Introduction to passive solar design; passive solar heating techniques; direct gain, indirect gain, and isolated gain systems; thermosiphon systems; passive solar cooling techniques; shading devices and techniques; solar control glazing and advanced fenestration; natural ventilation strategies; thermal mass and night ventilation; termodeck systems; building form and building operation.

Text Books

3. Frank Kreith and D. Yogi Goswami, *Energy Management and Conservation Handbook*, Second Edition, CRC Press.
4. Clive Beggs, *Energy Management, Supply and Conservation*, Second Edition.
5. Craig B. Smith, *Energy Management Principles*, Pergamon Press.
6. Jyoti Parikh, *Energy Systems and Developments*, Oxford University Press.
7. Wayne C. Turner, *Energy Management Handbook*, The Fairmont Press, Inc., 1997.
8. Albert Thumann and William J. Younger, *Handbook of Energy Audits*, CRC Press, 2003.

Reference Books

3. *Energy Conservation Act – 2001* and related rules and standards.
4. Publications of the Bureau of Energy Efficiency (BEE).
5. IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities.
6. Kankar Bhattacharya, Jaap E. Daalder, Math H. J. Bollen, *Operation of Restructured Power Systems*, Kluwer Academic Publishers, 2001.
7. Charles M. Gottschalk, *Industrial Energy Conservation*, John Wiley & Sons, 1996.
8. Chaman Kashkari, *Energy – Resources, Demand and Conservation with Reference to India*, Tata McGraw-Hill Co. Ltd.
9. *Integrated Renewable Energy for Rural Development*, Proceedings of National Solar Energy Convention, Calcutta.

Note: The paper setter will set the paper as per the question paper template provided.

B. Tech (8 th Semester) Mechanical Engineering							
B23-MEO-414	Block Chain Technology						
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	0	0	3	70	30	100	3
Purpose	To provide a comprehensive understanding of blockchain cryptocurrency, smart contracts to build secure, transparent, and distributed applications and privacy and security issues in blockchain.						
Course Outcomes							
CO 1	Students will explain distributed record keeping needs, the Byzantine Generals Problem, and Nakamoto's motivations for blockchain cryptocurrency, including borrowed technologies like hash pointers and consensus mechanisms.						
CO 2	Students will analyze atomic broadcast, Byzantine fault tolerance models, and cryptographic primitives (hash functions, digital signatures, zero-knowledge systems), then compare Bitcoin's PoW/PoS consensus and scripting with alternatives.						
CO 3	Students will evaluate Ethereum's Turing-complete smart contracts versus Bitcoin scripting, their verification challenges, legal enforcement potential, and Hyperledger Fabric's permissioned mechanisms.						
CO 4	Students will identify blockchain privacy issues (pseudo-anonymity, zk-SNARKs in Zcash) and attacks, assessing defenses like Algorand and sharding.						

UNIT-I

Introduction: Need for Distributed Record Keeping, Modeling faults and adversaries, Byzantine Generals problem, Consensus algorithms and their scalability problems

Why Nakamoto Came up with Blockchain based cryptocurrency? Technologies Borrowed in Blockchain – hash pointers, consensus, byzantine fault-tolerant distributed computing, digital cash etc.

UNIT-II

Basic Distributed Computing: Atomic Broadcast, Consensus, Byzantine Models of fault tolerance, Basic Crypto primitives: Hash functions, Puzzle friendly Hash, Collision resistant hash, digital signatures, public key crypto, verifiable random functions, Zero-knowledge systems.

Blockchain 1.0: Bitcoin blockchain, the challenges, and solutions, proof of work, Proof of stake, alternatives to Bitcoin consensus, Bitcoin scripting language and their use.

UNIT-III

Blockchain 2.0: Ethereum and Smart Contracts, The Turing Completeness of Smart Contract Languages and verification challenges using smart contracts to enforce legal contracts, comparing Bitcoin scripting vs. Ethereum Smart Contracts

Blockchain 3.0: Hyperledger fabric, the plug and play platform and mechanisms in permissioned blockchain

UNIT-IV

Privacy, Security issues in Blockchain: Pseudo-anonymity vs. anonymity, Zcash and Zk-SNARKS for anonymity preservation, attacks on Blockchains – such as Sybil attacks, selfish mining, 51% attacks -advent of algorand, and Sharding based consensus algorithms to prevent these.

Text Books:

1. Draft version of “S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, ‘Blockchain Technology: Cryptocurrency and Applications’, Oxford University Press, 2019.
2. Josh Thompson, ‘Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming’, Create Space Independent Publishing Platform, 2017

Reference Books:

- 1 Blockchain Technology By Chandramouli Subramanian, Asha George, Abhilash K A and Meena Karthikeyan , Universities Press Publication
- 2 Blockchain Blueprint for a New Economy, By Melanie Swan,O’Reilly Publication
- 3 Blockchain For Dummies By Tiana Laurence, Wiley Publication

Note: The paper setter will set the paper as per the question paper template provided.

B. Tech (8th Semester) Mechanical Engineering							
B23-MEO-416	Gender Sensitivity						
Lecture	Tutorial	Practical	Credits	End Semester Exam	Internal Assessment	Total	Time (Hrs.)
3	0	0	3	70	30	100	3
Purpose	To sensitize the students regarding the issues of gender and the gender inequalities prevalent in society, develop social consciousness among the students, introduce gender sensitization and related issues and encourage capacity building among the students to enable them to engage in policy decisions to remove gender biases in all fields of life in the process of gender equality for nation building.						
Course Outcomes							
CO 1	Students will understand Masculinity and Feminity, Patriarchy and Matriarchy.						
CO 2	Students will understand the role of family in formation of gender identity.						
CO 3	Students will know the women's right and laws.						
CO 4	Students will understand the role of media for gender sensitivity.						

UNIT-I

Understanding Concepts: Sex and Gender; Masculinity and Feminity; Patriarchy and Matriarchy

UNIT-II

Construction Gender: Patriarchy as Ideology and Practice; Biology vs. Gender; Public vs. Private; Role of family in the formation of gender identity.

Gender- Based Violence

UNIT-III

Women's Rights and Law: Dowry Prohibition Act; Divorce Act; Domestic Violence Act; Rape; Property Right Act, Sexual Harassment at the Workplace.

UNIT-IV

Women and Media: Projection of women through media- Positive and Negative aspects; Impact of Media on Women; Commodification of Women.

Film/Documentary Screening , Field Visits, Group discussion and debate, Awareness Songs, Street plays, theatre and presentation skills for personality development.

Text Books

1. Gill, Rajesh, Contemporary Indian Urban Society- Ethnicity, Gender and Governance, Bookwell Publishers, New Delhi, 2009
2. Jain, Devaki and Rajput, Pam, (eds), Narratives from the Women's Studies Family, Sage, New Delhi, 2003.
3. Mies, Maria, Indian Women and Patriarchy, Concept Publishing Company, New Delhi, 2004.
4. Tazi, Nadia (ed) Keywords: Gender, Vistaar Pub, New Delhi, 2004.
5. AgarawalSupriya, Gender, History & Culture, Rawat, Jaipur, 2009.

Reference Books

1. Chatterjee, Mohini, Feminism and Gender Equality, Aavishkar, Jaipur,2005
2. Gupta, Parachi, Religion and Feminism, ABD Pub, Jaipur,2007
3. Spade, Joan, The Kaleidoscope of Gender, Sage, Los Angeles, 2008
4. Rege, Sharmila (ed), Sociology of Gender: The Challenge of Feminist Sociological Knowledge, Sage, New Delhi, 2003.
5. Marriage and the reproduction of caste? Endogamy and exogamy: Uma Chakravarti, Gendering Caste: Through a Feminist Lens, Kolkata, Stree, 2003.
6. SharmilaRege, Dalit Feminist Standpoint, in Anupama Rao ed. Caste and Gender, Delhi Kali for Women, 2003.

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