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

क्रमांक / प.नि.प्र. / 2024 / 2682 जबलपुर, दिनांक 18 / 10 / 2024

सूचना

महाविद्यालय में अध्ध्यनरत B.Tech. (AICTE) / B.Tech. (PTDC) [AICTE] [Regular/Ex.] विद्यार्थियों को सूचित किया जाता है कि वे नवम्बर 2024 की परीक्षा एवं आगामी सत्र की परीक्षाओं में सम्मिलित होने से पूर्व अपने पेपर / विषय का Equivalence Syllabus महाविद्यालय के पोर्टल से Download कर प्राप्त कर सकते हैं अथवा महाविद्यालय के परीक्षा नियंत्रण प्रकोष्ठ में संपर्क कर सकते हैं। नवम्बर 2024 परीक्षा एवं आगामी सत्र की परीक्षा में उन्हें अपने पेपर / विषय में Equivalence Syllabus में ही सम्मिलित होना है। अतः Equivalence Syllabus की जानकारी न होने की दशा में सम्पूर्ण जिम्मेदारी स्वयं छात्र / छात्राओं की होगी।

Equivalence Syllabus हेतु निम्नानुसार Link का उपयोग कर सकते है:–

https://www.jecjabalpur.ac.in/UploadContent/frm_ViewScheme.aspx

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जबलपुर इंजीनियरिंग महाविद्यालय
जबलपुर

पृ.क्रमांक / प.नि.प्र. / 2024 / जबलपुर, दिनांक / 10 / 2024

प्रतिलिपिः–

01. समस्त विभागाध्यक्ष, जबलपुर इंजीनियरिंग महाविद्यालय, जबलपुर।
02. पीटीडीसी कार्यालय, जबलपुर इंजीनियरिंग महाविद्यालय, जबलपुर।

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जबलपुर इंजीनियरिंग महाविद्यालय
जबलपुर

EQUIVALENCE OF SUBJECTS OF DIFFERENT SCHEMES OF UNDER GRADUATE COURSES (B.Tech.)
OF Mechatronics Engineering

S.No.	Schemes	Subject Code & Subject Name (Semester) Having Equivalence in Syllabus	Final Subject code & subject (after equivalence)
1	AICTE	MT303 Digital Circuit Design **B.Tech. III Sem.**	MT33 Digital Electronics **B.Tech. III Sem.**
	Scheme 2023	MT33 Digital Electronics **B.Tech. III Sem.**	
2	AICTE	MT403 Theory of Machines **B.Tech. IV Sem.**	MT43 Theory of Machines **B.Tech. IV Sem.**
	Scheme 2023	MT43 Theory of Machines **B.Tech. IV Sem.**	
3	AICTE	MT405 Linear Control Theory **B.Tech. IV Sem.**	MT45 Linear Control Theory **B.Tech. IV Sem.**
	Scheme 2023	MT45 Linear Control Theory **B.Tech. IV Sem.**	
4	AICTE	BT511 Professional Ethics **B.Tech. V Sem.**	BT51 Professional Ethics **B.Tech. V Sem.**
	Scheme 2023	BT51 Professional Ethics **B.Tech. V Sem.**	
5	AICTE	MT502B Finite Element Analysis **B.Tech. V Sem.**	MT51A Finite Element Methods **B.Tech. V Sem.**
	Scheme 2023	MT51A Finite Element Methods **B.Tech. V Sem.**	
6	AICTE	MT502C Industry 4.0 & IIOT **B.Tech. V Sem.**	MT63 Industry 4.0 **B.Tech. VI Sem.**
	Scheme 2023	MT63 Industry 4.0 **B.Tech. VI Sem.**	

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7	AICTE	MT503 Thermodynamics & Applications **B.Tech. V Sem.**	MT52 Thermodynamics & Applications **B.Tech. V Sem.**
	Scheme 2023	MT52 Thermodynamics & Applications **B.Tech. V Sem.**	
8	AICTE	MT505 Machine Design **B.Tech. V Sem.**	MT51C Machine Design **B.Tech. V Sem.**
	Scheme 2023	MT51C Machine Design **B.Tech. V Sem.**	
9	Scheme 2024	MT702M, EV and HV Technology **B.Tech. VII Sem.**	MT74 EV and HV Technology **B.Tech. VII Sem.**
	Scheme 2023	MT74 EV and HV Technology **B.Tech. VII Sem.**	
10	AICTE	MT601B Dynamics of Machinery **B.Tech. VI Sem.**	MT61B Dynamics of Machines **B.Tech. VI Sem.**
	Scheme 2023	MT61B Dynamics of Machines **B.Tech. VI Sem.**	
11	Scheme 2024	MT701M, Mechatronics Systems Design **B.Tech. VII Sem.**	MT73 Mechatronics System Design **B.Tech. VII Sem.**
	Scheme 2023	MT73 Mechatronics System Design **B.Tech. VII Sem.**	
12	Scheme 2024	MT703M AI & ML **B.Tech. VII Sem.**	MT75 AI & ML **B.Tech. VII Sem.**
	Scheme 2023	MT75 AI & ML **B.Tech. VII Sem.**	
13	Scheme 2024	MT704M A CAD/CAM **B.Tech. VII Sem.**	MT71A CAD/CAM **B.Tech. VII Sem.**
	Scheme 2023	MT71A CAD/CAM **B.Tech. VII Sem.**	
14	Scheme 2024	MT704M B Mechanical Vibration & Noise **B.Tech. VII Sem.**	MT71B Mechanical Vibration & Noise **B.Tech. VII Sem.**
	Scheme 2023	MT71B Mechanical Vibration & Noise **B.Tech. VII Sem.**	

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15	Scheme 2024	MT704M C Power Plant Engineering **B.Tech. VII Sem.**	MT71C Power Plant Engineering **B.Tech. VII Sem.**
	Scheme 2023	MT71C Power Plant Engineering **B.Tech. VII Sem.**	
16	Scheme 2024	MT705M A Wireless Sensor Networks **B.Tech. VIII Sem.**	MT72A Wireless Sensor Networks **B.Tech. VIII Sem.**
	Scheme 2023	MT72A Wireless Sensor Networks **B.Tech. VIII Sem.**	
17	Scheme 2024	MT705M B Aerial Robotics **B.Tech. VII Sem.**	MT72B Aerial Robotics **B.Tech. VII Sem.**
	Scheme 2023	MT72B Aerial Robotics **B.Tech. VII Sem.**	
18	Scheme 2024	MT705M C Simulation & Modelling **B.Tech. VII Sem.**	MT72C Simulation & Modelling **B.Tech. VII Sem.**
	Scheme 2023	MT72C Simulation & Modelling **B.Tech. VII Sem.**	
19	Scheme 2024	MT801M A Total Quality Management **B.Tech. VIII Sem.**	MT81A Total Quality Management **B.Tech. VIII Sem.**
	Scheme 2023	MT81A Total Quality Management **B.Tech. VIII Sem.**	
20	Scheme 2024	MT801M B Renewable Energy Technology **B.Tech. VIII Sem.**	MT81B Renewable Energy Technology **B.Tech. VIII Sem.**
	Scheme 2023	MT81B Renewable Energy Technology **B.Tech. VIII Sem.**	
21	Scheme 2024	MT801M C Refrigeration and Air Conditioning **B.Tech. VIII Sem.**	MT81C Refrigeration and Air Conditioning **B.Tech. VIII Sem.**
	Scheme 2023	MT81C Refrigeration and Air Conditioning **B.Tech. VIII Sem.**	
22	Scheme 2024	MT802M A Image Processing & Machine Vision **B.Tech. VIII Sem.**	MT82A Image Processing & Machine Vision **B.Tech. VIII Sem.**
	Scheme 2023	MT82A Image Processing & Machine Vision **B.Tech. VIII Sem.**	

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23	Scheme 2024	MT802M B MEMS and NEMS Technology **B.Tech. VIII Sem.**	MT82B MEMS and NEMS Technology **B.Tech. VIII Sem.**
	Scheme 2023	MT82B MEMS and NEMS Technology **B.Tech. VIII Sem.**	
24	Scheme 2024	MT802M C Operation Research & Supply Chain **B.Tech. VIII Sem.**	MT82C Operation Research and Supply Chain **B.Tech. VIII Sem.**
	Scheme 2023	MT82C Operation Research and Supply Chain **B.Tech. VIII Sem.**	

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COURSE CONTENTS **w.e.f. July 2023**

Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours Per Week			Total Credits
		Theory			Practical			L	T	P	
		End Sem	Mid Sem. Exam	Quiz/ Assignment	End Sem	Lab Work					
MT- 33	Digital Electronics	70	20	10	30	20	150	3	-	2	4

MODULE-I

Number Systems: Decimal, Binary, Octal and Hexadecimal systems, arithmetic operations of binary numbers, conversion from one base to another, Codes-BCD, Excess- 3, Gray codes, error correcting and error detecting codes- Hamming codes, ASCII, EBCDIC. Logic gates and binary operations- AND, OR, NOT, NAND, NOR, Exclusive–OR and Exclusive– NOR.

MODULE-II

Implementations of Logic Functions using gates, NAND–NOR implementations – Multi level gate implementations- Multi output gate implementations. Boolean postulates and laws – De-Morgan's Theorem - Principle of Duality, Boolean function, Canonical and standard forms, Minimization of Boolean functions, Minterm, Maxterm, Sum of Products (SOP), Product of Sums (POS), Karnaugh map Minimization, Don't care conditions, Quine - McCluskey method of minimization.

MODULE-III

Design and analysis of combinational circuits: Design and analysis of code convertor, half-adders, half subtractor, full adders, full subtractor circuits, Series & parallel adders and BCD adders. look-ahead carry generator and adders. Decoders, Encoders, Binary Multiplier – Binary Divider, multiplexers & demultiplexers, parity checker, parity generators, code converters, Magnitude Comparator. Designing of combinational circuits with ROM and PLA.

MODULE-IV

Sequential Logic Design: Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Designing synchronous circuits like Pulse train generator, Pseudo Random Binary Sequence generator, Clock generation Unit-4 Registers and Counters: Asynchronous Ripple or serial counter. Asynchronous Up/Down counter - Synchronous counters – Synchronous Up/ Down counters – Programmable counters

MODULE-V

Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of Programmable logic devices like FPGA. Logic implementation using Programmable Devices

Text & Reference Books:

1. W. H. Gothman, "Digital Electronics" (PHI) "
2. R.J. Tocci, "Digital Systern Principles & Application.
3. Z. Kohair (TMH), "Switching & Automata Theory"
4. M. Mano (PHI) "Digital Logic & Computer Design"
5. M. Mano (PHI) "Digital Design".

List of Experiments:

1. To study the operation & working of various types of logic gets with the help of electronic kit.
2. To study of Binary Adder.
3. Study of Binary subtractor.
4. To study of Encoder & Decoder.
5. To study of multiplexer and demultiplexer.
6. Experiment on Astable multivibrator.
7. Experiment on Bistable multivibrator.
8. Experiment on Monostable multivibrator.
9. Study of Analog to Digital convertor.
10. Study of Digital to Analog convertor.

Course Outcomes: Upon successful completion of course students will be able to:

CO1	Understand Binary Number System, Logic Gates.
CO2	Understand De-morgan's Theorem and K-Map to simplify Boolean expression.
CO3	Design and analysis of Combinational Circuits.
CO4	Design and Analysis of Sequential Circuits.
CO5	Describe semiconductor memories with PLA.

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COURSE CONTENTS **w.e.f. July 2023**

Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours Per Week			Total Credits
		Theory			Practical			L	T	P	
		End. Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work					
MT- 43	Theory of Machines	70	20	10	30	20	150	3	-	2	4

Module 1. Mechanisms and Machines: Links, Pairs, Chains, Structure, Mechanism, Machine, Equivalent linkage, Degrees of freedom, Gruebler's & Kutzback's criterion, Inversions of four bar chain, Mechanism with lower pairs Pantograph, Straight line motion mechanisms, Davis and Ackermann's steering mechanisms, Hooke's joint, Numerical problems based on above topics.

Module 2. Motion: Plane motion, Absolute & Relative motion, Displacement, Velocity and Acceleration of a point, Velocity and Acceleration Analysis by Graphical & Analytical methods, Velocity of rubbing, Kennedy's Theorem, Acceleration polygon, Coriolis acceleration component, Klein's construction, Numerical problems based on above topics.

Module 3. Gears: Classification of gears, Helical, Spiral, Bevel and Spur Gear, Spur Gear Terminology, Law of gearing, Tooth profiles, velocity of sliding, Path of contact, Arc of contact, Contact Ratio, Interference and Undercutting, Conjugate action, Numerical problems based on above topics.
Gear Trains: Simple, compound, reverted and epi-cyclic gear trains. Velocity ratio and torque calculation in gear trains.

Module 4. Cams: Classification of Cams and Followers, Radial Cam Terminology, Analysis of Follower motion (uniform, modified uniform, simple harmonic, parabolic, cycloidal), Pressure Angle, Radius of Curvature, Cam Profile for radial and offset followers Synthesis of Cam Profile by Graphical Approach, Cams with Specified Contours.
Gyroscope: Gyroscopic Action in Machines, Angular Velocity and Acceleration, Gyroscopic torque/ couple, gyroscopic effect on Naval Ships, Stability of Two and Four Wheel Vehicles, Rigid disc at an angle fixed to a rotating shaft.

Module 5. Belt Rope & Chain Drive: Types of Belts, Velocity ratio of a belt drive, Slip in belts, Length of open belt and crossed belt, Limiting ratio of belt-Tensions, Power transmitted by a belt, Centrifugal tension, Maximum tension in a belt, Condition for maximum power transmitted, Initial tension in a belt, Creep in belt, Applications of V-Belt, Rope and Chain drives.

Text & Reference Books:

1. Thomas Bevan; Theory of Machines; Pearson Education.
2. Rattan SS; Theory of machines; MC Graw Hills.
3. Ambekar AG; Mechanism and Machine Theory; PHI. Eastern Economy Edition 2015.
4. Uicker&Shigley, Theory of machines & Mechanism Second Edition Oxford University Press.
5. Rao JS and Dukkipati; Mechanism and Machine Theory; New Age Delhi.
6. Abdulla Shariff, Theory of Machines.
7. Theory of machines by R.K.Bansal.

List of Experiments:

1. To finds out gyroscopic couple.
2. To find out velocity & acceleration of slider crank mechanism by Klin"s Construction.
3. To find out velocity ratio of various gear trains.
4. To study of various types of belt drives & find out the velocity ratio of the drive.
5. To draw the cam profile.
6. Study of working models of various popular mechanisms like quick return mechanism etc.
7. To draw Involute profile of a gear by generating method.

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

CO1	Explain the kinematics of mechanism and their inversions.
CO2	Analyze velocity and acceleration of different links of mechanisms using different methods.
C03	Design different types of gears and gear trains.
C04	Draw cam profile for different follower motions.
CO5	Analyze Gyroscopic effect on Naval ship and Stability of Two and Four Wheel Vehicles.

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COURSE CONTENTS **w.e.f. July 2023**

Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours Per Week			Total Credits
		Theory			Practical			L	T	P	
		End. Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work					
MT- 45	Linear Control Theory	70	20	10	-	-	100	3	1	-	4

Module I Basic Control System Introduction and Classification of control System, open and closed loop systems Linear Control System, Mathematical models of physical systems, Transfer function, Block Diagram Representation, Signal flow Graph, MIMO, Mason's gain formula, Linearization.

Module II Error Analysis -Effects of Feedback on gain and time constant, pole location, bandwidth, Sensitivity, Disturbance signal, Control over System Standard Test Signals, Time Response of1st Order System, Design of Higher order system, Steady-State Errors and Error coefficients, Constants, Effects of Additions of Poles and Zeros to Open Loop and Closed Loop System. Design Specification of Dynamic first and higher order system, Performance Indices.

Module III Domain Stability Analysis- Concept of Stability of Linear Systems, Effects of Location of Poles on Stability, Necessary Conditions for Stability, Routh-Hurwitz Stability Criteria, Relative Stability Analysis, Root Locus technique, Experimental determination of transfer function. Frequency Domain Stability Analysis- Performance Specification in Frequency Domain, Co- relation between frequency Domain and Time Domain, Bode Plot, Minimum-Phase and Non- Minimum Phase System, Polar Plots, Inverse Polar Plot, Nyquist Stability Criterion, Assessment of Relative Stability (Phase Margin, Gain Margin and Stability), Constant-M and N Circle, Nichols Chart.

Module IV Approaches to System Design, Types of Compensation, Design of Phase-Lag, Phase

Lead and Phase Lead-Lag Compensators in Time and Frequency Domain, Proportional, Derivative, Integral and PID Compensation. Modeling of discrete -time systems -sampling -mathematical derivations for sampling sample and hold -Z-transforms-properties -solution of difference equations using Z transforms -examples of sampled data systems -mapping between s plane and z plane

Module V State variables Analysis and Design- Concept of State Variables and State Model, State Space Representation of Systems, Solution of State Equation, Transfer Function Decomposition, Discrete time system.

Text & Reference Books:

1. Ziemer R.E., Tranter W.H. & Fannin D.R., "Signals and Systems", Pearson Education Asia

2 Ogata K., "Modern Control Engineering", Prentice Hall India

3. Nagarath I.J. & Gopal M., "Control System Engineering", Wiley Eastern Ltd.

4. Kuo B.C., "Digital Control Systems", Oxford University Press.

5. Computer-Based Industrial Control. Author, Krishna Kant. Publisher, Prentice Hall India.

COURSE OUTCOMES: Upon successful completion of course, students will be able to:

CO1	Describe mathematical model of the electrical and mechanical systems and simplify complex systems using different graphical techniques in closed and open loop systems.
CO2	Apply time domain analysis and steady state response in control systems
CO3	Analyze Time Domain and frequency domain stability Techniques in control systems
CO4	Design control systems with the desired phase and gain performance.
CO5	Demonstrate the concept of state, state variable and state model and apply this knowledge in steady state analysis automation systems.

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COURSE CONTENTS **w.e.f. July 2023**

Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours Per Week			Total Credits
		Theory			Practical			L	T	P	
		End. Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work					
BT- 51	Professional Ethics	70	20	10	-	-	100	3	1	-	4

Module l. HUMAN VALUES:

Morals, values and Ethics-Integrity-Work Ethics-Service Learning-Civics virtue-respect for others- Living peacefully - Caring – Sharing - Honestly – Courage - Valuing time- Cooperation - Commitment- Empathy - Self Confidence – Character – Spirituality - Introduction to Yoga and meditation for professional excellence and stress management.

Module ll: ENGINEERING ETHICS:

Sensors of Engineering Ethics- Variety of moral Issues- Types of Inquiry – Moral dilemmas- Moral autonomy- Kohiberg's theory – Gilligan's theory – Consensus and Controversy – Models of Professional roles – Theories about right action – self interest – Customs and Religion- Uses of Ethical Theories.

Module III : ENGINEERING AND SOCIAL EXPERIMENTATION:

Engineering as Experimentation – Engineering as responsible Experimenters – Codes of Ethics – A balanced Outlook on Law.

Module IV: SAFETY, RESPONSIBILITIES AND RIGHT:

Safety and Risk – Assessment of Safety and Risk – Risk Benefit analysis and Reducing Risk – Respect for Authority – Collective Bargaining – Confidentially – Conflict of interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

Module V : GLOBAL ISSUES:

Multinational Corporations – Environment Ethics – Computer Ethics – Weapons Development – Engineering as Managers – Consulting Engineers – Engineering as Expert Witnesses and Advisors – Moral Leadership – Code of Conduct – Corporate social Responsibility.

Text & Reference Books:

1. Mike W.Martin and Roland Schinzinger, "Ethics in Engineering" Tata Mc-Graw Hill New Delhi,2003.
2. Govindaranjan M, Natarajan S, Senthil Kumar V.S, "Engineering Ethics", Prentice Hall of India, New Delhi,2004.
3. Charies B. Feddermann, "Engineering Ethics" Pearson Prentics Hall, New Jersey 2004
4. Charies E. Herris Michael S. Pritchard and Michael J. Rabins "Engineering Ethics Concepts and cases" Learning, 2009.
5. John R Boatright, "Ethics and the conduct of Business" , Pearson Education New Delhi 2003.
6. Edumund G Seebauer and Robert L Barry, "Fundamental of Ethics for Scientists and Engineers", Oxford University Press, Oxford 2001.
7. Laura P. Hartman and joe Desjardins, "Buisness Ethics: Decision Making for Personal Intigrity and Social Responsibility" Mc Graw Hill Education India Pvt Ltd, New Delhi 2013.
8. World Community Service Centre, "Value Education",Vethathiri publication, Erode 2011.

COURSE OUTCOMES: At the end of the course the student will be able to

CO1	Understand Human Values
CO2	Apply Engineering Ethics.
CO3	Apply Engineering as Social expectation.
CO4	Assess Safety and Risks.
CO5	Deep Perception of Global Issues.

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COURSE CONTENTS **w.e.f. July 2023**

Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours Per Week			Total Credits
		Theory			Practical			L	T	P	
		End. Sem.	Mid Sem. Exam	Quiz/ Assign.	End Sem	Lab Work					
MT-51 A	Finite Element Methods	70	20	10	-	-	100	3	1	-	4

Module-I. Introduction: Structural analysis, objectives, static, Dynamic and kinematics analyses, Skeletal and continuum Structures, Modeling of infinite Degree of freedom(D.O.F) system into finite D.O.F. system, Basic steps in finite element problem formulation, General applicability of the method.

Module-II. Element Types and Characteristics: Discretization of the domain, Basic element shapes, Aspect ratio, Shape functions, generalized co-ordinates and nodal shape functions. 1D bar and beam elements, 2D rectangular and triangular elements, Axisymmetire elements.

Module-III. Assembly of Elements and Matrices : Concept of element assembly, Global and local Co-ordinate systems, Band width and its effects, Banded and skyline assembly, Boundary conditions, Solution of simultaneous equations, Gaussian elimination and Choleksy decomposition methods, Numerical integration, ID and 2D applications.

Module-IV. Higher Order and Iso-parametric Elements: One dimensional quadratic and cubic elements, Use of natural Co-ordinate system, Area Co-ordinate system continuity and convergence requirements, 2D rectangular and triangular requirement.

Module-V. Static & Dynamic Analysis: Analysis of trusses and frames, Analysis of machine subassemblies, Use commercial software packages, Advantages and limitations Hamilton's principle, Derivation of equilibrium, Consistent and lumped mass matrices, Derivation of mass matrices for ID elements, Determination of natural frequencies and :node shapes, Use of commercial software packages.

Text & Reference Books:

1. Rao, S.S., The Finite Element Method in Engineering, 2nd ed., Peragarnon Press, Oxford.
2. Robert, D. Cook. David, S. Malkins, and Michael E. Plesha, Concepts andApplication of Finite Element Analysis 3 rd ed., John Wiley
3. Chandrupatla, T.R. anBelegundu, A.D., Introduction to Finite Elements inEngincering, Prentice Hall of India Pvt. Ltd.
4. Zienkiewicz OC, The Finite Element Method, 3rd ed, Tata Mc Graw Hill.

COURSE OUTCOMES: At the end of the course the student will be able to:

CO1	Make use of finite element method to solve simple problems from Structural & Dynamic domain.
CO2	Develop the concept of various elements and their characteristics.
CO3	Create element and global stiffness, displacement and force matrices for ID and 2D FEA Problems.
CO4	Apply the finite Element analysis using available commercial FEA tools.
CO5	Perform Static & Dynamic Analysis.

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COURSE CONTENTS **w.e.f. July 2023**

Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours Per Week			Total Credits
		Theory			Practical			L	T	P	
		End Sem	Mid Sem. Exam	Quiz/ Assign.	End Sem.	Lab Work					
MT-63	Industry 4.0	70	20	10	30	20	150	3	-	2	4

Module 1: Introduction to Industrial IoT (IIOT) Systems:

The Various Industrial Revolutions, Role of Internet of Things (IoT) & Industrial Internet of Things (IIoT) in Industry, Industry 4.0 revolutions, Support System for Industry 4.0, Smart Factories.

Module 2: Implementation systems for IIOT:

Sensors and Actuators for Industrial Processes, Sensor networks, Process automation and Data Acquisitions on IoT Platform, Microcontrollers and Embedded PC roles in IIOT, Wireless Sensor nodes with Bluetooth, WiFi, and LoRa Protocols and IoT Hub systems.

Module 3: IIOT Data Monitoring & Control:

IoT Gate way, IoT Edge Systems and It's Programming, Cloud computing, Real Time Dashboard for Data Monitoring, Data Analytics and Predictive Maintenance with IIOT technology.

Module 4: Cyber Physical Systems:

Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Introduction to Artificial Intelligence, Big Data and Advanced Analysis

Module 5: Industrial IoT- Applications:

Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management, Smart Factory.

Text & Reference Books:

1. Industry 4.0 The Industrial Internet of Things Alasdair Gilchrist Publications: Apress.

2. The Concept Industry 4.0 An Empirical Analysis of Technologies and Applications in Production Logistics Authors: Bartodziej, Christoph Jan Springer: Publication in the field of economic science.

3. Embedded System: Architecture, Programming and Design by Rajkamal, TMH3.

4. Dr. OvidiuVermesan, Dr. Peter Friess, "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers.

List of Experiments:

1. Demonstration of a wireless router works with neat architectural sketch.
2. Design a Virtual Machine to manage the control room of COVID DISASTER MANAGEMENT with your own specifications
3. Case study of any 3 Applications of AI in INDUSTRY 4.0 with its advantages and disadvantages.
4. Design an IOT system to save energy and visualize data using a machine and implement algorithms to tackle problems in the industry.
5. Demonstrate and explain how Jabalpur can be converted into a smart city with the applications of IOT in smart cities.
6. Demonstration of the working of Mobile IP.

COURSE OUTCOMES: At the end of the course the student will be able to;

CO1	Knowledge of theory and practice related to Industrial IoT Systems.
CO2	Ability to identify, formulate and solve engineering problems by using Industrial IoT.
CO3	Demonstrate the cyber physical systems.
CO4	Ability to implement real field problem by gained knowledge of Industrial applications.
CO5	Ability to implement real field problem by gained knowledge of Industrial applications with IoT capability

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COURSE CONTENTS **w.e.f. July 2023**

Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours Per Week			Total Credits
		Theory			Practical			L	T	P	
		End. Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work					
MT-52	Thermodynamics & Applications	70	20	10	30	20	150	3	-	2	4

Module I. Introduction of Thermodynamics: Fundamentals - System and Control volume, Property, State & Process, Cycle, Temperature, Types of equilibrium, Zeroth law of thermodynamics, Temperature scales, Various thermometers, Heat & Work transfer.

Module II. The First Law of Thermodynamics: Heat/work interaction in systems, First Law for Cyclic & Non-cyclic processes, Total energy, Various modes of energy, Internal energy and Enthalpy, First Law for Flow Processes, Steady state flow processes, Unsteady processes, Limitations of first law of thermodynamics.

Module III. The Second Law of Thermodynamics: Second law-Kelvin-Planck and Clausius statements, Heat engine, Heat reservoir, Refrigerator, Heat pump, Thermal efficiency and COP, Reversible and irreversible processes, Carnot cycle, Internal and external irreversibility, Absolute temperature scale. Clausius inequality, Entropy, Entropy for solids, liquids, ideal gases undergoing various processes, Principle of increase of entropy, T-S diagrams, Irreversibility and Availability, Energy.

Module IV. Properties of Pure Substance: Pure Substance, Phase, Phase-transformations, Formation of steam, Properties of steam, PVT surface, HS, TS, PV, PH, TV diagram, Processes of vapor, Measurement of dryness fraction, Use of Steam tables and Mollier chart.

Module V. Air Standard Cycles and Non-reactive Gas Mixture: Carnot, Otto, Diesel, Dual cycles and their comparison, Brayton Cycle, PVT relationship, Mixture of ideal gases, Properties of mixture of ideal gases-Internal energy, Enthalpy and Specific heat of gas mixtures.

Text & Reference Books:

1. P.K.Nag: Engineering Thermodynamics; TMH
2. VanGJ; Thermodynamics;John Wylen
3. CengelY: Thermodynamics; TMH
4. AroraCP, Thermodynamics TMH

5. Omkar Singh Engineering Thermodynamics, New Age International.
6. Radha Krishanan Engineering Thermodynamics PHI India Pvt. Ltd.
7. M.Achuthan Engineering Thermodynamics, PHIIndia.

List of Experiments:

1. To find mechanical equivalent of heat using Joule's apparatus.
2. To study working of impulse and reaction steam turbine by models.
3. To study working of Gas turbines by models and to identify various processes of Brayton Cycle.
4. To calculate COP of vapor compression refrigeration system and to plot on T-s, p-H diagrams.
5. To plot specific fuel consumption versus rpm diagrams for diesel and petrol engines.
6. Verification of First law of thermodynamics.
7. Study of low-pressure boilers and Mountings and Accessories.
8. Measurement of dryness fraction by Separating and Throttling Calorimeter.
9. Study of 2 stroke and 4 stroke petrol engines.
10. Study of 2 stroke and 4 stroke diesel engines.

COURSE OUTCOMES: At the end of the course the student will be able to

CO1	Analyze the laws of thermodynamics, and their applications
CO2	Explain working of heat engine, heat reservoir entropy, entropy change.
CO3	Explain Real gas, it's deviation with ideal gas Maxwell relations and their applications.
CO4	Analyze Pure Substance, phase, phase-transformations use of steam table and Mollier chart
CO5	Understand working of Air Standard cycles, Carnot, Otto, Diesel, Dual cycles

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		Theory			Practical			L	T	P	
		End. Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work					
MT-51 C	Machine Design	70	20	10	-	-	100	3	1	-	4

Module l. Stress concentration and fatigue: Causes of stress concentration, stress concentration in tension, bending and torsion, reduction of stress concentration, theoretical stress concentration factor, notch sensitivity, fatigue stress concentration factor, cyclic loading, endurance limit, S-N Curve, loading factor, size factor, surface factor. Design consideration for fatigue, Goodman and modified Goodman's diagram, Soderberg equation, Gerber parabola, design for finite life, cumulative fatigue damage factor.

Module ll: Shafts: Design of shaft under combined bending, twisting and axial loading, shock and fatigue factors, design for rigidity, design of shaft subjected to dynamic load, design of keys and shaft couplings.

Module III : Design of Bearings: Sliding Bearing, hydrodynamics lubrication, mechanical aspects of bearing design, lubricants, journal bearing design, rolling element bearings.

Module IV: Brakes & Clutches: Materials for friction surface, uniform pressure and uniform wear theories, Design of friction clutches: Disk, plate clutches, cone & centrifugal clutches, Design of brakes: Rope, band & block brake, Internal expending brakes, Disk brakes.

Module V : Design of Power screws types, screw drives, threaded joints efficiency, stresses in power screws, design procedure and calculation.

Text & Reference Books:

1. Shigley J.E; Machine Design; TMH
2. Sharma and Purohit; Design of Machine elments; PHI
3. Wentzell Timothy H; Machine Design; Cengage learning
4. Mubeen; Machine Design; Khanna Publisher
5. Ganesh Babu K and Srithar k; Design of Machine Elements; TMH
6. Sharma & Agrawal; Machine Design; Kataria & sons
7. Maleev; Machine Design

COURSE OUTCOMES: At the end of the course the student will be able to

CO1	Understand modes of failure, fatigue and different factors used in design.
CO2	Design cotter joints, knuckle joints and welded joints used in different machines.
CO3	Design shafts under combined bending, twisting and axial loading.
CO4	Select bearing for given conditions using design procedure.
CO5	Design different types of Power screws.

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COURSE CONTENTS w.e.f. July 2023

Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours Per Week			Total Credits
		Theory			Practical			L	T	P	
		End. Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work					
MT 74	EV and HV Technology	70	20	10	30	20	150	3	-	2	4

Module 1. Introduction to Electric Vehicle: History of Electric Vehicles, Development towards the 21st Century, Types of Electric Vehicles in use today – Battery Electric Vehicle, Hybrid (ICE & others), Fuel Cell EV, Solar Powered Vehicles. Motion and Dynamic Equations of the Electric Vehicles: various forces acting on the Vehicle in static and dynamic conditions.

Module 2. Induction to Hybrid Electric Vehicle: Social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid Drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

Module 3. Electric Drive Trains: Basic concept of electric traction, introduction to various electric drive train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

Module 4. Types of Storage Systems: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Calculation for the ratings.

Module 5. Battery Management Systems (BMS): Introduction to BMS, Objectives of the BMS: Discharging control, Charging control, State-of-Charge Determination, State-of-Health Determination. Cell Balancing; BMS topologies: Distributed Topology, Modular Topology and Centralized Topology, Firmware development, Certification, Aging. **Modelling of Hybrid Electric Vehicle Range:** Driving Cycles, Types of Driving Cycles, Range modelling for Battery Electric Vehicle, Hybrid (ICE & others), Fuel Cell EV, Solar Powered Vehicles. Case study of 2 wheeler, 3 wheeler and 4 wheeler vehicles

Text & Reference Books:

1. James Larminie, J. Lowry, "Electric Vehicle Technology Explained", John Wiley & Sons Ltd. 2003.

2. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.

3. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies",Springer, 2015.

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

5. Ali Emadi, "Advanced Electric Drive Vehicles", CRC Press, 2015.

6. Berker B., James W. J. & A. Emadi, "Switched Reluctance Motor Drives", CRC Press, 2019.

List of Experiments:

1. Vector control of PMSM and IM drives over complete drive cycle of EV.

Objective: - To familiarize with the basic vector control of PMSM and IM drive with speed/torque control operation. Two-level DC-AC voltage source converter, fed from a DC power source, would be used for operating the motor.

2. Characterization of power, torque and efficiency for EV over drive cycle.

Objective: - Chassis of 4-wheeller EV would be operated in all possible modes for this experiment. Power, torque and efficiency would be plotted against speed of EV over the complete range of operation.

3. Power flow in EV power train during charging, V2G feeding, motoring and braking.

Objective: - To understand the flow of energy in the power train of EV during various modes of operation i e. charging, V2G feeding, motoring and braking. EV would be operated in the aforementioned modes and power would be measured at different sections of EV.

4. Forward & backward motoring and regenerative braking of EV consisting of multiple motor drives

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COURSE CONTENTS **w.e.f. July 2023**

Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours Per Week			Total Credits
		Theory			Practical			L	T	P	
		End. Sem	Mid Sem. Exam	Quiz/ Assignment	End Sem.	Lab Work					
MT-61 B	Dynamics of Machine	70	20	10	-	-	100	3	1	-	4

Module-I Dynamics of Engine Mechanism: Displacement, velocity and acceleration of piston; turning moment on crankshaft, turning moment diagram, fluctuation of crankshaft speed, analysis of flywheel.

Module-II. Governor Mechanisms: Governor Mechanisms: Types of governors, characteristics of centrifugal governors, gravity and spring controlled centrifugal governors, hunting of centrifugal governors, effort and power of governor.

Module-III Balancing of Inertia Forces and Moments in Machines: Balancing of rotating masses, two plane determination of balancing masses (graphical and analytical methods), balancing of rotor:

Module-IV. Friction: Frictional torque in pivots and collars by uniform pressure and uniform wear rate criteria, Clutches: Single plate and multi plate clutches, Cone clutches.

Module-V. Brakes: Band brake, block brakes, Internal expanding shoe brakes, Dynamometer, Different types and their applications.

Text & Reference Books:

1. Ambekar, AG: Mechanism and Machine Theory; PHI
2. Rattan SS; Theory of machines; TMH
3. Sharma and Purohit: Design: of Machine elements; PHI
4. Bevan; Theory of Machine
5. Ghosh and Malik; Theory of Mechanisms and Machines; Affiliated Fast-Wes. Press, Delhi
6. Norton RL; kinematics and dynamics of machinery; TMH
7. Grover; Mechanical Vibrations
8. Balaney; Theory of Machines
9. Theory of Vibrations by Thomson
10. Theory of machines through solved problems by J.S.RAO.

COURSE OUTCOMES: Upon successful completion of course, students will be able to:

CO1	Illustrate the working of flywheel, governor, clutch, brake and dynamometer.
CO2	Examine the turning moment diagrams, characteristic curve of governors, unbalanced forces and couple, failure of clutches and brakes.
CO3	Assess the motion of piston, hunting effort and power of governor.
CO4	Understand balancing masses characteristics.
CO5	Assess the frictional torque.

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Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours Per Week			Total Credits
		Theory			Practical			L	T	P	
		End. Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work					
MT 73	Mechatronics System Design	70	20	10	30	20	150	3	-	2	4

Module 1: Introduction to Mechatronics System Design:
Introduction to Mechatronics system, Elements of Mechatronics system: Sensor, actuator, plant, and controller, Applications of Mechatronics system, Systems like CDROM and scanner: exploration of internal components and their functionality.

Module 2: Integrated Mechanical-Electronics Design and Microprocessor Fundamentals:
Integrated mechanical-electronics design philosophy, Examples of real-life Mechatronics systems, Smart sensor concept, Utility of compliant mechanisms in Mechatronics, Microprocessor building blocks, Combinational and sequential logic elements, Memory, timing, and instruction execution fundamentals, Example of a primitive microprocessor.

Module 3: Microcontrollers for Mechatronics and Mathematical Modeling:
Microcontrollers for Mechatronics, Philosophy of programming interfaces, Setting sampling time, Getting started with TIVA programming, Microcontroller programming philosophy with emphasis on TIVA, Programming different interfaces like PWM, QEI, etc., Mathematical modelling of Mechatronics systems, Modelling friction, DC motor, Lagrange formulation for system dynamics.

Module 4: Control Systems in Mechatronics:
Dynamics of a 2R manipulator, Simulation using MAT lab, Selection of sensors and actuators, Concept of feedback and closed-loop control, Mathematical representations of systems, Control design in the linear domain, Basics of Lyapunov theory for nonlinear control, Notions of stability, Lyapunov theorems and their application, Trajectory tracking control development based on Lyapunov theory.

Module 5: Signal Processing and Practical Implementations:
Basics of sampling a signal, Signal processing, Digital systems and filters for Mechatronics system implementation, Research examples/case studies of the development of novel Mechatronics systems:3D micro-printer, Hele Shaw system for micro fabrication

Text Reference Books:

1.Mechatronics Systems Design and Solid Materials by Satya Bir Singh (Editor); Prabhat Ranjan (Editor); Alexander V. Vakhrushev (Editor); A. K. Haghi (Editor).

2.The Design of High Performance Mechatronics - 3rd Revised Edition by R. Munnig Schmidt; G. Schitter; A. Rankers

3.Mechatronics System Design, Devdas Shetty, Richard A. Kolk, Cengage Learning, 2010.

List of Experiments:

1: The Principles of Switching.

2: Stepper Motor Control.

3: Dc Motor Speed- Control Using PWM.

4: Design of Temperature Control System.

5: Design of Simple Hydraulic Presser.

6. Datasheets Analysis of Industrial Sensors.

7: Analysis Of Mechatronics System: The ROBOTINO.

8: VFD & SPEED Time Profiling.

COURSE OUTCOMES: At the end of the course the student will be able to;

CO1	Understand mechatronics system elements and their interplay.
CO2	Apply integrated mechanical-electronics design to real-life systems.
CO3	Program microcontrollers (TIVA) for control and signal processing.
CO4	Master mathematical modeling for friction, DC motors, and system dynamics.
CO5	Gain expertise in control systems, feedback, linear control design, and Lyapunov theory.

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Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours Per Week			Total Credits
		Theory			Practical			L	T	P	
		End. Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work					
MT 75	AI & ML	70	20	10	30	20	150	3	-	2	4

Module - I: Introduction to Regression, Mathematics Foundations, Model Building using Least squares, Model Accuracy & Selection, Overfitting, Interpretability of regression models.

Module - II: Overview of the Classification Module, Nearest-neighbour Methods, Naïve Bayes Classifier, Logistic Regression, Decision Tree, Optimization Foundations for Support Vector Machines, Support Vector Machines, Support Vector Machines in overlapping class distributions & Kernels, Ensemble Methods.

Module - III: Introduction to Unsupervised Learning, Clustering, K-Means Algorithm, K-Means – Variations, Detecting Outliers, Math Fundamentals for EM Algorithm, EM Algorithm, Clustering for Customer Segmentation, Association Rule Mining, Apriori Algorithm, Time series Prediction and Markov Process, Hidden Markov Model.

Module - IV:. Feature extraction: Statistical features, Principal Component Analysis. Feature selection: Ranking, Decision tree - Entropy reduction and information gain, Exhaustive, best first, Greedy forward & backward, Applications of feature extraction and selection algorithms in Mechanical Engineering.

Module - V: Introduction to Deep Learning, Artificial Neural Network, Sequence Modeling in Neural Network, Deep Learning, Convolution Networks with Deep Learning, Auto-encoders with Deep Learning Generative deep learning models.

Text & Reference Books:

1. Rich E and Knight K, Artificial Intelligence, TMH New Delhi.
2. Nelsson N.J., Principles of Artificial Intelligence, Springer Verlag, Berlin.
3. Barr A, Fergenbaub E.A. and Cohen PR. Artificial Intelligence, Addison Wesley, Reading Waterman D.A., A guide to Expertsystem, Adision - Wesley, Reading.
4. Artificial Intelligence Hand book, Vol. 1-2, ISA, Research Triangle Park. Kos Ko B, Neural Networks and Fuzzy system –PHI.
5. Haykin S, Artificial Neural Networks-Comprehensive Foundation, Asea,Pearson.

List of Experiments:

1. Study of PROLOG Programming language and its Functions. Write simple facts for the statements using PROLOG.
2. Implementation of Depth First Search for Water Jug problem.
3. Implementation of Breadth First Search for Tic-Tac-Toe problem.
4. Solve 8-puzzle problem using Best First Search. Write a program to Implement A*.
5. Write a PROLOG program to solve N-Queens problem.
6. Implementation of Traveling Salesman Problem.
7. Implementation of Python Basic Libraries such as Statistics, Math, Numpy and Scipy

a) Usage of methods such as floor(), ceil(), sqrt(), isqrt(), gcd() etc.

b) Usage of attributes of array such as ndim, shape, size, methods such as sum(), mean(), sort(), sin() etc.

c) Usage of methods such as det(), eig() etc.

d) Consider a list datatype (1D) then reshape it into 2D, 3D matrix using numpy

e) Generate random matrices using numpy

f) Find the determinant of a matrix using scipy

g) Find eigenvalue and eigenvector of a matrix using scipy

8. Implementation of Python Libraries for ML application such as Pandas and Matplotlib.

a) Create a Series using pandas and display

b) Access the index and the values of our Series

c) Compare an array using Numpy with a series using pandas

d) Define Series objects with individual indices

e) Access single value of a series

f) Load datasets in a Dataframe variable using pandas

g) Usage of different methods in Matplotlib.

9. Creation and Loading different types of datasets in Python using the required libraries.

i. Creation using pandas

ii. Loading CSV dataset files using Pandas

iii. Loading datasets using sklearn

10. Write a python program to compute Mean, Median, Mode, Variance, Standard Deviation using Datasets.

Course Outcomes: Upon successful completion of course, students will be able to:

CO1	Characterize Artificial intelligence system
CO2	Describe knowledge representation in AI systems
CO3	Illustrate reasoning using fuzzy
CO4	Elaborate natural language processing
CO5	Knowledge of neural networks

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		End. Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work					
MT 71 A	CAD / CAM	70	20	10	-	-	100	3	1	-	4

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

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

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

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

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

Text & Reference Books:

1. Automation. Production systems & Computer integrated Manufacturing, Groover, P.E.
2. CAD/CAM/CIM, Radhakrishnan and Subramaniah, New Age, 3rd edition, 2008.
3. Principles of Computer Aided Design and Manufacturing, FaridAmirouche, Pearson.
4. CAD/CAM Theory and Practice, R. Sivasubramaniam, TMH.
5. Computer Aided Design and Manufacturing, K.Lalit Narayan, PHI, 2008.
6. Computer Aided Manufacturing, T.C. Chang, Pearson, 3rd edition, 2008

Course Outcomes:

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

CO1	Analyze geometric transformations and CAD models.
CO2	Develop and validate CNC programs to manufacture engineering components.
CO3	Knowledge of geometric modelling.
CO4	Analyze Numerical control and part programming.
CO5	Illustrate the elements of group technology in an automated manufacturing environment.

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		End. Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work					
MT 71 B	Mechanical Vibration & Noise	70	20	10	-	-	100	3	1	-	4

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

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

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

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

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

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

Reference Books:

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

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

CO1	Analyse Un-damped and Damped free vibration systems.
CO2	Evaluate the two Degrees of Freedom.
CO3	Explain whirling motion and critical speed in Harmonically excited Vibration.
CO4	Evaluate sound pressure level (SPL), sound power level and sound intensity.
CO5	Analyse sources, isolation and control mechanism.

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		Theory			Practical			L	T	P	
		End. Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work					
MT 71 C	Power Plant Engineering	70	20	10	-	-	100	3	1	-	4

Module 1: Renewable Energy Power Plants: Introduction to methods of converting various energy sources of electric power, direct conversion methods renewable energy sources, solar, wind, tidal, geothermal, bio-thermal, biogas and hybrid energy systems, fuel cells, thermoelectric modules, MHD-Converter.

Module 2: Fossil Fuel Steam Stations: Fossil Fuel Steam Stations: Basic principles of station design, recent trends in turbine and boiler sizes and steam conditions, plant design and layout, outdoor and indoor plant, system components, fuel handling, burning systems, feed water treatment plant, condensing plant and circulating water systems, cooling towers, turbine room and auxiliary plant equipment., instrumentation, testing and plant heat balance. Combined cycle power generation, heat recovery steam generator, co-generation plant.

Module 3: Nuclear Power Station: Nuclear Power Station: Importance of nuclear power development in the world and Indian context, Review of atomic structure and radio activity, binding energy concept, fission and fusion reaction, fissionable and fertile materials, thermal neutron fission, important nuclear fuels. moderators and coolants. Types of reactors, pressurized water reactor, boiling water reactor., breader reactor , CANDU reactor, gascooled reactor,

Module 4: Hydro-Power Station: Classification on of hydroelectric power plant, introduction to hydrology, Plant layout, hydro plant auxiliaries, cost of plant, life of plant, hydro power control, electrical and mechanical components, comparison of hydro power station with thermal power station, automatic and remote control of power plant, safety measures and preventive maintenance of hydro power plant, calculation of available hydro power.

Module 5: Power Station Economics: Estimation and prediction of load. Maximum demand, load factor, diversity factor, plant factor and their influence on plant design, operation and economics; comparison of hydro and nuclear power plants typical cost structures, simple problems on cost analysis, economic performance and tariffs, interconnected system and their advantages, elements of load dispatch in interconnected systems.

Text & Reference Books:

1. Nag PK; Power plant Engg; TMH
2. AI-Wakil MM; Power plant Technology; TMH
3. Sharma C: Power plant Engg: Kataria and sons, Delhi
4. Domkundwar: Power Plant Engg, Dhanpatraic sons.
5. Rajput RK, A text book ot Power plant Engg.,Laxmi Publications.
6. Yadav R, Steam and gas turbine and power plant engg.

COURSE OUTCOMES: At the end of the course the student will be able to

CO1	Define the procedure of site selection for power plant and able to know the procedure to convert renewable, fossil fuel energy, nuclear energy & fluid energy in to electric power.
CO2	Explain function of different mechanism of power plant like fuel handling, its combustion, Utilization of potential of energy to convert in power by using mechanical and electrical equipments.
CO3	To draw the layout of power plant like renewable energy based, fossil fuel based, hydro and nuclear based power plants.
CO4	Estimate the power plant load, maximum demand, load factors, diversity factor.
CO5	Assess, plant factor and their influence on plant design, operation and economics.

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		End. Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work					
MT 72 A	Wireless Sensor Networks	70	20	10	-	-	100	3	1	-	4

Module-1 OVERVIEW OF WIRELESS SENSOR NETWORKS: Single Node Architecture Hardware Components Network Characteristics unique constraints and challenges, Enabling Technologies for Wireless Sensor Networks, Types of wireless sensor networks.

Module-2 ARCHITECTURES: Network Architecture Sensor Networks, Scenarios Design Principle, Physical Layer and Transceiver Design Considerations, Optimization Goals and Figures of Merit, Gateway Concepts WSN Communication standards.

Module-3 NETWORKING SENSORS: MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts – SMAC, BMAC Protocol, IEEE 802.15.4 standard and ZigBee, the Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols, Classifications, Energy Efficient Routing, Geographic Routing.

Module-4 INFRASTRUCTURE ESTABLISHMENT: Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.

Module-5 SENSOR NETWORK PLATFORMS AND TOOLS: Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node level Simulators, State-centric programming.

Text/Reference Books:

1. Holger Karl & Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2005.

2. Feng Zhao & Leonidas J.Guibas, "Wireless Sensor Networks An Information Processing Approach", Elsevier, 2007.

3. Waltenegus Dargie , Christian Poellabauer, "Fundamentals of Wireless Sensor Networks Theory and Practice", John Wiley & Sons Publications, 2011.

4. Kazem Sohraby, Daniel Minoli, & Taieb Znati, "Wireless Sensor NetworksTechnology, Protocols,
and Applications", John Wiley, 2007.
5. Anna Hac, ' Wireless Sensor Network Designs", John Wiley, 2003.

COURSE OUTCOMES: At the end of the course the student will be able to:

CO1	Understand challenges and technologies for wireless networks
CO2	Understand architecture and sensors
CO3	Describe the communication, energy efficiency, computing, storage and transmission
CO4	Establishing infrastructure and simulations
CO5	Explain the concept of programming the in WSN environment

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Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours Per Week			Total Credits
		Theory			Practical			L	T	P	
		End. Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work					
MT 72 B	Aerial Robotics	70	20	10	-	-	100	3	1	-	4

MODULE 1 - Fundamentals of Aerial robotics: Introduction to Aerial robotics, Types and classification of UAVs. Basic principles of Flight and Aerodynamics. Components of aerial robots UAV Design considerations.

MODULE 2 - Control systems and Dynamics: Introduction to control systems PID controllers for Aerial robotics, Modeling and dynamics of UAVs, Stability and control of aerial systems, Trajectory planning and control algorithms.

MODULE 3 - Computer vision and sensing for Aerial robots: Basics of computer vision, Image processing for UAVs, Sensors for aerial robotics- Cameras, lidar, IMU. Object detection and tracking, Visual SLAM for Autonomous navigation.

MODULE 4 - Autonomous navigation and Mission planning: Localization techniques for UAVs, Path planning and obstacle avoidance, GPS and inertial navigation, Waypoint navigation and mission planning. Autonomous decision-making Algorithms.

MODULE 5 - Applications for Industries: Industry- specific applications e.g. agriculture, surveillance, Search and Rescue. Payload integration and data collection. Legal & ethical considerations, Aerial robotics, Making program for an aerial robot for a specific application.

Text Books/References:

1. Nagrath IJ and Mittal RK; Robotics and Control; TMH
2. "Introduction to UAV Systems", Paul S. Brian and Samuel M. Nof Publication: Wiley, 2012
3. Spong Mark and Vidyasagar; Robot Modelling and control; Wiley India
4. Murphy; Introduction to Al Robotics; PHI Learning
5. "Computer Vision: Algorithms and Applications", Richard Szeliski Publication: Springer, 2010.
6. "Planning Algorithms", Steven M. LaValle, Cambridge University Press, 2006.

COURSE OUTCOMES: At the end of this course, the students will have the ability to;

CO1	Il ustrate the concept of aerial robotics and UAV.
CO2	Understanding the control system and dynamics of UAV.
CO3	Explain the working of various types of sensors and their application.
CO4	Operation of different aerial robots.
CO5	Different application and programming of aerial robotics.

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		Theory			Practical			L	T	P	
		End. Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work					
MT 72 C	Simulation and Modelling	70	20	10	-	-	100	3	1	-	4

Module-1 Introduction to modelling and simulation: Modelling and simulation methodology, system modelling , concept of simulation, continuous and discrete time simulation.

Module-2 Basic concept of probability and random variables continuous and discrete random variables, distribution of random variables: discrete and continuous, Compartmental models: linear, nonlinear and stochastic models.

Module-3 Introduction to Queuing Theory: Characteristics of queuing system, Poisson's formula, birth-death system, equilibrium of queuing system, analysis of M/M/1 queues. Application of queuing theory in computer system like operating systems, computer networks etc.

Module-4 System Dynamics modelling: Identification of problem situation, preparation of causal loop diagrams and flow diagrams, equation writing, level and rate relationship. Simulation of system dynamics models.

Module-5 Verification and validation: Design of simulation experiments, validation of experimental models, testing and analysis. Simulation languages comparison and selection, study of Simulation softwares -SIMULA, DYNAMO, STELLA, POWERSIM.

Text and Reference Books :

1. Gorden G., System simulation, Printice Hall.
2. Payer T., Introduction to system simulation, McGraw Hill.
3. Seila, Applied Simulation Modeling, Cengage
4. Spriet, Computer Aided Modeling and Simulation, W.I.A.
5. Sushil, System Dynamics, Wiley Eastern Ltd. 23
6. Shannon R.E., System simulation, Prentice Hall

Course Outcomes: Upon successful completion of course students will be able to:

CO1	Learn the utility of simulation and modelling.
CO2	Describe concept of probability and random variables.
CO3	Illustrate reasoning using Queuing Theory.
CO4	Elaborate system dynamics modelling.
CO5	Analyse verification and validation in experiments.

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		End. Sem	Mid Sem. Exam	Quiz/ Assign	End Sem	Lab Work					
MT 81A	Total Quality Management	70	20	10	-	-	100	3	1	-	4

MODULE I Evolution of total quality management, historical perspective, teamwork, TQM and IS09000; information technology and Business Process Re-engineering (BPR); TPM and quality awards; aids and barriers to quality management, creating vision and initiating transformation, establishing programs for education and self-coordination, policy setting and review, flowchart of policy management and relation with daily mgt. improvements, measurement of key indicators; quality management leader; cross functional teams and coordination, policy setting and review, flowchart of policy management and relation with daily mgt.

MODULE II Process- definition, variation and feedback, funnel-marble experiment- rules of adjustment and its effects, quality- definition, goalpost and kaizen view, quality of design, conformance and performance; Taguchi loss function, cost of quality, chain action of improving quality to productivity to motivation and low cost; Deming's theory of management, fourteen points and variance reduction; attributes enumerative and variables analytic studies.

MODULE III SQC-Control charts: basic discrete and continuous distributions, measures of central tendency, variability and shapes, sampling, size and central value theorem, control chart structure, process plotting and stability, study of out-of-control evidences, defect detection and prevention, use of control charts in evaluating past, present and future trends; attribute control charts, count and classification charts, construction and interpretation of p , np , c and u charts, PDSA cycle(plan, do, study, act), and R charts, and s charts, individual and moving range chart, trial control limits and out of control points.

MODULE IV Process diagnostics: Between and Within Group variations, periodic and persistent disturbances, control chart patterns-natural, level-shift, cycle, wild, multi-universe, relationship and other out of control patterns; diagnosing a process, brainstorming; cause-effect, Ishikava, interrelationship, systematic and matrix diagrams; change concepts and waste elimination

MODULE V Process improvement: Performance and technical specifications, attribute-process and variable-process capability studies; unstable and stable process capability studies and examples; attribute and variable improvement studies; Inspection: acceptance sampling(AS)- lot formation, single, double and multiple/sequential sampling plans, operating characteristic (OC) curve, producer and consumer risk, theoretical invalidation of AS, kp rule for stable and chaotic processes.

Text & Reference Books:

1. Gitlow HS, Oppenheim et al; Quality Management;TMH'
2. Gryna FM; Juran's Quality Planning and Analysis; TMH'
3. Crosby Phil ps; Quality is still free; New Amer Library'
4. Kulkami VA and Bewoor AK;Quality Control;Wiley'
5. Jankiraman B and Gopal RK; Total Quality Management- Text and Cases; PHI Learning.
6. SugandhiLandSamualA;TotalQualityManagement;PHILearning'
7. Subburaj R; Total Quality Management; TMH'
8. Naidu Babu and Rajendran; TQM; New age International pub'
9. Chase Richard B et al; Operations management; SIE-TMH'
10. Chary SN; Production and Operations Management; TMH'

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

CO1	Understand the concept of quality, its measurement, and improvements techniques.
CO2	Knowledge of quality of design, conformance and performance, motivation attributes.
CO3	Selection and application of sampling techniques and use of control charts.
CO4	Able to diagnose a process and prepare systematic and matrix diagrams.
CO5	Ability of inspection, process improvement and capability studies.

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		Theory			Practical			L	T	P	
		End. Sem.	Mid Sem. Exam.	Quiz/ Assign	End Sem.	Lab Work					
MT 81 B	Renewable energy Technology	70	20	10	-	-	100	3	1	-	4

MODULE-I Solar Radiation: Extra-terrestrial and terrestrial, radiation measuring instrument, radiation measurement and predictions. Solar thermal conversion: Basics, Flat plate collectors-liquid, and air type. Theory of flat plate collectors, selective coating, advanced collectors, Concentrators: optical design of concentrators, solar water heater, solar dryers, solar stills, solar cooling, and refrigeration. Solar photovoltaic: Principle of photovoltaic conversion of solar energy; Technology for fabrication of photovoltaic devices; Applications of solar cells in PV generation systems; Organic PV cells.

MODULE-II Wind Energy: Characteristics and measurement: Metrology of wind speed distribution, wind speed statistics, Weibull, Rayleigh, and Normal distribution, Measurement of wind data, Energy estimation of wind regimes; Wind Energy Conversion: Wind energy conversion principles; General introduction; Types and classification of WECS; Power, torque and speed characteristics; power curve of wind turbine, capacity factor, matching wind turbine with wind regimes; Application of wind energy.

MODULE-III Production of biomass: Photosynthesis-C3 & C4 plants on biomass production; Biomass resources assessment; Co2 fixation potential of biomass; Classification of biomass; Physicochemical characteristics of biomass as fuel Biomass conversion routes: biochemical, chemical and thermochemical Biochemical conversion of biomass to energy: anaerobic digestion, biogas production mechanism, technology, types of digesters, design of biogas plants, installation, operation and maintenance of biogas plants, biogas plant manure-utilization and manure values. Biomass Gasification: Different types of power generation from gasification, cost-benefit analysis of power generation by gasification.

MODULE-IV Small Hydropower Systems: Overview of micro, mini, and small hydro system; hydrology; Elements of the turbine; Assessment of hydropower; selection and design criteria of turbines; site selection and civil works; speed and voltage regulation; Investment issue load management and tariff collection; Distribution and marketing issues. Ocean Energy: Ocean energy resources, ocean energy routes; ocean thermal energy conversion system principle, ocean thermal power plants. Principles of ocean wave energy and Tidal energy conversion.

MODULE-V Geothermal Energy: Origin of geothermal resources, type of geothermal energy deposits, site selection geothermal power plants; Hydrogen Energy: Hydrogen as a source of energy, Hydrogen production and storage. Fuel Cells: Types of the fuel cell, fuel cell system and subsystem, Principle of working basic thermodynamics

References:

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

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

CO1	Classify Solar energy conversion systems and applications.
CO2	Selection and estimation of the Wind energy potential of site and turbines.
CO3	Understand the production and advantages of Biomass.
CO4	Explain assessment of hydro power and Tidal energy conversion.
CO5	Analyze Geothermal energy, Hydrogen Production and storage and Fuel cell.

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		Theory			Practical			L	T	P	
		End. Sem.	Mid Sem. Exam.	Quiz/ Assign	End Sem.	Lab Work					
MT 81 C	Refrigeration and Air Conditioning	70	20	10	-	-	100	3	1	-	4

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

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

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

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

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

Text & Reference Books:

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

Course Outcomes: Upon successful completion of course students will demonstrate the ability to:

CO1	Explain the principles and methods of refrigeration.
CO2	Explain the working of Vapour compression systems and applications.
CO3	Evaluation of Vapor absorption systems and applications
CO4	Analyze psychrometric properties and processes.
CO5	Elaborate the heating and cooling load for a given AC system.

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		End. Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work					
MT 82 A	Image Processing & Machine Vision	70	20	10	-	-	100	3	1	-	4

MODULE-I IMAGE PROCESSING: Elements of image processing system, Image acquisition using sensors, Image formation and contrast sensitivity, Sampling and quantization, Neighbors of a pixel, Distance measures, Pixel connectivity, Image geometry.

MODULE-II IMAGE ENHANCEMENT: Definition, Spatial domain methods, Contrast stretching, Slicing, Averaging, Frequency domain methods Histogram modify techniques, Neighborhood averaging, Segmentation techniques, Media and filtering, Edge detection, Image sharpening by differentiation, Low and high pass filtering.

MODULE-III IMAGE TRANSFORMS: Introduction to Fourier transform-DFT, Properties of two dimensional DFT, Average value, FFT algorithm, Walsh transforms, Hadamard transform, Haar transform, K-L transform, Discrete cosine transform, Wavelet transform and comparison of all transforms.

MODULE-IV APPLICATIONS: Transforming sensor reading, Mapping Sonar Data, Aligning laser scan measurements - Vision and Tracking: Following the road, Iconic image processing, Multiscale image processing, Video Tracking - Learning landmarks: Landmark spatiograms, K-means Clustering, EM Clustering.

MODULE-V ROBOT VISION: Basic introduction to Robotic operating System (ROS) - Real and Simulated Robots - Introduction to OpenCV, Open NI and PCL, installing and testing ROS camera Drivers, ROS to OpenCV - The cv_bridge Package.

REFERENCE BOOKS:

1. "Digital Image Processing" by Rafael, C. Gonzlez and Paul, Wintz, Addision-Wesley Publishing Company.

2. "Fundamentals of Digital Image Processing" by Anil K. Jain Prentice Hall.

3. "Digital Image Processing" by Sosenfeld, and Kak. A.C., Academic Press.

4. The Image Processing Handbook,(5/e), CRC, 2006 by J.C. Russ.

5. Digital Image Processing with MATLAB by R.C. Gonzalez & R.E. Woods, Prentice Hall 2003.

6. Carsten Steger, Markus Ulrich, Christian Wiedemann, "Machine Vision Algorithms and Applications", WILEY-VCH, Weinheim,2008.

7. Damian m Lyons," Cluster Computing for Robotics and Computer Vision", World Scientific, Singapore, 2011.

Course Outcomes: Upon successful completion of course students will demonstrate the ability to:

CO1	Knowledge of elements of digital image processing system.
CO2	Understand image enhancement techniques.
CO3	Apply different transforms over images.
CO4	Implement restoration techniques in Digital Images.
CO5	Develop various image compression techniques.

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		End. Sem.	Mid Sem. Exam.	Quiz/ Assign	End Sem.	Lab Work					
MT 82 B	MEMS and NEMS Technology	70	20	10	-	-	100	3	1	-	4

Module 1: INTRODUCTION TO MEMS and NEMS - Overview of Micro electro mechanical systems and Nano Electro mechanical systems, devices and technologies, Laws of scaling- Survey of materials- Smart Sensors-Applications of MEMS and NEMS.

Module 2: MICRO-MACHINING AND MICROFABRICATION TECHNIQUES - Photolithography- Film deposition, Etching Processes- wafer bonding- Bulk micro machining, silicon surface micro machining- LIGA process.

Module 3: MICRO SENSORS AND MICRO ACTUATORS - Transduction mechanisms in different energy domain- Micro-machined capacitive, piezoelectric, piezoresistive and Electromechanical and thermal sensors/actuators and applications

Module 4: NEMS TECHNOLOGY - Atomic scale precision engineering- Nano Fabrication techniques - NEMS in measurement, sensing, actuation and systems design.

Module 5: MEMS and NEMS APPLICATION - Introduction to Micro/Nano Fluids and applications- Bio MEMS- Optical NEMS- Micro and Nano motors- Recent trends in MEMS and NEMS.

Text & Reference Books:

1. Chang Liu, "Foundations of MEMS", Pearson International Edition, 2006.

2. Marc F madou" Fundamentals of micro fabrication" CRC Press 2002 2nd Edition Marc Madou.

3. M.H.Bao "Micromechanical transducers :Pressure sensors, accelerometers and gyroscopes", Elsevier, Newyork, 2000.

4. Maluf, Nadim "An introduction to Micro Electro-mechanical Systems Engineering "AR Tech house, Boston 2000.

5. Mohamed Gad – el – Hak "MEMS Handbook" Edited CRC Press 2002 2. Sabriesolomon "Sensors Handbook", Mc Graw Hill 1998.

6. Tai-.Ran Hsu, "MEMS and Microsystems: design , manufacture, and Nanoscale"- 2nd Edition, John Wiley & Sons, Inc., Hoboken, New Jersey, 2008

7. Lyshevski, S.E. " Nano- and Micro-Electromechanical Systems: Fundamentals of Nano-and Microengineering " (2nd ed.). CRC Press,2005.

COURSE OUTCOMES: At the end of this course, the students will have the ability to;

CO1: Explain the material properties and the significance of MEMS and NEMS for industrial automation.
CO2: Demonstrate knowledge delivery on micromachining and micro fabrication.
CO3: Apply the fabrication mechanism for MEMS sensor and actuators.
CO4: Apply the concepts of MEMS and NEMS to models, simulate and process the sensors and actuators.
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on MEMS and NEMS technology.

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		Theory			Practical			L	T	P	
		End Sem	Mid Sem. Exam.	Quiz/ Assign	End Sem.	Lab Work					
MT 82 C	Operation Research and Supply Chain	70	20	10	-	-	100	3	1	-	4

MODULE I Linear system and distribution models: Mathematical formulation of linear systems by LP, Graphical solution of LP for two variables, Simplex method, special cases of LP-transportation and assignment models and their solution, Vogel's Approximation Method (VAM) or penalty method, cell evaluation degeneracy, basics of SW Lindo, Tora, Excell..

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

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

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

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

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

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

References:

1. Hillier FS and Liberman GJ; Introduction to Operations Research concept and cases; TMH
2. Simchi-Levi, Keminsky; Designing and managing the supply chain; TMH.
3. Srinivasan G; Quantitative Models In Operations and SCM; PHI Learning 4. Mohanty RP and Deshmukh SG; Supply Chain Management; Wiley India
5. Taha H; Operations research; PHI
6. Sen RP; Operations Research-Algorithms and Applications; PHI Learning
7. Sharina JK; Operations Research; Macmillan
8. Ravindran, Phillips and Solberg; Operations research; Wiley India
9. Vollman, Berry et al; Manufacturing planning and control for SCM; TTMH.
10. Bowersox DJ, Closs DJ, Cooper MB; Supply Chain LogistiMgt; TMH
11. Burt DN, Dobler DW, StarlingSL; World Class SCM; TMH
12. Bronson R; Theory and problems of OR; Schaum Series; TMH
13. George Hadley; Linear programming; Addison Wesley

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

CO1	Formulate linear programming problems.
CO2	Elaborate optimum solution of transportation problems and forecasting in the supply chain.
CO3	Determine average queue length and waiting time of queuing models.
CO4	Estimate optimum inventory and cost in inventory models.
CO5	Design a model for project planning.

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