



Shri Shamrao Patil (Yadravkar) Educational & Charitable Trust's
Sharad Institute of Technology College of Engineering
(An Autonomous Institute)
Yadrav (Ichalkaranji)-416121, Dist. – Kolhapur

Department of Mechanical Engineering
Third-Year Engineering
Teaching and Evaluation Scheme
and
Syllabus
as per New Education Policy 2020




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SIT COE, Yadrav

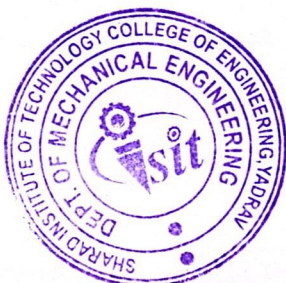


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Abbreviations

- L:** Lecture
T: Tutorial
P: Practical
CA1- Continuous Assessment 1
CA2- Continuous Assessment 2
MSE: Mid Semester Exam
ESE: End Semester Exam
BSC: Basic Science Course
ESC: Engineering Science Course
PCC: Programme Core Course
PEC: Programme Elective Course
MDM: Multidisciplinary Minor
OE: Open Elective
VSEC: Vocational and Skill Enhancement Course
AEC: Ability Enhancement Course
IKS: Indian Knowledge System
VEC: Value Education Course
RM: Research Methodology
CEP: Common Engineering Project
FP: Field Project
CC: Co-curricular Courses
ELC: Experimental Learning Course
HSSM: Humanity Social Science and Management




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Class: T.Y. B. Tech.

Semester: V

Course Code	Type of Course	Name of the course	Teaching Scheme			Evaluation scheme					Credit
			L	T	P	CA-I	CA-II	MSE	ESE	Total	
23ME3501	PCC	Design of Machine Elements -I	3	0	0	10	10	30	50	100	3
23ME3502	PCC	Machine Tool and Control	3	0	0	10	10	30	50	100	3
23ME3503	PCC	Heat Transfer	3	0	0	10	10	30	50	100	3
23ME3504	PEC	Program Elective Course-I	3	0	0	10	10	30	50	100	3
23ME3505	PCC	Heat transfer Laboratory	0	0	2	15	15	-	20	50	1
23ME3506	PCC	Design of Machine Element-I Laboratory	0	0	2	25	25	-	-	50	1
23ME3507	VSEC	CAD/CAM Laboratory	0	0	2	15	15	-	20	50	1
23ME3508	CEP	Mini Project-III	0	0	2	25	25	-	-	50	Audit
23ME3509	VSEC	Industrial/Field Training	0	0	0	0	0	-	50	50	Audit
23MEMDXX	MDM	Multidisciplinary Minor-III	3	0	0	10	10	30	50	100	3
23OEME33	OE	Open Elective III	3	0	0	10	10	30	50	100	3
23HSSM05	VEC	Language Skill-III	0	0	2	25	25	-	-	50	Audit
23HSSM06	VEC	Aptitude Skill-III	2	0	0	25	25	-	-	50	Audit
Total			20	0	10	215	215	180	390	1000	21

Program Elective Course-I

Basket A (Thermal)	Basket B (Design)	Basket C (Production)
Renewable Energy Engineering (23ME3504A)	Dynamics of Machines (23ME3504B)	Additive Manufacturing and Reverse Engineering (23ME3504C)




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Multidisciplinary Minor-III

Basket A (Production and Operation Management)	Basket B (Aerospace)	Basket C (Mechatronics)
Management Information System (23MEMDA3)	Aero Engine gas Turbine (23MEMDB3)	Sensor Technology-Physics, Fabrication and Circuits (23MEMDC3)




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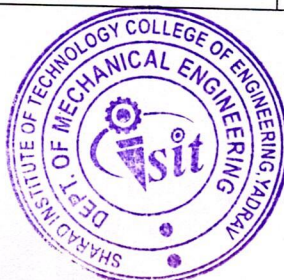
Class: T.Y. B. Tech.

Semester: VI

Course Code	Type of Course	Name of the course	Teaching Scheme			Evaluation scheme					Credit
			L	T	P	CA-I	CA-II	MSE	ESE	Total	
23ME3601	PCC	Design of Machine Elements -II	3	0	0	10	10	30	50	100	3
23ME3602	PCC	Finite Element Analysis	3	0	0	10	10	30	50	100	3
23ME3603	PCC	Refrigeration and Air Conditioning	3	0	0	10	10	30	50	100	3
23ME3604	PEC	Program Elective Course -II	3	0	0	10	10	30	50	100	3
23ME3605	PEC	Program Elective Course -III	3	0	0	10	10	30	50	100	3
23ME3606	VSEC	Design and Modeling of transmission system Laboratory	0	0	2	25	25	-	-	50	1
23ME3607	PCC	Refrigeration and Air Conditioning Laboratory	0	0	2	15	15	-	20	50	1
23ME3608	PCC	Finite Element Analysis Laboratory	0	0	2	15	15	-	20	50	1
23ME3609	ELC	Capstone Project-I	0	0	4	25	25	-	50	100	2
23MEMDX4	MDM	Multidisciplinary Minor-IV	3	0	0	10	10	30	50	100	3
23HSSM07	VEC	Language Skill-IV	0	0	2	25	25	-	-	50	Audit
23HSSM08	VEC	Aptitude Skill-IV	1	0	0	25	25	-	-	50	Audit
Total			19	0	12	190	190	180	390	950	23

Program Elective Course –II

Basket A (Thermal)	Basket B (Design)	Basket C (Production)
Power Plant Engineering (23ME3604A)	Design of Composite Materials (23ME3604B)	Automation in Manufacturing (23ME3604C)



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Program Elective Course –III

Basket A (Thermal)	Basket B (Design)	Basket C (Production)
Introduction to CFD (23ME3605A)	Reliability Engineering (23ME3605B)	Computer Integrated Manufacturing (23ME3605C)

Multidisciplinary Minor-IV

Basket 1 (Production and Operation Management)	Basket 2 (Aerospace)	Basket 3 (Mechatronics)
Strategic Management (23MEMDA4)	Introduction to Air Breathing Propulsion (23MEMDB4)	Mechatronics in Automotive Systems (23MEMDC4)

List of Courses offered for Honors in Robotics

Sr. No	Course Name	Semester	Course Link
1	Introduction to Robotics	V	https://onlinecourses.nptel.ac.in/noc23_de12/preview
2	Design of Mechatronics System	V	https://onlinecourses.nptel.ac.in/noc23_me136/preview
3	Wheeled Mobile Robot	VI	https://nptel.ac.in/courses/112106298
4	Robotics and Control : Theory and Practice	VI	https://nptel.ac.in/courses/112107289

List of Courses offered for minor in Mechanical Engineering

Sr. No	Course Name	Semester	Course Link
1	Basics of Material Engineering	V	https://onlinecourses.nptel.ac.in/noc22_me90/preview https://nptel.ac.in/courses/112106293
2	Numerical Methods for Engineers	V	https://onlinecourses.nptel.ac.in/noc23_ge35/preview
3	Introduction to Fluid Mechanics	VI	https://nptel.ac.in/courses/112105269
4	Manufacturing Process Technology I & II	VI	https://nptel.ac.in/courses/112104195



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Policy for Honors with Research

Semester	Requirement	Credits
VI, VII and VIII	Research paper- I publication on Capstone Project in UCG care/SCOPUS/ESCI/SCI indexed Journal	9
	Research paper- II publication on Capstone Project in UCG care/SCOPUS/ESCI/SCI indexed Journal	9
	Total	18

T. Y. curriculum credit distribution:

Course Category	PCC	PEC	MDM	OE	VSEC	ELC	Total
Cumulative Sum of Credits	22	9	06	03	02	02	44
NEP Guideline	18-22	12	06	02	02	00	40-44




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Exit Policy

Exit Criteria after First Year (Certificate): UG Certification

Course after First Year Exit	L	P	Credits
Drafting and 3 D Modeling Software	2	1	3
Hands on Training in any Workshop (3Weeks) /Minor Project			3
Total			6

Exit Criteria after Second Year: UG Diploma

Course after First Year Exit	L	P	Credits
CAM Programming	2	1	3
Internship in Mechanical Industry (3Weeks)/ Minor Project			3
Total			6

Exit Criteria after Third Year: B. Vocational

Course after First Year Exit	L	P	Credits
Hands on Simulation software	2	1	3
Internship in Mechanical Industry (3Weeks)/Minor Project		3	3
Total			6




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Design of Machine Elements -I

23ME3501	PCC	Design of Machine Elements I	3-0-0	3 Credits
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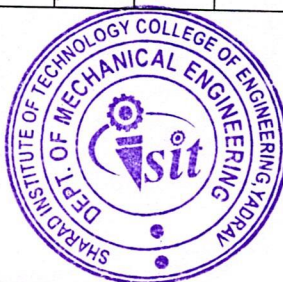
Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Basic Mechanical Engineering, Strength of Materials, Kinematics of Machines

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

CO1	Extend the knowledge of types of stresses, types of load, and theories of failure and factor of safety for the design of machine elements. (L2)
CO2	Analyze failure modes of simple machine elements for the applied load. (L4)
CO3	Determine the dimensions of shaft, keys and couplings for given transmitted power. (L5)
CO4	Determine stresses, deflections, and number of coils of springs under various loading conditions. (L5)
CO5	Apply design equations to evaluate the torque required and stresses induced in power screws. (L3)
CO6	Design against fluctuating loads. (L6)

Course Outcomes	Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2									2	2	
CO2	3	2									2	2	
CO3	3	2									2	2	
CO4	3	2									2	2	
CO5	3	2									2	2	
CO6	3	2									2	2	



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Course Contents:

Unit 1: Introduction and Role of Materials Introduction, General design procedures, Types of loads, types of stresses and use of design data book, Stress analysis, material selection, factor of safety, calculation of allowable stresses, theories of failure, aesthetic and ergonomic considerations in design.	[6]
Unit 2: Design of Simple Machine Elements Design of knuckle joint, Turn-buckle and bell crank lever	[6]
Unit 3: Design of shaft, Keys and Couplings Strength & deflection - ASME code for transmission shafting including axial loads (Problems not involving more than 2 transmitting elements.) Selection of keys, check for stresses. Introduction, classification, advantages, and applications of Couplings, design of Rigid & flexible coupling, Design of flexible coupling continued Bush and Pin type coupling.	[6]
Unit 4: Design of Springs Terminology, materials and specifications-Classification and Applications of Springs, Stress in springs, Wahl's correction factor, Deflection of springs, Design of helical compression springs subjected to uniform applied loads like I.C. engine valves, weighing balance, Problems on helical compression springs; Construction and application of Leaf springs	[6]
Unit 5: Design of Power Screws Power Screws: Types of threads used for power screw and their applications, torque analysis for square and trapezoidal threads, efficiency of screw, collar friction, overall efficiency, self-locking in power screws, stresses in the power screw, design of screw and nut, differential and compound screw, re-circulating ball screw. Design of screw jack: (Complete Design).	[6]
Unit 6: Design against Fluctuating Loads: Stress concentration, stress concentration factors, fluctuating stresses, fatigue failure, endurance limit, notch sensitivity, approximate estimation of endurance limit, design for finite life and infinite life under reversed stresses, Soderberg and Goodman diagrams.	[6]
Text Books: 1. V. B. Bhandari, "Design of Machine Elements", Tata McGraw Hill Publications, New Delhi, 2008. 2. R. L. Norton, "Machine Design: An Integrated Approach", Pearson Education Singapore, 2001 3. Machine Design R.S. Khurmi & J.K. Gupta S. Chand publication. 4. Machine design S G Kulkarni McGraw Hill Education Publications 5. Introduction to Machine design V B Bhandari McGraw Hill Education Publications. 6. Design Of Machine Elements Vol I, Vol II J.B.K. Das , P.L. Srinivas Murthy Sapna publication 7. Machine Component Design William Orthwein Jaico publication	
Reference Books: 1. R. C. Juvinall, K. M. Marshek, "Fundamental of machine component design", John Wiley & Sons Inc., New York, 3rd edition, 2002. 2. J. Hamrock, B. Jacobson and Schmid Sr., "Fundamentals of Machine Elements", International	



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Edition, New York, 2nd edition, 1999.

3. S. Hall, A. R. Holowenko, H. G. Langhlin, "Theory and Problems of Machine Design", Schaum's Outline Series, Tata McGraw Hill book Company, New York, 1982.
4. J. E. Shigley and C. Mischke, "Mechanical Engineering Design", Tata McGraw Hill Publications, 7th edition, 2004.
5. M. F. Spotts, "Design of Machine Elements", Prentice Hall of India, New Delhi.
6. Machine Design by Robert L. Norton, Tata McGraw Hill Publication
7. Fundamentals of Machine Component Design by Junvinall Wiley India
8. Mechanical System Design by Anurag Dixit SCITECH publication
9. Design of Machine Element/Machine Design by Kannaiah SCITECH publication
10. Design of Machine Element by Spotts/Shoup/Hornberger/Jayram/Venketesh Pierson Education
11. Machine Design by T H Wentzell Cengage Learning




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Machine Tool Control

23ME3502	PCC	Machine Tool Control	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Machine Tools

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

CO1	Explain the fundamental principles of machine control systems, their components, and their applications. (L2)
CO2	Develop mechanical and electrical analogies for translational and rotational systems(L3)
CO3	Apply PID controller tuning methods (Ziegler-Nichols, Cohen-Coon) to optimize controller performance. (L3)
CO4	Analyze the interfacing of sensors and actuators with control systems for real-time applications (L4)
CO5	Interpret the transient behavior of first and second order systems in response to standard inputs using transfer functions, and assess system performance based on damping ratio,
CO6	Analyze the working principles and applications of Programmable Logic Controllers (PLC) industrial automation (L4)

Course Outcomes	Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	1										3	
CO2	3	2										3	
CO3	3	2										3	
CO4	3	2										3	



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CO5	3	3										3	
CO6	3	2										3	

Course Contents:

Unit 1: Introduction to Machine Control Systems: Introduction to automation and control systems. Types of machine control systems (open-loop, closed-loop). Components of a machine control system (sensors, actuators, controllers). Applications of machine control systems in various industries	[6]
Unit 2: Mathematical Modeling of Machine Control System: Differential Equations and Transfer Functions, Block Diagram Representation, Mechanical Translational Systems, Rotational System, Grounded Chair Representation, Electrical Elements, Analogous Systems, Force – Voltage Analog, Force – Current Analog	[6]
Unit 3: Feedback Control Systems: Basic feedback control concepts. Proportional (P), Integral (I), and Derivative (D) control. PID controller tuning methods (Ziegler-Nichols, Cohen-Coon). Stability analysis (Routh-Hurwitz criterion, Root locus) Steady-state error analysis	[6]
Unit 4: Sensors and Actuators: Types of sensors (position, velocity, force, temperature). Types of actuators (DC motors, stepper motors, servo motors, pneumatic/hydraulic actuators). Sensor and actuator interfacing. Selection criteria for sensors and actuator	[6]
Unit 5: Transient Response: General form of transfer function, response of systems (first and second order) to various input, damping ratio and natural frequency, transient response specifications.	[6]
Unit 6: Control System Components and Controllers, Control Elements: Motors, Valves, Relays, Programmable Logic Controllers (PLC) Supervisory Control and Data Acquisition (SCADA)	[6]
Text Books: 1. Radhakrishnan P. – Computer Numerical Control Machines Covers CNC systems, servo control, and automation in machine tools. 2. Venkataraman K. – Motion Control of Machine Tools 3. HMT (Hindustan Machine Tools) – Mechatronic	
Reference Books: 1. Jayakumar V. & Ramesh Babu V. – Mechatronics and Machine Control Systems 2. Gopal K. Dubey – Fundamentals of Electrical Drives 3. M. Mahadevan & K. Balaveera Reddy – Design Data Handbook for Mechanical Engineering 4. Biswajit Mallick & Amitabha Bhattacharya – Advanced Machine Tool Design and Research	



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Heat Transfer

23ME3503	PCC	Heat Transfer	3-0-0	3 Credits
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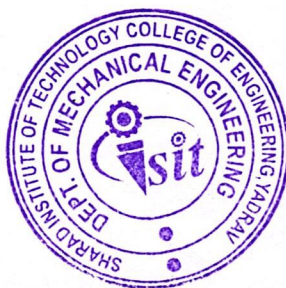
Teaching Scheme:	Evaluation Scheme:
Lecture: 3 hrs/week	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Thermal Engineering; Fluid Mechanics

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

CO1	Explain the basic laws of heat transfers (L2).
CO2	Solve one dimensional steady state heat conduction and unsteady state heat conduction problems (L3).
CO3	Determine effectiveness and efficiency of fins (L5).
CO4	Estimate heat transfer coefficient for free and forced convection heat transfer (L5).
CO5	Compare heat exchangers (L5)
CO6	Evaluate radiation view factors and solve radiation heat transfer problems (L5).

Course Outcomes	Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	1										3	
CO2	3	2										3	
CO3	3	2										3	
CO4	3	2										3	
CO5	3	2										3	
CO6	3	2										3	



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Course Contents:

Unit 1: Introduction to Heat and Mass Transfer Modes of heat transfer, basic laws of heat transfer, thermal conductivity and its variation with temperature for various engineering materials. Introduction to mass transfer: Modes of mass transfer, Fick's law of diffusion. Concept of Nano-fluids.	[6]
Unit 2: Steady state and unsteady state heat conduction One dimensional steady state heat conduction: heat conduction through plane wall, cylinder, sphere, critical radius of insulation for cylinder and sphere, the economic thickness of insulation. Unsteady state heat conduction: Lumped heat capacity analysis, Biot and Fourier number and their significance.	[6]
Unit 3: Heat Transfer through Extended Surfaces Boundary and initial conditions, types and applications of fins, heat transfer from rectangular and pin fins, fin effectiveness and efficiency, error estimation in temperature measurement in thermos-well.	[6]
Unit 4: Fundamentals of Convection Principles of convection, Classification of convection, convention heat transfer coefficient. dimensional analysis in free and forced convection, physical significance of the dimensionless numbers related to free and forced convection, empirical correlations for free convection and forced convection for heat transfer	[6]
Unit 5: Heat Exchangers and Phase Change Phenomenon Classification and types of heat exchangers, fouling factor, and overall heat transfer coefficient, heat exchanger analysis using LMTD and NTU methods for parallel and counter flow, design consideration of heat exchangers, compact heat exchangers Nucleate and film boiling phenomenon: drop wise and film wise condensation, Nusselt's theory of condensation nature of heat transfer in such phenomenon,	[6]
Unit 6: Radiation Fundamental concepts, Black body radiation, Planck's distribution law, Wien's displacement law and the Stefan-Boltzmann law, radiative properties of a surface, Radiation shape factor, Kirchhoff's law, Lambert's cosine law, Radiation shields, Gas radiation, Solar radiation,	[6]
Text Books: 1. "Engineering Heat and Mass Transfer", Mahesh M. Rathore, Laxmi Publications Pvt Limited, 2006N. P. Bali, A Text Book of Engineering Mathematics, Laxmi Publications, New Delhi. 2. "A Text Book on Heat Transfer", Dr. S. P. Sukhatme, Orient Longman, Hyderabad (2005) 3. P.K. Nag, "Heat Transfer", Tata McGraw Hill Publishing, 5th edition, 2008	



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4. Incropera and Dewitt, "Fundamentals of Heat and Mass Transfer", Wiley publications, 2nd edition, 2007
5. "Fundamentals of Heat and Mass Transfer", R. C. Sachdeva, Willey Eastern Ltd., 2012
6. "Heat and Mass Transfer", S. C. Arora and S. Domkoundwar, Dhanpat Rai and Sons, Delhi (2012)

Reference Books:

1. Yunus A. Cengel, "Heat Transfer: A Practical Approach", McGraw-Hill Higher Education, 2002.
2. J.P. Holman: "Heat Transfer"; McGraw-Hill, 1996
3. Latif M. Jiji, "Heat Conduction", Springer, 3rd edition, 2009.
4. H. Schlichting, K. Gersten, "Boundary Layer Theory" Springer, 8th edition, 2000.




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Renewable Energy Engineering

23ME3504A	PEC	Renewable Energy Engineering	3-0-0	3 Credits
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Teaching Scheme:	Evaluation Scheme:
Lecture: 3 hrs/week	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

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

CO1	Explain the different renewable energy sources (L2).
CO2	Identify the applications of solar energy (L3).
CO3	Develop on grid Solar Photovoltaic System (L3).
CO4	Classify wind mills (L2).
CO5	Compare different Renewable energy sources (L2).
CO6	Estimate Energy Utilization through Energy Audit Case Study (L5).

Course Outcomes	Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3											3	
CO2	3	2										3	
CO3	3	2										3	
CO4	3											3	
CO5	3	2										3	
CO6	3	2										3	




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Course Contents:

Unit 1: Introduction of Renewable Energy and Solar Radiation Renewable Energy resources, Estimation of renewable energy reserves in India, Solar energy, Solar geometry, Attenuation of solar radiation in Earth's atmosphere, Measurement of solar radiation.	[6]
Unit 2: Solar Collectors and Solar Energy Applications Flat Plate Solar Collectors: Construction of collector, material, selection criteria for flat plate collectors, testing of collectors, Limitation of flat plate collectors, Introduction to ETC. Concentrating type collectors: Types of concentrators, advantages, paraboloid, parabolic trough, Heliostat concentrator, Selection of various materials used in concentrating systems, tracking. Solar Energy Applications: Air/Water heating, Space heating/cooling, solar drying, and solar still	[6]
Unit 3: Solar Photovoltaic System Operating Principle of Photovoltaic cell concepts, Photo-cell materials, Cell module array, Series and parallel connections, Maximum power point tracking, Design of standalone system with battery and AC or DC load (Descriptive Treatment), Applications	[6]
Unit 4: Wind Energy and Biomass Types of wind mills, Wind power availability, and wind power development in India. Evaluation of sites for bio-conversion and bio-mass, Bio-mass gasification with special reference to agricultural waste	[6]
Unit 5: Introduction to Other Renewable Energy Sources Tidal, Geo-thermal, OTEC; Mini/micro hydro-electric, Geo-thermal, Wave, Tidal System design, components and economics.	[6]
Unit 6: Energy Auditing Elements and concepts, Types of energy audits, Instruments used in energy auditing. Economic Analysis: Cash flows, time value of money, formulae relating present and future cash flows-single amount, uniform series	[6]
Texts books: 1. Chetansingh Solanki, Renewable Energy Technologies, Prentice Hall of India, 200	
References: 1. S. P. Sukhatme, Solar Energy: Principles of Thermal Collection and Storage, Tata McGraw Hill Publications, New Delhi, 1992. 2. G. D. Rai, Solar Energy Utilization, Khanna Publisher, Delhi, 1992	




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Dynamics of Machines

23ME3504B	PEC	Dynamics of Machines	3-0-0	3 Credits
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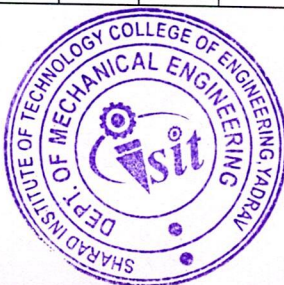
Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Basic mechanical Engineering, Kinematics of Machines

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

CO1	Explain the gyroscopic couple and its effects on stability and control in vehicles, ships, and aircraft. (L5)
CO2	Apply analytical methods to evaluate the performance of governors in different operating conditions. (L3)
CO3	Determine position and magnitude of the balance mass using analytical and graphical methods. (L5)
CO4	Explain the principles governing different types of vibrations, including free, forced, damped, and undamped systems. (L2)
CO5	Determine natural frequencies, damping coefficients, and system responses using analytical and computational techniques. (L5)
CO6	Determine vibration amplitude, and transmissibility in forced vibration systems using analytical methods. (L5)

Course Outcomes	Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	1										2	
CO2	3	1										2	
CO3	3	1										2	



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CO4	3	1										2	
CO5	3	1										2	
CO6	3	1										2	

Course Contents:

Unit 1: Angular Motion Gyroscopes – effect of precession – motion on the stability of moving vehicles such as motorcycle – motorcar – aero planes and ships. Static and Dynamic Force, Analysis of planar mechanisms.	[6]
Unit 2: Governors Watt, porter, spring loaded governors – Hartnell with auxiliary springs. Sensitiveness, isochronism and hunting.	[6]
Unit 3 Balancing Balancing of rotating masses single and multiple – single and different planes, use analytical and graphical methods. Primary, secondary, and higher balancing of reciprocating masses. analytical and graphical methods, unbalanced forces and couples, examination of “V” multi cylinder in line and radial engines for primary and secondary balancing	[6]
Unit 4: Fundamentals of Vibrations Basic concepts and definitions, vibration measuring parameters- Displacement, Velocity and acceleration, Free and forced vibrations, Equivalent Springs. Types of damping.	[6]
Unit 5: Single degree of freedom systems Free vibrations with and without damping (Rectilinear, Torsional & Transverse), degree of damping. Logarithmic decrement, equivalent viscous damping, Coulomb damping.	[6]
Unit 6: Forced vibrations Forced vibrations with viscous damping, magnification factor, frequency response curves, vibration isolation and transmissibility, forced vibrations due to support excitation.	[6]
Text Books: 1. Theory of Machines by Rattan S.S. (Tata McGraw Hill) 2. Theory of Machines & Mechanisms by Shigley (Tata McGraw Hill) 3. Mechanical Vibrations by Grover G.K., Nemchand Publi. 4. Mechanism and Machine Theory by Rao, Dukupati, New Age International.	
Reference Books: 1. Theory of Machines by Dr. V.P.Singh, Dhanpat Rai Publications. 2. Theory of Machines by Ballaney, Khanna Publications. 3. Theory of Machines by Jagdishlal, Metropolitan Publi. 4. Theory of Machines by R.K.Bansal (Laxmi Publications) 5. Mechanical Vibrations by S.S.Rao, Pearson Education Publi.	



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6. Theory of vibrations with applications by W.T. Thomson (CBS Publications)
7. Mechanical vibrations by Tse, morse and Hinkle (PHI Publications)
8. Mechanical Vibrations by V.P. Singh, Dhanpat Rai Publications.
9. Solved vibrations in Mechanical Vibrations, Schaums Series
10. Mechanisms and Dynamics of machines by J. Srinivas (SciTech Publications)




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Additive Manufacturing and Reverse Engineering

23ME3504C	PEC	Additive Manufacturing and Reverse Engineering	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 Hours/Week	CA-I:10 Marks CA-II:10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Manufacturing Processes, Engineering Material Sciences, engineering graphics, CAD

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

CO1	Explain the working principles and process parameters of additive manufacturing processes (L2)
CO2	Analyze the working principles, process parameters, and performance characteristics of liquid-based and solid-based additive manufacturing systems (L4)
CO3	Distinguish the requirements of powder-based additive manufacturing systems to assess their suitability for specific applications and part requirements. (L4)
CO4	Compare different post-processing techniques to select appropriate methods for improving the quality and usability of additive manufactured parts. (L4).
CO5	Examine the methodologies and abstraction levels involved in reverse engineering in analyzing existing product designs. (L3)
CO6	Classify scanning technologies and geometric modeling techniques determine appropriate methods for reconstructing complex physical objects (L4)

Course Outcomes	Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2		2							3	2
CO2	3	2	3		2							3	2
CO3	3	2	3		2							3	2



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CO4	2	1	3		2						2	2
CO5	2	2	2		2						2	2
CO6	3	2	2		3						3	3

Course Contents:

Unit 1: Introduction to Additive Manufacturing Introduction to Additive Manufacturing (AM), Need - Development of AM systems – AM process chain - Impact of AM on Product Development, rapid tooling, Classification of AM processes-Benefits- Applications, materials for AM	[6]
Unit 2: Liquid Based And Solid Based Additive Manufacturing Systems Stereolithography Apparatus (SLA): Principle, pre-build process, part-building and post-build processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications. Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and applications.	[6]
Unit 3: Powder Based Additive Manufacturing Systems: Selective Laser Sintering (SLS): Principle, process, Indirect and direct SLS- powder structures, materials, post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and applications– Case Studies.	[6]
Unit 4: Methods for Post-processing of Additive Manufacturing parts Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using thermal techniques & non-thermal techniques, Part Cleaning and finishing, Process Strength & limitations.	[6]
Unit 5: Reverse Engineering Need of reverse engineering, Methodologies for Reverse Engineering, understanding of Reverse Engineering through example, reasons for reverse engineering, conceptual System Reasons for Reverse Engineering, Difficulties in Reverse Engineering, Levels of abstraction: Application level, functional level, structural level.	[6]
Unit 6: Tools and Techniques for reverse engineering Object scanning, Contact scanners, Non-contact scanners, destructive method, Point data processing, pre processing and post processing of captured data, geometric modeling techniques- wire, frame, surface and solid modeling.	[6]
Text Books: - Additive Manufacturing by C.P. Paul, A.N. Jinoop. - Additive Manufacturing by Hari Prasad, A.V. Suresh. - Rapid Prototyping and Engineering Applications, Frank W. Liou, CRC Press - Introduction to Rapid Prototyping, Amitav Ghosh, North West Publication, New Delhi. - Reverse Engineering, A.Ingale, Katherryn, McGraw hill, 1994	
Reference Books:	



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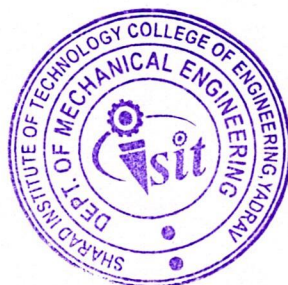
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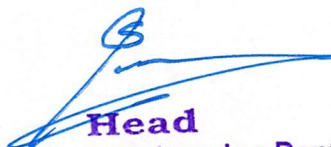


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1. Rapid Manufacturing, Flham D.T & Dinjoy S.S Verlog London 2001.
2. Rapid Prototyping Materials, Gurumurthi, IISc Bangalore
3. Rapid Automated, Lament wood. Indus press New York.
4. Stereo Lithography and other RP & AM Technologies, Paul F. Jacobs: SME, NY1996.
5. Rapid Prototyping, Terry Wohlers Wohler's Report2000" Wohler's Association2000.




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Heat Transfer Laboratory

23ME3505	PCC	Heat Transfer Laboratory	0-0-2	1 Credit
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Teaching Scheme:	Evaluation Scheme:
Lecture: - Practical: 2 hrs./week	CA-I: 15 Marks CA-II : 15 Marks End Semester Exam: 20 Marks

Pre-Requisites: Thermodynamics, Fluid Mechanics

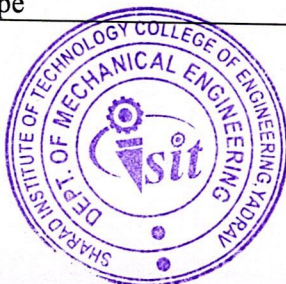
Course Outcomes: At the end of the course, students will be able to:

CO1	Determine thermal conductivity of materials and combinations (L5)
CO2	Estimate heat transfer coefficients in natural and forced convection heat transfer and demonstrate heat pipe (L5)
CO3	Determine emissivity and Stefan Boltzmann constant (L5).

Course Outcomes	Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2										3	
CO2	3	2										3	
CO3	3	2										3	

The Heat Transfer Laboratory experiments

1. Determination of thermal conductivity of insulating powder/ Metal rod.
2. Determination of thermal conductivity of material in Composite wall / Lagged pipe.
3. Determination of local and average heat transfer coefficient in Natural convection heat transfer from a vertical cylinder.
4. Determination of Heat Transfer Coefficient under forced convection to air from a heated pipe.
5. Determination of emissivity of a Nonblack surface.
6. Determination of Stefan Boltzmann Constant.
7. Determination of Critical Heat Flux.
8. Determination of overall heat transfer coefficient and effectiveness in a Heat Exchanger.
9. Study and Demonstration of Heat Pipe




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Design of Machine Element-I Laboratory

23ME3506	PCC	Design of Machine Element-I Laboratory	0-0-2	1 Credit
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Teaching Scheme	Evaluation Scheme
Practical: 2 hrs/week	CA-I: 25 Marks CA-II: 25 Marks

Pre-Requisites: Basic mechanical Engineering, Strength of Materials, Kinematics of Machines

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

CO1	Select suitable material from design data book for the given component. (L3)
CO2	Design simple machine elements like Knuckle, turnbuckle, Lever, Shaft, Keys and Couplings and create 3D model of the same. (L6)
CO3	Design of helical compression springs. (L6)
CO4	Design of screw jack. (L6)
CO5	Design mechanical components to withstand fluctuating loads while considering stress concentrations, material properties, and fatigue life. (L6)

Course Outcomes	Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3						1				2	2	
CO2	3	2	3	1	2		2	3	1		2	2	
CO3	3	2									2	2	2
CO4	3	2									2	2	
CO5	3	2									2	2	

The Machine Design-I Laboratory Lab consists of list of experiment as follows

- 1. The term work shall consist of two design projects based on design, Drawing of the following.**
 1. Knuckle joint or turn buckle.
 2. Rigid or flexible flange coupling.
- Each design project draft through CAD software, consist of assembly drawings with a part list and

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overall dimensions and other drawings of individual components.

Assignment based on the following.

1. Selection of materials for various engineering applications showing their IS codes, composition and properties
2. Problems on design of helical Springs subjected to static load.
3. Problems on design of power screws.
4. Problems on fluctuating loads and fatigue life.

Text Books:

1. V. B. Bhandari, "Design of Machine Elements", Tata McGraw Hill Publications, New Delhi, 2008.
2. R. L. Norton, "Machine Design: An Integrated Approach", Pearson Education Singapore, 2001
3. Machine Design R.S. Khurmi & J.K. Gupta S. Chand publication.
4. Machine design S G Kulkarni McGraw Hill Education Publications
5. Introduction to Machine design V B Bhandari McGraw Hill Education Publications.
6. Design Of Machine Elements Vol I, Vol II J.B.K. Das , P.L. Srinivas Murthy Sapna publication
7. Machine Component Design William Orthwein Jaico publication

Reference Books:

1. R. C. Juvinall, K. M. Marshek, "Fundamental of machine component design", John Wiley & Sons Inc., New York, 3rd edition, 2002.
2. J. Hamrock, B. Jacobson and Schmid Sr., "Fundamentals of Machine Elements", International Edition, New York, 2nd edition, 1999.
3. S. Hall, A. R. Holowenko, H. G. Langhlin, "Theory and Problems of Machine Design", Schaum's Outline Series, Tata McGraw Hill book Company, New York, 1982.
4. J. E. Shigley and C. Mischke, "Mechanical Engineering Design", Tata McGraw Hill Publications, 7th edition, 2004.
5. M. F. Spotts, "Design of Machine Elements", Prentice Hall of India, New Delhi.
6. Machine Design by Robert L. Norton, Tata McGraw Hill Publication
7. Fundamentals of Machine Component Design by Juvinall Wiley India
8. Mechanical System Design by Anurag Dixit SCITECH publication
9. Design of Machine Element/Machine Design by Kannaiah SCITECH publication
10. Design of Machine Element by Spotts/Shoup/Hornberger/Jayram/Venketesh Pierson Education
11. Machine Design by T H Wentzell Cengage Learning

Design Data Handbook:

1. Design Data Hand Book, K. Lingaiah, McGraw Hill, 2nd Ed.
2. Data Hand Book, K. Mahadevan and Balaveera Reddy, CBS Publication
3. Design Data Hand Book, H.G. Patil, I. K. International Publisher, 2010.
4. Design data PSG College of Technology Coimbatore



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CAD/CAM Laboratory

23ME3507	VSEC	CAD/CAM Laboratory	0-0-2	1 Credit
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Teaching Scheme:	Evaluation Scheme:
Practical: 2 hrs./week	CA-I: 15 Marks CA-II : 15 Marks Practical and Oral Exam: 20 Marks

Pre-Requisites: Engineering graphics; machine drawing and CAD

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

CO1	Extend knowledge of machine drawing and computer aided drafting (CAD) for part modeling (L2)
CO2	Construct CAD part models, assembly model and drafting of machine elements using CAD software (L3)
CO3	Make use of CAM software to develop part program for turning and milling operations (L3).

Course Outcomes	Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	1			3			1			2	1	2
CO2	3	2			3			1			2	1	2
CO3	3	2			3			1			2	1	2

The CAD/CAM Laboratory consists of following experiments

1. Part modeling of machine elements using CAD software.
2. Assembly modeling of engineering products using CAD software.
3. Drafting of Parts and Assembly of engineering assembly using CAD software.
4. Develop CAM programs for CNC Turning operations using CAM software (for two jobs).
5. Develop CAM programs for VMC Milling operations using CAM software (for two jobs).



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Mini Project-III

23ME3508	CEP	Mini Project III-Hackathon	0-0-2	Audit
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Teaching Scheme	Evaluation Scheme
Practical: 2 hrs/week	CA-I: - 25 Marks CA-II: -25 Marks

Pre-Requisites: Mini Project, Mini Project II

About Hackathon

The project is a part of addressing societal and industrial needs. Hackathon is one of the platforms where students will solve real world challenges. This Course focuses on the selection of methods/engineering tools/analytical techniques for problem solving.

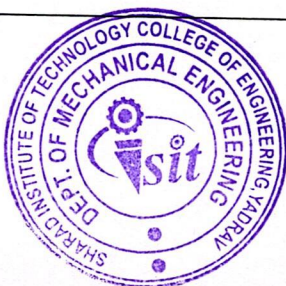
Through this course, students will gain the understanding of engineering basics and ideas, gain practical experience, have the opportunity to display their skills and learn about teamwork, financial management, communication skills and responsibility

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

CO1	Select the appropriate method for solving the problem
CO2	Make use of various engineering techniques and tools to give a solution
CO3	Justify the methods /tools used to develop the solution
CO4	Design / simulate the model/ project work
CO5	Describe the solution with help of a project report and presentation
CO6	Conclude the outcomes of project.

Course Contents:

Week 1: Survey Design-1 Ensure case study group students have made necessary communication and done a preparatory visit.	[2]
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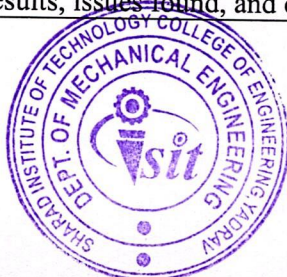


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• Watch the lecture on survey design and study the notes. • Prepare a questionnaire and try it out with your group members as mock.	
Week 2: Survey Design-2 • Review survey questionnaire prepared by case study groups. • Decide sampling strategy. • Prepare a detailed schedule for fieldwork	[2]
Week 3: Fieldwork • Data Collection: Collect quantitative data (e.g., statistics, usage metrics) and qualitative data (e.g., user stories, testimonials). • Use data collection tools like questionnaires, observation checklists, and digital analytics. • Ensure data accuracy and reliability through proper sampling and recording methods.	[2]
Week 4: Trails and Experimentation-1 • Initial Setup and Configuration • Concept Validation • Feasibility Testing	[2]
Week 5: Trails and Experimentation-2 • Prototyping • Functionality Testing	[2]
Week 6: Trails and Experimentation-3 • Bug Identification and Fixing • Integration Testing • Security Testing • 75% Presentation has to be conducted by mentor/guide based on above activity.	[2]
Week 7 : Results • Coordinator has to check and verify below points in term of result: • Functional Performance • Accuracy and Precision • Efficiency • Safety	[2]
Week 8: Validation • Coordinator has to check and verify below points in term of validation: • Testing and Verification • Compliance with Standards	[2]
Week 9: Integration Testing • Validate that the hardware integrates seamlessly with other systems or components as intended • Perform compatibility tests with software, other hardware, and network systems.	[2]
Week 10: Documentation and Reporting • Maintain comprehensive documentation of design, development, testing, and validation processes • Provide detailed reports on test results, issues found, and corrective actions taken.	[2]

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Week 11: Final Presentation 100% Presentation has to be conducted by mentor/guide based on above activity. - Prototype/Final Software solution is mandatory at the time of final presentation along with report	[2]
Week 12: Exhibition Mini project exhibition will be schedule with interdepartmental evaluation.	[2]



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Industrial/Field Training

23ME3509	VSEC	Industrial/Field Training	0-0-0	Audit
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Teaching Scheme	Evaluation Scheme
	End Semester Exam: 50 Marks

Pre-Requisites: Basic knowledge of all courses

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

CO1	Develop technical skill in real industrial situations.
CO2	Develop interpersonal communication skills.
CO3	Discuss activities and functions of the industry in which the Internship/training has done.

Course Outcomes	Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	2	1		1	1	2	2	2	3	1
CO2	3	3	3	2	1		1	1	2	2	2	3	1
CO3	3	3	3	2	1		1	1	2	2	2	3	1

Course Contents:

Course Description:

Internship / Training is educational and career development opportunity, providing practical experience in a field or discipline. At the end of the **Fourth semester**, every student should undergo practical training in an industry / professional organization / Research laboratory with the prior approval of the HoD/TPO/Principal of the college and submit the report along with the completion certification from the Industry/ Organization. The report will be evaluated during the **Fifth** semester by the department.



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Guideline for Students:-

1. Arrive at work as per schedule, ready to work and stay for the agreed upon time.
2. Present yourself in a professional manner at all times, including being appropriately dressed at workplace.
3. Communicate any concerns with your supervisor and the internship/Training coordinator in a timely manner and respectfully.
4. Demonstrate enthusiasm and interest in what you are doing, ask questions and take the initiative as appropriate.
5. Complete and submit assigned tasks by designated timelines. Meet all deadlines.

Student's Diary/ Daily Log

The main purpose of writing daily diary is to cultivate the habit of documenting and to encourage the students to search for details. It develops the students' thought process and reasoning abilities. The students should record in the daily training diary the day to day account of the observations, impressions, information gathered and suggestions given, if any. It should contain the sketches and drawings related to the observations made by the students.

The daily training diary should be signed after every day by the supervisor/ in charge of the section where the student has been working. The diary should also be shown to the Faculty Mentor.

Student's Diary and Internship Report should be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry to the SITCOE immediately after the completion of the training. It will be evaluated on the basis of the following criteria:

- Regularity in maintenance of the diary.
- Adequacy and quality of information recorded.
- Drawings, sketches and data recorded.
- Thought process and recording techniques used.
- Organization of the information.

Internship Report

After completing the internship, the student should prepare a comprehensive report to indicate what he/she has observed and learned in the training period. Daily diary will also help to a great extent in writing the industrial report since much of the information has already been incorporated by the student into the daily diary. The competent authority should sign the training report. The Internship report should be evaluated on the basis of following criteria:

- i. Originality.
- ii. Adequacy and purposeful write-up.



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| iii. | Organization, format, drawings, sketches, style, language etc. |
| iv. | Variety and relevance of learning experience. |
| v. | Practical applications, relationships with basic theory and concepts taught in the course. |




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Management Information System

23MEMDA3	MDM	Management Information System	3-0-0	3 Credits
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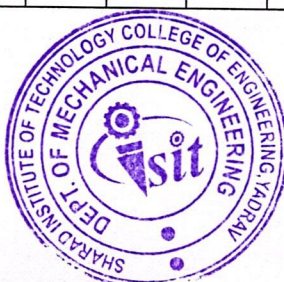
Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Operation research and management

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

CO1	Explain the role, scope, and impact of MIS in business organizations. (L2)
CO2	Explain the classifications and dimensions of information and systems. (L2)
CO3	Apply decision-making frameworks to hypothetical or real business situations. (L3)
CO4	Apply principles of information quality management in the development of MIS. (L3)
CO5	Apply MIS principles to optimize operations in different departments of an organization. (L3)
CO6	Apply ERP concepts to align business processes such as SCM and CRM. (L3)

Course Outcomes	Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2									1	2	1	
CO2	2									1	2	1	
CO3	3									2	2	1	
CO4	3									2	2	1	
CO5	3									2	2	1	
CO6	3									2	2	1	



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Course Contents:

Unit 1: Introduction to Management Information System Management Information System (MIS)- concept and definition, Role of MIS, Impact of the Management Information System, Nature and scope of MIS, Characteristics of MIS, Types of MIS, Challenges of MIS.	[6]
Unit 2: Information Systems and Organization Concepts Introduction, Information- A definition, classification of information, information quality, dimensions of information, System- A definition, Kinds of systems, elements of system, information system, Organization- A concept, and impact of information system on Organization.	[6]
Unit 3: Decision Making Process Introduction, Decision-Making- A concept, Simons Model of Decision Making, Programmed and Non- Programmed decisions, Decision Support Systems, Characteristics and components of Decision Support System.	[6]
Unit 4: Development of Management Information System (MIS) Development of long range plans of the MIS, Implementation of the Management Information System, Management of Information Quality in the MIS, Organization for Development of MIS, Features contributing to Success and Failures.	[6]
Unit 5: Applications of MIS in Manufacturing and Service Sector Introduction, Personal Management (PM), Financial Management (FM), Production Management (PM), Raw materials Management (RMM), MIS applications in Service Industry.	[6]
Unit 6: Introduction to Enterprise Management Systems Enterprise Management System (EMS), Enterprise Resource Planning (ERP) system, Benefits of the ERP, ERP Implementation, Supply Chain Management, Customer Relationship Management.	[6]
Text Books: 1. Management Information Systems, Effy OZ, Thomson Learning/Vikas Publications, Edition 5, Revised edition 2018. 2. Management Information Systems, James A. O'Brein, George M. Marakas, Ramesh Behl Tata McGraw-Hill, 11 th Edition 2019	
Reference Books: 1. Management Information System, W.S Jawadekar, Tata Mc Graw Hill Publication, 6th Edition 2020. 2. MIS: Management Perspective, D.P. Goyal, Macmillan Business Books, 4th Edition 2014. 3. MIS and Corporate Communications, Raj K. Wadwha, Jimmy Dawar, P. Bhaskara Rao, Kanishka Publishers. 4. MIS: Managing the digital firm, Kenneth C. Landon, Jane P. Landon, Pearson Education 13 th edition 2014. 5. Management Information System, David Kroenke, Tata Mc Graw Hill Publication, 2 nd edition, 1992	




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Aero Engine Gas Turbine

23MEMDB3	MDM	Aero Engine Gas Turbine	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Engineering Thermodynamics, Fluid Mechanics

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

CO1	Explain the working principles of gas turbine engines and their components. (L2)
CO2	Apply control volume analysis to different components of a gas turbine engine.(L3)
CO3	Compare fan driven by Low Pressure Turbine (LPT) and the compressor driven by the High Pressure Turbine (HPT) (L2)
CO4	Classify various cooling techniques used in gas turbine engines (L2)
CO5	List characteristics of turboprop engines.(L4)
CO6	Identify recent advancements in aircraft engine technology. (L3)

Course Outcomes	Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	1										1	
CO2	3	2										1	
CO3	3	2										1	
CO4	3											1	
CO5	3	2										1	



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CO6	3											1	
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Course Contents:

Unit 1: Fundamentals of Gas Turbine Engines and Aero engine Performance Introduction to gas turbine engines used in Aero engines; Mechanical creation of thrust by all components; fundamentals of Propulsive efficiency; Thermal efficiency; Propeller efficiency; Overall efficiency; Takeoff thrust; Specific fuel consumption; Total Equivalent Horsepower.	[6]
Unit 2: Control Volume Analysis and Performance of Gas Turbine Components Control Volume analysis of Inlet Diffuser; Compressor; Combustion chamber; Turbine and Exhaust Nozzle; Adiabatic and Polytropic efficiencies for Compressors and Turbines; Shaft Energy Balance; Use of various components and their special needs in gas turbine engine.	[6]
Unit 3: Forward Fan Unmixed Two-Spool Engines Forward fan unmixed two-spool engines; The fan and low-pressure compressor on one shaft; Fan driven by the Low Pressure Turbine (LPT) and the compressor driven by the High Pressure Turbine (HPT); Discussions based on effect of various cycle parameters on performance of engine	[6]
Unit 4: Cooling and Materials for Gas Turbines Cooling techniques: film cooling; internal cooling, and impingement cooling; High-temperature materials and coatings; Thermal barrier coatings (TBC) and super alloys	[6]
Unit 5: Turbo-Prop Engines – Design, Performance, and Thermal Cycle Analysis Introduction to turbo prop engines; Advantages and disadvantages of turboprop engines; Thermal cycle analysis of single spool and two spool Turboprop Engines.	[6]
Unit 6: Recent Advancements in Aircraft Engine Technologies Recent advancements aircraft engines; Aft fan turbofan engine; Turbofan engine with intercooler and regeneration; Hybrid, Electric; and Hydrogen-Based Propulsion	[6]
Text Books: 1. "Introduction to Aircraft Gas Turbine Engines" by B. H. K. Narayana 2. "Principles of Jet Propulsion and Gas Turbines" by D. P. Mishra 3. Saeed Farokhi, Aircraft Propulsion, 2009, John Wiley & Sons, Inc. 4. Hill Philip, Peterson Carl, Mechanics and Thermodynamics of Propulsion, Second edition, Pearson	
Reference Books: 1. "Elements of Propulsion: Gas Turbines and Rockets" by J.D. Mattingly and H. von Ohain 2. "Aircraft Propulsion" by Saeed Farokhi 3. Roy Bhaskar, Aircraft Propulsion, 2008, Elsevier (India) 4. J. H. Horlock, Advanced gas turbine cycles, 2003, Elsevier science Ltd. 5. "Aircraft Gas Turbine Engine Technology" by Irwin E. Treager	




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Sensor Technology: Physics, Fabrication and Circuits

23MEMDC3	MDM	Sensor Technology: Physics, Fabrication and Circuits	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 Hours/Week	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Fundamentals of Mechatronics.

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

CO1	Explain the different parameters involved in sensors. (L2)
CO2	Compare various types of capacitive sensors. (L2)
CO3	Classify the different types of thermal sensors. (L2)
CO4	Choose the appropriate sensor applications. (L3)
CO5	Select the feasible sensor fabrication technique. (L3)
CO6	Identify the different circuits involved in sensor systems. (L3)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3				2	2					1	3	2
CO2	3				2	2					1	3	2
CO3	3				2	2					1	3	2
CO4	3				2	2					1	3	2
CO5	3				2	2					1	3	2
CO6	3				2	2					1	3	2



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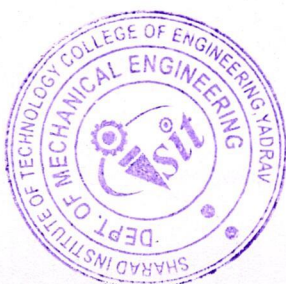


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Course Contents:

Unit 1: Basics of Sensors Sensors and Transducers – Basics, Introduction to Sensors, Materials for Sensors, Multidisciplinary Aspects of Sensors, Introduction to Sensor Parameters, Sensor Parameters-II, Sensor Parameters-III, Sensor Parameters-IV, Sensor Parameters-V.	[6]
Unit 2: Physics of Sensors Introduction: Physics of Sensors, Capacitive Sensor Architecture, Different Types of Capacitive Sensors.	[4]
Unit 3: Physics of Thermal and Chemical Sensors Thermal Sensors Basics, Dynamic Condition of Thermal Sensors, Classification of Thermal Sensors, Chemical Sensor Basics, Electrochemical Sensors, Impedimetric Sensors.	[6]
Unit 4: Physics of Other Sensors Physics of Optical Sensors, Physics of Magnetic Sensors, Physics of Acoustic Sensors, Physics of Microfluidic Sensors, Various Sensor Geometries and Examples.	[6]
Unit 5: Sensor Fabrication and Characterization Techniques Microfabrication Technologies, Deposition Techniques, Physical Vapor Deposition, Chemical Vapor Deposition, Patterning Techniques, Lithography Techniques, Basics of Etching Techniques, Dry Etching Techniques, Optical and Electron Microscopy, Other Microscopy Techniques.	[8]
Unit 6: Sensor Systems and Circuits Sensor System: Basic Circuits, Amplifier Circuits, Instrumentation Amplifier, Filter Circuits.	[6]
Text Books: 1. Sensors and Transducers, I.R. Sinclair, Third Edition, Newnes Oxford, 2001. 2. Measurement Systems: Application & Design, E.A. Doebelin, McGraw Hill, 1990.	
Reference Books: 1. Design of Analog CMOS Integrated Circuits, B. Razavi, McGraw-Hill Int. Edition, 2001. 2. A. Paul, M. Bhattacharjee, R. Dahiya, Solid-State Sensors, Wiley+IEEE, 2023.	




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Language Skill- III

23HSSM05	VEC	Language Skill- III	0-0-2	Audit
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Teaching Scheme:	Evaluation Scheme:
Lecture: NA Tutorial: NA Practical: 2 hrs/week	CA-I: 25 Marks CA-II: 25 Marks

Pre-Requisites: Language Skill and II

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

CO1	Develop a program to read input and return output.
CO2	Develop a program using data types, Strings and variables
CO3	Develop a program using Unary, Binary and Ternary operator
CO4	Develop a program using Conditional and Logical statements.

Mapping of CO's with PO's:

CO's\ PO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PSO1	PSO2
CO1	2	1			1		1	1			1		
CO2	2	1			1		1	1			1		
CO3	2	1			1		1	1			1		
CO4	2	1			1		1	1			1		
Course Code	2	1			1		1	1			1		

1. Write a Python program to print "Hello, World!" o Objective: Understand basic syntax, indentation, and output.	[2]
2. Write a program to demonstrate the use of different types of comments in Python. o Objective: Single-line and multi-line comments.	[2]



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3. Write a Python program that declares different types of variables and displays their data types using the type() function. ○ Objective: Variables, data types, and type identification.	[2]
4. Write a program to demonstrate type casting and type conversion between int, float, and string. ○ Objective: Type conversion, casting functions.	[2]
5. Write a Python script to perform string operations such as slicing, concatenation, upper(), lower(), and len(). ○ Objective: String manipulation and built-in functions.	[2]
6. Write a program to demonstrate the use of all arithmetic, logical, and bitwise operators. ○ Objective: Operator functionality.	[2]
7. Write a Python program to use membership and identity operators with examples. ○ Objective: in, not in, is, is not.	[2]
8. Write a Python program using a ternary operator to find the larger of two numbers. ○ Objective: Conditional (inline) expressions.	[2]
9. Write a program that takes user input for age and prints whether the person is a child, teenager, adult, or senior citizen using if-elif-else. ○ Objective: Conditional statements and user input.	[2]
10. Write a program to find the sum of the first 10 natural numbers using a while loop. ○ Objective: Looping with while.	[2]
11. Write a Python script to display the multiplication table of a number using a for loop. ○ Objective: Looping with for and range().	[2]
12. Write a program that uses break, continue, and pass statements in appropriate looping scenarios. ○ Objective: Loop control statements.	[2]
Text Books: 1. Python Projects (Author: Laura Cassell, Alan Gauld) Wrox publication 2. murach's Python Programming. Aut.:Michael Urban, Joel Murach, murach's Publication.	
Reference Books: 1. Fundamentals of Python (First Program) Cengage MINDTAP Publication 2nd Edition. Author: K.A. Kambert	



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Aptitude Skill-III

(Verbal Ability)

23HSSM06	VEC	Aptitude Skills- III	1-0-0	Audit
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Teaching Scheme:	Evaluation Scheme:
Lecture: 1 hr	CA-I: 25 Marks CA-II: 25 Marks

Pre-Requisites: Aptitude Skills-I and II

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

CO1	Solve the questions on ordering of words & Parts of Speech
CO2	Organize contents of Business Communications such as CV, emails and letters.
CO3	Solve the questions based on jumbled paragraphs and reading comprehension.
CO4	Solve the questions on spotting error and sentence correction.
CO5	Summarize proceedings of any event or conference.
CO6	Discuss about current and critical issues during group discussion.

CO PO Mapping:

CO's\ PO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PSO1	PSO2
CO1							1		1		1		
CO2							1		1		1		
CO3							1		1		1		
CO4							1		1		1		
Course Code							1		1		1		



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Course Contents:

Unit 1	Parts of Speech, Punctuation Word Family (Using the same word as different Parts of Speech)	[2] [2]
Unit 2	Analogy, Letter Writing (Formal), E-Mail Writing, CV Writing	[2]
Unit 3	Reading Comprehension, Paragraph Jumbles	[2]
Unit 4	Spotting Errors (in different parts of sentence), Subject-Verb Agreement Sentence Correction, Sentence Completion	[2]
Unit 5	One Word Substitution, Narrating Events/Reports, Summary/Precis Writing	[2]
Unit 6	Dialogue writing Group Discussion, Interview Skills (Using formal notations & gestures etc.)	[2]

Text Books:

1. Raymond Murphy, Essential English Grammar with Answers, Murphy
2. Objective General English by R.S. Aggarwal, S Chand Publishing; Revised edition (15 March 2017)

Reference Books:

1. Rao and ,D,V,Prasada, Wren & Martin High School English Grammar and Composition Book, S Chand Publishing, 2017
2. Murphy, Intermediate English Grammar with Answers, Cambridge University Press; Second edition




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Design of Machine Elements-II

23ME3601	PCC	Design of Machine Elements-II	3-0-0	3 Credits
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Teaching Scheme:	Evaluation Scheme:
Lecture: 3 hrs/weeks	CA I: 10 Marks CA1: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Analysis of Mechanical Elements, Machine Design-I

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

CO1	Select appropriate rolling contact bearing for various mechanical applications using manufacturer catalogues (L3).
CO2	Analyze hydrodynamic and hydrostatic sliding contact bearings using dimensionless parameters (L4).
CO3	Design spur gears considering bending strength, and wear strength ([L6)
CO4	Design helical and bevel gears by considering bending strength and pitting strength. (L6)
CO5	Design worm gear (L6)
CO6	Construct structure diagrams, ray diagrams, and speed diagrams to design multi-stage constant mesh gearboxes for machine tool applications. (L6)

Course Outcomes	Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2									2	2	
CO2	3	2									2	2	
CO3	3	2									2	2	
CO4	3	2									2	2	
CO5	3	2									2	2	
CO6	3	2									2	2	



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Course Contents:

Unit 1: Design of Rolling contact Bearings Classification, selection of bearing type for given application, Static and dynamic load carrying capacity, selection of deep groove ball bearings from manufacturer's catalogue, Lubrication and mountings of rolling contact bearings.	[6]
Unit 2: Design of Sliding Contact Bearings Design and analysis of sliding contact bearings, hydrodynamic and hydrostatic bearings, numerical solutions using dimensionless parameters of hydrodynamic and hydrostatic bearings.	[6]
Unit 3: Design of Spur Gears Terminology of spur gear, Force analysis, Gear tooth failures, Design based on reversed bending stresses, and wear strength.	[6]
Unit 4: Design of Helical and Bevel Gears: Design of helical and bevel gears based on fluctuating bending strength and pitting strength.	[6]
Unit 5: Design of Worm Gears: Terminology of worm gears, Proportions of worm gears, Force analysis of worm gears, Design of worm gears.	[6]
Unit 6: Design of Gearboxes for Machine Tool Applications: Determination of variable speed range, Structure diagram, Ray diagram and Speed diagram, Design of constant mesh single/ multi speed gearboxes with multiple stages.	[6]
Text Books: 1. V. B. Bhandari, "Design of Machine Elements", Tata McGraw Hill Publications, New Delhi, 2008. 2. R. L. Norton, "Machine Design: An Integrated Approach", Pearson Education Singapore, 2001. 3. A Machine Design R.S. Khurmi & J. K. Gupta S. Chand publication 4. Machine design S G Kulkarni McGraw Hill Education Publications	
Reference Books: 1. PSG Design Data Book, Third Edition, 1978. 2. R. C. Juvinall, K. M. Marshek, "Fundamental of machine component design", John Wiley & Sons Inc., New York, 3rd edition, 2002. 3. J. Hamrock, B. Jacobson and Schmid Sr., "Fundamentals of Machine Elements", International Edition, New York, 2nd edition, 1999. 4. A. S. Hall, A. R. Holowenko, H. G. Langhlin, "Theory and Problems of Machine Design", Schaum's Outline Series, Tata McGraw Hill book Company, New York, 1982. 5. J. E. Shigley and C. Mischke, "Mechanical Engineering Design", Tata McGraw Hill Publications, 7th edition, 2004. 6. M. F. Spotts, "Design of Machine Elements", Pearson Education, 8th edition, 2011.	




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Finite Element Analysis

23ME3602	PCC	Finite Element Analysis	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 End Semester Exam: 50

Pre-Requisites: -

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

CO1	Explain the fundamental concepts of finite element method. (L2)
CO2	Illustrate computer implementation of the finite element method(L2)
CO3	Solve 1D problems using finite element formulation. (L3)
CO4	Make use of constant strain triangle to solve 2D problems. (L3)
CO5	Develop axisymmetric formulation for analysis of axisymmetric solid. (L3)
CO6	Analyze trusses to find global stiffness matrix and stresses(L4)

Course Outcomes	Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3											2	
CO2	3											2	
CO3	3	2			1							2	1
CO4	3	1			1							2	1
CO5	3	2	1		1							2	1
CO6	3	2	1		1							2	1



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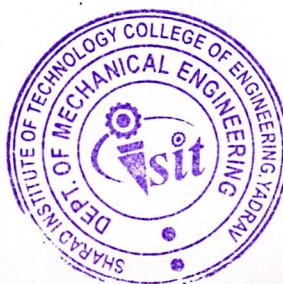


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Course Contents:

Unit: 1 Fundamental Concepts Introduction to FEA, Brief History, General FEM procedure, Simplification of problem through Symmetry, Various terminologies associated with FEA (Discretization, nodes and element) Stiffness matrix and its properties.) Application of FEM in various fields. Advantages and Disadvantages of FEA	[6]
Unit: 2 Computer Implementation of the Finite Element Method Pre-processing: Model definition – nodal coordinates element connectivity, material and element type and property definitions, type of analysis (static/modal), loading and boundary conditions. Meshing techniques- free and mapped meshing, Quality checks – aspect ratio, warp angle, skew, distortion, stretch, included angle, taper Processing: Element level calculations, Equation assembly, Equation solver (sparse solvers, factorization, numerical/computational issues)	[6]
Unit: 3 One Dimensional Element Introduction to One dimensional element, Types of One dimensional element, Derivation of Stiffness matrix and Shape function for one dimensional Linear and Quadratic element. Stress analysis of a Stepped bar, Thermal analysis of a Composite Wall and Torsion analysis of a shaft using 1 D element. Treatment of Boundary conditions by Elimination approach and Penalty approach.	[6]
Unit: 4 Two-Dimensional Element Introduction to two dimensional elements, Derivation of stiffness matrix and shape function for two dimensional linear elements. Numericals on two dimensional analysis using 2D element (Constant Strain triangle)	[6]
Unit: 5 Analysis of Axisymmetric Solids Introduction & applications of Axisymmetric elements, axisymmetric formulation, finite element modeling, triangular element and stress calculations	[6]
Unit: 6 Analysis of Truss Trusses:-Plane trusses, Local and Global coordinate systems, Derivation of Global stiffness matrix, Formulae for calculating L and M, element stiffness matrix, Stress Calculations, Assembly of global stiffness matrix.	[6]
Text Books: 1. "Introduction to Finite Elements in Engineering"; Chandrupatla-Belgundu, PHI. 2. "Finite Element Method with Application in Engineering" Y. M. Desai, T. I. Eldho, A. H. Shah, Pearson. 3. "Textbook of Finite Elements Analysis", P. Sheshu, Prentice-Hall of India Private Limited, New Delhi. 4. "An Introduction to Finite Element Method"; J. N. Reddy; 2/e, McGraw Hill International Editions, ISBN 0-07-112799-2 5. Finite Element Analysis – Theory and Practice"; M.J. Fagan, Longman Scientific & Technical. 6. "Finite Element Analysis", UdaiBorker, Nandu Printers & Publishers Pvt. Ltd. Mumbai.	



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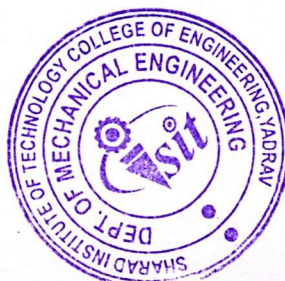


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Reference Books:

1. "Practical Finite Element Analysis", N.S. Gokhale, S.S. Deshpande, S.V. Bedekar, A.N.Thite,Finite to Infinite Publication.
2. "Concepts of Finite Element Methods",ManickaSelvam, SCITECH publication
3. "Finite Elements Analysis – Theory and Application with ANSYS, Sawed Mouveni, Prentice HallInc.
4. "Applied Finite Elements Analysis", Larry J. Segerlind, BSP Books Pvt Ltd.



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Refrigeration and Air-conditioning

23ME2303	PCC	Refrigeration and Air-conditioning	3-0-0	3 Credits
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Teaching Scheme:	Evaluation Scheme:
Lecture: 3 hrs/week	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Basic Mechanical Engineering, Thermal Engineering, Fluid Mechanics, Heat and Mass Transfer.

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

CO1	Explain refrigeration cycles with p-h and T-s diagram (L2).
CO2	Outline various refrigeration equipment's and extend the usage of refrigerants (L2).
CO3	Summarize multi pressure and Vapour absorption system (L2)
CO4	Analyze psychometric terms its application in HVAC, comfort conditions (L4).
CO5	Estimate heating and cooling loads of system (L5).
CO6	Evaluate pressure losses in duct systems (L5).

Course Outcomes	Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	1										3	
CO2	3	1										3	
CO3	3	2										3	
CO4	3	2										3	
CO5	3	2										3	
CO6	3	1										3	



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Course Contents:

Unit 1: Refrigeration Cycles: Carnot cycle, reversed Carnot cycle, simple Vapour compression cycle, sub and superheating, liquid to suction Vapour heat exchanger, actual Vapour compression cycle, Bell Coleman cycle, air cycles for aircraft's.	[6]
Unit 2: Refrigeration Equipment's and Refrigerants Refrigeration Equipment's: Compressor, condenser, evaporator, expansion devices, types, selection, use of insulation, methods of charging and testing. Refrigerants: Classification, desirable properties like thermodynamic, physical, comparison among commonly used refrigerants, selection of refrigerants, effect on ozone depletion and global warming, alternative refrigerants. Non-conventional methods of refrigeration.	[6]
Unit 3: Multi-Pressure and Vapour Absorption System Flash inter-cooling, water cooling, multistage, multi-evaporator and cascade system, introduction to cryogenic engineering system, Claude cycle, Linde cycle, introduction to Vapour absorption system	[6]
Unit 4: Psychrometry and Comfort Psychrometry: Psychrometric properties of air, basic psychrometric processes in air conditioning, sensible heat factor, bypass factor, air washer. Comfort: Thermal exchange between human body and environment, factors affecting comfort, effective temperature comfort chart.	[6]
Unit 5: Heating and Cooling Load Calculation Air conditioning system, components of cooling loads, different heat sources, load analysis room sensible heat factor, grand sensible heat factor, effective room sensible heat factor, Applications of Air-conditioning systems.	[6]
Unit 6: Central Air Conditioning System Types of supply air outlets, methods used for duct design, losses in duct system, duct arrangement systems, air-distribution system, and applications of central air conditioning systems.	[6]
Text Books: 1. "Refrigeration and Air Conditioning" Arora C P, Tata McGraw Hill 2. "Refrigeration and Air Conditioning" Arora Domkundwar, Dhanpat Rai and Sons	
Reference Books: 1. "Principal of Refrigeration" Dossat Ray J., S.I. Version, Wiley Eastern Limited, 2000 2. "Refrigeration and Air-conditioning" Manohar Prasad, Wiley Eastern Limited, 1983 3. "Refrigeration and Air-conditioning" Stocker W.F. and Jones J.W., McGraw Hill International editions 1982 4. "Thermal Environmental Engineering", Threlkeld J.L., Prentice Hall Inc. New Delhi 5. "Basic of Refrigeration and Air Conditioning", Anantnarayan, Tata McGraw Hill Publications 6. ASHRAE and ISHRAE Handbook 7. ASHRAE, Air Conditioning System Design Manual, 2nd edition ASHRAE	



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Power Plant Engineering

23ME3604A	PEC	Power Plant Engineering	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Engineering Thermodynamics, Fluid Mechanics, Turbo Machines

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

CO1	Explain various energy sources (L2).
CO2	Classify hydroelectric power plant (L2)
CO3	Outline steam power plants (L2)
CO4	Summarize advantages of combined cycle power plants (L2)
CO5	Classify reactors used in nuclear power plants (L2)
CO6	Solve problems of power plant economic analysis (L3)

Course Outcomes	Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3											3	
CO2	3											3	
CO3	3											3	
CO4	3											3	
CO5	3											3	
CO6	3	2										3	

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Course Contents:

Unit 1: Introduction of power plant engineering Energy resources and their availability; Types of power plants; Selection of the plants; Review of basic thermodynamic cycles used in power plants.	[6]
Unit 2: Hydro Electric Power Plant Rainfall and run-off measurements and plotting of various curves for estimating stream flow and size of reservoir; Power plants design; Construction and operation of different components of hydro-electric power plants; Site selection; comparison with other types of power plants.	[6]
Unit 3: Steam Power Plants Flow sheet and working of modern thermal power plants; Super critical pressure steam stations; Site selection; Coal storage; Preparation; Coal handling systems; Feeding and burning of pulverized fuel; Ash handling systems; Dust collection mechanical dust collector and electrostatic precipitator.	[6]
Unit 4: Combined Cycles Constant pressure gas turbine power plants; Arrangements of combined plants (steam and gas turbine power plants); Re-powering systems with gas production from coal Pressurized fluidized bed combustion (PFBC) systems; With organic fluids; Parameters affecting thermodynamic efficiency of combined cycle and numerical treatment.	[6]
Unit 5: Nuclear Power Plants Principles of nuclear energy; Basic nuclear reactions, Nuclear reactors - Pressurized water reactor (PWR), Boiling water reactor (BWR), Canadian deuterium nuclear reactor (CANDU); Sodium graphite; Fast breeder; Homogeneous; Gas cooled; Advantages and limitations; Nuclear power station; Waste disposal.	[6]
Unit 6: Power Plant Economics Load curve; Different terms and definitions; Cost of electrical energy; Tariffs methods of electrical energy; Performance and operating characteristics of power plants- Incremental rate theory; Input-output curves; Efficiency; Heat rate; Economic load sharing and numerical treatment.	[6]
Text Books: 1. A Text Book of Power Plant Engineering, R.K. Rajput, Laxmi Publications. 2. Power Plant Engineering, P.C. Sharma, S.K. Katariaand Sons. 3. Power Plant Engineering, G.R. Nagpal, Khanna Publishers. 4. Power station Engineering and Economy by Bernhardt G.A. Skrotzki and William A. 5. Power Plant Engineering, P.K. Nag, 2 nd Edition, TMH, New Delhi.	
Reference Books: 1. Power Plant Engineering, A K Raja, Amit Praksh Shrivastava, Manish Dwivedi, New Age International Publishers. 2. Nuclear Power Plant Engineering, James Rust, Haralson Publishing Company. 3. Nuclear Power Plants, Edited by Soon Heung Chang, InTech Publishers.	



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Design of Composite Materials

23ME3604B	PEC	Design of Composite Materials	3-0-0	3 Credits
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Teaching Scheme:	Evaluation Scheme:
Lecture: 3 hrs/week	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Engineering Physics, Analysis of Mechanical Elements, Machine Design

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

CO1	Explain the basic terms of Composite Material
CO2	Classify the types of Fibers and Matrix
CO3	Compare different manufacturing processes of composites
CO4	Illustrate different lamination theories
CO5	Select different testing methods for the applications of composite
CO6	Solve the problems on the composite material under different loading conditions.

Course Outcomes	Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3											2	
CO2	3											2	
CO3	3											2	
CO4	3											2	
CO5	3	3										2	
CO6	3	3										2	



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Course Contents:

Unit 1: Introduction of Composite Material Definition, Composite Material and its Application, Classification, Advantages, Limitations, Properties of composite Material	[6]
Unit 2: Materials:(Fibers and Matrix) Types of fibers, Glass fiber, Graphite fiber, Aramid fiber, Boron Fiber, Ceramic Fiber, Carbon Fiber, Matrix: Polymer Matrix and Thermoset Matrix, Thermoplastic Matrix	[6]
Unit 3: Manufacturing of Composites Fundamentals, Hand lay-up process, Bag moulding, Compression moulding, Pultrusion, Filament Winding, Liquid composite moulding process	[6]
Unit 4: Mechanics of Laminate Composite Basic Terminology, Behavior of Unidirectional composite-Longitudinal Tensile Loading, Transverse Tensile Loading, Longitudinal Compressive Loading, Transverse Compressive Loading, Laminated structure, Lamination Theories	[6]
Unit 5: Performance of Composite Static Mechanical Properties, Tensile Properties-Test Method and Analysis, Unidirectional Laminates, Cross-Ply Laminates, Multidirectional Laminates, Woven Fabric Laminates, Sheet-Molding Compounds, Compressive Properties, Flexural Properties	[6]
Unit 6: Design of Composites Laminate Design Considerations- Design Philosophy, Design Criteria, Design Allowable, Design of a Tension Member, Design of a Compression Member, Design of a Beam, Design of a Torsional Member	[6]
Text Books: 1. P.K. Mallick, "Fiber-Reinforced Composite Materials", ISBN 13:978-0-8493-4205-9, Third Edition, USA. 2. Robert M. Jones, "Mechanics of Composite Material", ISBN 1-56032-712-X, Second Edition, USA. 3. Carl T Herakovich " Mechanics of Fibrous Composite" ISBN 0-471-10636-4, First Edition USA	
Reference Books: 1. Author K Kaw "Mechanics of Composite Material" ISBN-0-8493-1343-0, USA 2. Ronald F Gibson "Principles of Composite Material Mechanics" ISBN 0-07-023451-5, USA	



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Automation in Manufacturing

23ME3604C	PEC	Automation in Manufacturing	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 Hours/Week	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Manufacturing Processes

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

CO1	Explain the concepts and levels of automation in production systems (L2).
CO2	Apply the automation concepts to automated flow lines with no internal parts (L3).
CO3	Analyse the performance of various automated assembly systems (L4)
CO4	Outline various material handling and transport equipment (L2)
CO5	Examine the principles, components, and types of Flexible Manufacturing Systems (FMS) (L4)
CO6	Demonstrate the principles of modular design and modular automation with their applications in manufacturing environments through case studies on casting shop design, press working shop design, and machine shop design.(L2)

Course Outcomes	Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2			1							3	1
CO2	3	2			2							3	2
CO3	3	3			2							3	2
CO4	3	2			1							3	1



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CO5	3	3			2						3	2
CO6	3	2			1						3	1

Course Contents:

Unit 1: Introduction to Automation : Automation and its types, reasons for automation, automation principles and strategies, basic elements of an automation system, Automated Manufacturing Systems, Advanced Automation Functions, Levels of automation, pneumatic and hydraulic components circuits.	[6]
Unit 2: Automated Flow Lines: Analysis of flow lines with no internal parts storage: cycle time analysis, processing time, production time, line frequency; performance measure- actual and ideal production rate, line efficiency. (simple problems)	[6]
Unit 3 Automated Assembly Systems: Fundamentals of automated assembly system, system configurations - in-line, dial type, carousel, single station; parts delivery at workstations, applications of automated assembly system, reasons for partial automation, single-station assembly system analysis- production rate, yield, cost, efficiency; multi-station assembly analysis - production rate, yield, cost, efficiency. assembly line balancing methods,	[6]
Unit 4: Material Transport and Storage Systems: Material handling equipment, design considerations in material handling, material transport equipment, types of material stored in a factory, conventional methods of storage and equipment, automated storage and retrieval systems..	[6]
Unit 5 Flexible Manufacturing Systems: Types of flexibility, types of FMS, FMS components, FMS Components-Workstations, Material Handling and Storage Systems, Computer Control System, Human Recourses, FMS Applications and Benefits., Quantitative analysis of FMS,	[6]
Unit 6 Modular Automation Design: Introduction to modular design, modular automations, Case study for modular design: 1. Casting shop design, 2. Press working shop design, 3. Machine shop design.	[6]
Text Books: 1. Automation, Production systems and computer integrated manufacturing, Mikel P. Groover / Pearson Education. 2. Frank Lamb - Industrial Automation , Mc Graw Hill, 2013	
Reference Books: 1. Yoram Koren, Computer control of Manufacturing Systems, McGraw-Hill Education, International Edition, 2017. 2. P. Radhakrishnan and S. Subramanyam, V. Raju, CAD/CAM/CIM, New Age International Pvt Ltd., 3rd Edition, 2009	



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Introduction to CFD

23ME3605A	PEC	Introduction to CFD	3-0-0	3 Credit
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 End Semester Exam: 50

Pre-Requisites: Fluid Mechanics, Mathematics, Heat Transfer.

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

CO1	Explain perception of major theories, approaches and methodologies used in CFD.(L2)
CO2	Apply differential equations to solve problems on one dimension steady state and unsteady state conduction.(L3)
CO3	Develop governing equation suitable for CFD grids.(L3)
CO4	Make use of finite elements for flow and heat transfer problems.(L3)
CO5	Identify finite volume philosophy.(L3)
CO6	Utilize finite volume method for diffusion and convection.(L3)

Course Outcomes	Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3											3	
CO2	3	2			1							3	1
CO3	3	2			1							3	1
CO4	3	2			1							3	1
CO5	3	2			1							3	1
CO6	3	2			1							3	1



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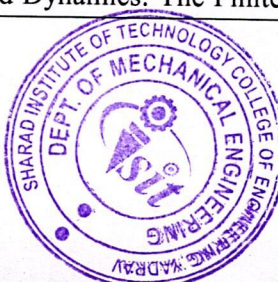


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Course Contents:

Unit: 1 Introduction and Basic Concepts Introduction of CFD, Types of fluids and basic equations of flow, Mass Conservation, Newton's second law of motion, Fluid flow governing equations, Navier– stokes equation, Boundary layer equations, Expanded form of Navier-stokes equations, Conservation of energy principle, Special form of energy equation.	[6]
Unit: 2 Differential Equations and Discretization Elementary Finite Difference Equations, Basic aspects of finite difference equations, errors and stability analysis, discretization, Taylor's series expansion, difference equation: explicit and implicit approach, Application to heat conduction and convection, problems on one dimension steady state and unsteady state conduction.	[6]
Unit: 3 Grid Transformation Introduction, general transformation equations, matrices and Jacobean, transformed version of governing equation particularly suited for CFD, compressed grids, elliptic grid generation, adaptive grids	[6]
Unit: 4 Introduction to finite element philosophy Basics of finite element method, stiffness matrix, Isoperimetric elements, Formulation of finite elements for flow and heat transfer problems.	[6]
Unit: 5 Introduction to finite volume philosophy Integral approach, discretization and higher order schemes, Application to complex geometry.	[6]
Unit: 6 Finite Volume Method a. For Diffusion Introduction, FVM for 1D steady state Diffusion, FVM for 2 D Diffusion b. For Convection Diffusion Introduction, Steady 1-D Convection and Diffusion, Central Differencing, Upwind Differencing, Hybrid Differencing, Power Law Scheme, QUICK scheme.	[6]
Text Books: 1. "Computational Fluid Mechanics the Basics with Applications", Anderson J. D. Jr, Tata McGraw Hill Education Pvt.Ltd. 2. "An Introduction to Computational Fluid Dynamics the Finite Volume Method" H. K. Versteeg and W. Malalasekera, Pearson Publication. 3. "Numerical Heat Transfer Fluid Flow", Suhas V. Patankar, Taylor and Francis. 4. "Introduction to Computational Fluid Dynamics", Pradip Niyogi, S. K. Chakrabarthy, M. K. Laha, Pearson Publication. 5. "Introduction to Computational Fluid Dynamics: Development, Application and Analysis", Atul Sharma, Wiley	
Reference Books: 1. Computational Fluid Dynamics the Basics with Applications, John D Anderson, Jr., McGraw Hill Book Company. 2. An Introduction to Computational Fluid Dynamics: The Finite Volume Method, H K Versteeg, W	




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Malalasekera, Pearson Education Ltd.

3. Introduction to Computational Fluid Dynamics, Anil W Date, Cambridge University Press.
4. Numerical Heat Transfer and Fluid Flow, Suhas V Patankar, Hemisphere Publishing Co.
5. Computational Fluid Dynamics: A Practical Approach, Jiyuan Tu, Guan Heng Yeoh, Chaoqun Liu, Elsevier.
6. Principles of Computational Fluid dynamics, Pieter Wesseling, Springer International Edition
7. Fundamentals of Computational Fluid Dynamics, Tapan K. Sengupta, Universities Press.
8. Introduction to Fluid Mechanics, Edward J Shaughnessy, Jr., Ira M Katz, Oxford University press



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Reliability Engineering

23ME3605B	PEC	Reliability Engineering	3-0-0	3 Credits
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Teaching Scheme:	Evaluation Scheme:
Lecture: 3 hrs/weeks	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: --

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

CO1	Explain the fundamental concepts of reliability engineering [L2].
CO2	Explain concept of availability and maintainability [L2].
CO3	Determine various reliability measures [L5].
CO4	Utilize basic reliability models to evaluate reliability parameters [L3].
CO5	Assess system reliability using reliability block diagrams [L5].
CO6	Explain terms of reliability testing. [L2]

Course Outcomes	Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2											1	
CO2	2											1	
CO3	2	2										1	
CO4	2	2										1	
CO5	2	2										1	
CO6	2											1	



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Course Contents:

Unit 1: Introduction: Overview of reliability engineering and its significance, Concepts, terms and definitions, Brief history, the life cycle of a system, concept of engineering failures and their causes, theory of probability and reliability, random variables, discrete and continuous probability distributions.	[6]
Unit 2: Maintainability and Availability Concept of maintainability, measures of maintainability, mean time to repair (MTTR), analysis of downtime, repair time distributions, stochastic point processes, maintenance concept and procedures, availability concepts and definitions, important availability measures.	[6]
Unit 3: Reliability Measures: Reliability function $R(t)$, cumulative distribution function (CDF)- $F(t)$, Probability density function (PDF)- $f(t)$, hazard rate function $\lambda(t)$, Mean time to failure (MTTF) and Mean time between failure (MTBF), median time to failure (t_{med}), mode (t_{mode}), variance (σ^2) and standard deviation (σ).	[6]
Unit 4: Basic Reliability Models: Constant failure rate (CFR) model, renewal and Poisson process, two parameter exponential distribution, redundancy with CFR model, time-dependent failure models, two and three parameter Weibull distributions, calculation of $R(t)$, $F(t)$, $f(t)$, $\lambda(t)$, (MTTF) (MTBF), (t_{med}), (t_{mode}), (σ^2) and (σ).	[6]
Unit 5: Reliability Evaluation of Systems: Reliability block diagram, series configuration, parallel configuration, mixed series- parallel configuration, Redundant systems, high level versus low level redundancy, k-out-of-n redundancy, complex configurations.	[6]
Unit 6: Design for Reliability and Maintainability: Reliability design process and design methods, failure modes, effects and criticality analysis (FMECA), fault tree analysis method, Reliability centered maintenance. Reliability Testing: Product testing, reliability life testing, burn-in testing, acceptance testing accelerated life testing.	[6]
Text Books: 1. An Introduction to Reliability and Maintainability Engineering, Charles E. Ebling, Waveland press, Third edition, 2019. 2. Engineering Reliability- New Techniques and Application, B. S. Dhillon, John Wiley and Sons, 1981.	
Reference Books: 1. Reliability Engineering Theory and Practice, Alessandro Birolini, Springer publisher, 2010.	




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Computer Integrated Manufacturing

23ME3605C	PEC	Computer Integrated Manufacturing	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 Hrs./week	CA-I : 10 Marks CA-II : 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 marks

Pre-requisite: CAD/CAM

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

CO1	Explain need of CAD/CAM/CIM (L2).
CO2	Illustrate concept of computer aided process panning, material resource planning and manufacturing control. (L2)
CO3	Make use of group technology fundamentals (L3).
CO4	Summarise elements of database management system. (L2)
CO5	Identify components, configuration and applications of communication (L3)
CO6	Utilize knowledge facts to find implementation issues in CIM (L3)

Course Outcomes	Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	1										3	1
CO2	3	1										3	1
CO3	3	1										3	1
CO4	3	1										3	1
CO5	3	1										3	1
CO6	3	1										3	1




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Course Contents:

Unit 1: Introduction to CIM Manufacturing Planning, Manufacturing control, disadvantages of traditional product cycle. Introduction to CAD/CAM – Concurrent Engineering Introduction to CIM and Automation: Automation in Production Systems.	[06]
Unit 2: Product cycle development through CIM Computer aided design (CAD): - Geometric modeling, finite element analysis and optimization, evaluation and design review (CAE), concurrent engineering Computer aided process planning (CAPP):- Concept, structure of process planning software, computerized material resource planning (CMRP) Computer aided business functions (CABF): - Enterprise resource planning (ERP), role in business, material resource planning (MRP)	[06]
Unit 3: Group Technology Concept, design and manufacturing attributed, part families, method of grouping, PFA, different classification and coding systems (OPITZ and MICLASS), relevance of GT in CIM, benefits and limitations	[06]
Unit 4: Database Management System Meaning of Data, database, DBMS, design requirements, criteria, comparison of DBMS with conventional file handling, types of DBMS model, scope of DBMS in CIMS	[06]
Unit 5: Communication Need of shop floor communication, hierarchy of computer communication, types, networking concepts, network topology, ISO-OSI reference model, introduction to MAP/TOP, role of computer communication in CIMS.	[06]
Unit 6: Planning and Implementation Issues: Need of planning, steps in planning, phases of CIMS implementation, partial and one time implementation, organization for CIM Planning and implementation, case studies on planning and implementation	[06]
Test Books: 1. Automation, Production systems and Computer Integrated Manufacturing by M. P. Groover (PHI) 2. Computer Integrated Design and Manufacturing by Bedworth, Henderson Wolfe (McGraw Hill) 3. CIM Handbook by Teicholtz and Orr (McGraw Hill) 4. CAD/CAM/CIM: Radhakrishnan, Subramanyam, Raju. 5. Computer Integrated Manufacturing: James Rehgh, H. W. Kraebber, Pearson Education. 6. CAD/CAM/CAE Chougule N.K SCITECH PUBLICATION 7. CIM: Principles of Computer-Integrated Manufacturing by Waldner J. B.	
Reference Books: 1. Principles of Computer Integrated Manufacturing by S. Kant Vajpayee (PHI) 2. Performance Modeling of Automated Production System by Narhari and Vishvanandhan (PHI).	





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Design and Modeling of Transmission System Laboratory

23ME3606	VSEC	Design and Modeling of transmission system Laboratory	0-0-2	1 Credit
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Teaching Scheme:	Evaluation Scheme:
Practical's: 2 hrs/weeks	CA I: 25 Marks CA II: 25 Marks

Pre-Requisites: Analysis of Mechanical Elements, Machine Design I

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

CO1	Apply fundamental principles of machine design to analyze and design various machine elements, considering factors like material properties, loads, stresses, and failure modes. (L3)
CO2	Solve engineering problems by applying design principles to machine elements. (L3)
CO3	Design industrial application-based machine elements. (L6)

Course Outcomes	Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2										2	
CO2	3	2										2	
CO3	3	2	3		2		2	2	2		2	2	2

Course Contents:

The design and modeling of transmission system laboratory course consists of the following experiments.

1. The term work shall consists of two design projects based on industrial applications. Each design project shall draft through CAD software, consists of assembly drawings with a part list and



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overall dimensions and other drawings of individual components. Manufacturing tolerances, surface finish symbols, and geometric tolerances should be specified, whenever necessary, so as to make it working drawing.

2. Four assignments based on the topics of the syllabus of Design of Machine Elements II.
3. Industrial visit based on topics of syllabus of Design of Machine Elements II.

Text Books:

1. V. B. Bhandari, "Design of Machine Elements", Tata McGraw Hill Publications, New Delhi, 2008.
2. R. L. Norton, "Machine Design: An Integrated Approach", Pearson Education Singapore, 2001.
3. A Machine Design R.S. Khurmi&J.K.Gupta S. Chand publication
4. Machine design S G Kulkarni McGraw Hill Education Publications
5. Design Data Hand Book for Mechanical Engineers K Mahadevan& K Balaveera Reddy CBS publications.

Reference Books:

1. PSG Design Data Book, Third Edition, 1978.
2. R. C. Juvinall, K. M. Marshek, "Fundamental of machine component design", John Wiley & Sons Inc., New York, 3rd edition, 2002.
3. J. Hamrock, B. Jacobson and Schmid Sr., "Fundamentals of Machine Elements", International Edition, New York, 2nd edition, 1999.
4. A. S. Hall, A. R. Holowenko, H. G. Langhlin, "Theory and Problems of Machine Design", Schaum's Outline Series, Tata McGraw Hill book Company, New York, 1982.
5. J. E. Shigley and C. Mischke, "Mechanical Engineering Design", Tata McGraw Hill Publications, 7th edition, 2004.
6. M. F. Spotts, "Design of Machine Elements", Pearson Education, 8th edition, 2011.




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Refrigeration and Air-conditioning Laboratory

23ME3607	PCC	Refrigeration and Air-conditioning Laboratory	0-0-2	1 Credit
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Teaching Scheme:	Evaluation Scheme:
Lecture: - Practical: 2 hrs./week	CA-I: 15 Marks CA-II: 15 Marks Practical and Oral Examination: 20 Marks

Pre-Requisites: Basic Mechanical Engineering, Thermal Engineering, Fluid Mechanics, Heat and Mass Transfer.

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

CO1	Estimate cooling capacity and coefficient of performance by conducting test on vapour compression refrigeration systems
CO2	Estimate COP for Ice plant
CO3	Determine COP for heat pump.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2										3	
CO2	3	2										3	
CO3	3	2										3	




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List of Experiments:

1. Study and demonstration of vapour absorption system.
2. Study of controls in refrigeration system
3. Trial on vapour compression refrigeration system.
4. Trial on Ice plant.
5. Trial on heat pump.
6. Trial on ducted air conditioning system.
7. Industrial visit related to refrigeration and air conditioning system.
8. A case study of refrigeration / air-conditioning system.

Text Books:

1. "Refrigeration and Air Conditioning" Arora C P, Tata McGraw Hill
2. "Refrigeration and Air Conditioning" Arora Domkundwar, Dhanpat Rai and Sons

Reference Books:

1. "Principal of Refrigeration" Dossat Ray J., S.I. Version, Wiley Eastern Limited, 2000
2. "Refrigeration and Air-conditioning" Manohar Prasad, Wiley Eastern Limited, 1983
3. "Refrigeration and Air-conditioning" Stocker W.F. and Jones J.W., McGraw Hill International editions 1982
4. "Thermal Environmental Engineering", Threlkeld J.L., Prentice Hall Inc. New Delhi
5. "Basic of Refrigeration and Air Conditioning", Anantnarayan, Tata McGraw Hill Publications
6. "Handbook of Refrigeration and Air Conditioning", Shan Wang, McGraw Hill Publications
7. "Industrial Refrigeration", Wilbert Stocker, McGraw Hill Publications
8. "Cryogenics systems" Randall Barron, Mc Graw Hill Book Co
9. "Absorption chillers and Heat Pumps", Keith Harold, McGraw Hill Publications
10. ASHRAE and ISHRAE Handbook
11. ASHRAE, Air Conditioning System Design Manual, 2nd edition ASHRAE



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Finite Element Analysis Laboratory

23ME3608	PCC	Finite Element Analysis Laboratory	0-0-2	1 Credit
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Teaching Scheme	Evaluation Scheme
Practical: 2 hrs/week	CA I -15 Marks CA II-15Marks End Semester Exam: 20 Marks

Pre-Requisites: NA

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

CO1	Illustrate the concept of Discretization
CO2	Solve the One dimensional problem.
CO3	Construct static analysis problems.

Course Outcomes	Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3											3	
CO2	3	2			2							2	1
CO3	3	2			2							2	1

List of Practical's/experiments:

- 1. Assignment on Discretization** – types of elements, choice of element and type of meshing – automatic, mapped, meshing in critical areas.
- 2. Finite Element Analysis of Stepped bar (Two or Three Steps only) using,**
 - a) Finite Element Approach(Theory)
 - b) Finite Element Software (ANSYS / HYPERWORKS etc.) Compare the results obtained by above methods.
- 3. Finite element analysis of Composite wall (Minimum three labs)**



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- a) Finite Element Approach(Theory)
b) Finite Element Software (ANSYS / HYPERWORKS etc.) Compare the results obtained by above methods.
- 4. Use of any ONE Standard software package like ANSYS / HYPER WORKS etc. for solving following problems:**
- Static Analysis of Truss
 - Static Analysis of Beam
 - Static Analysis of Plate with a circular hole
- 5. Finite element analysis of STEPPED BAR in ANSYS using APDL.**




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Capstone Project-I

23ME3609	ELC	Capstone Project-I	0-0-4	2 Credits
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Teaching Scheme	Evaluation Scheme
Project Slot: 4 hrs/week	CA-I: 25 Marks CA-II: 25 Marks End Semester Exam: 50 Marks

Pre-Requisites: Basic Knowledge of Core Mechanical Engineering Subjects

Course Outcomes: After learning the course, students will be able to:

CO 1	Identify a real-world problem and formulate a project proposal with clearly defined objectives and scope.
CO 2	Demonstrate an ability to conduct a comprehensive literature review to understand the problem domain and existing solutions.
CO 3	Develop a detailed project plan, including methodologies, timelines, and resource requirements.
CO 4	Implement and validate initial stages of the project by developing and testing at least 50% of the proposed work.

Course Outcomes	Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3						3	3	2	3	2	
CO2	3	3						3	3	2	3	2	
CO3	3	3	3				3	3	3	3	3	2	
CO4	3	3	3	2	3	2	3	3	3	3	3	2	3



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Course Contents:

The students in a group of not more than FOUR will work under the guidance of the faculty member on the project work undertaken by them. The completion of 50% work, the submission of the phase I report and assessment should be done at the end of Semester VI.

The project work should consist of any of the following or appropriate combination:

1. A comprehensive and up-to-date survey of literature related to study of a phenomenon or product.
2. Problem Identification
3. Design of any equipment and / or its fabrication and testing.
4. Critical Analysis of any design or process for optimizing the same.
5. Experimental verification of principles used in applications related to various specializations related to Mechanical Engineering.
6. Software development for particular applications.
7. A combination of the above.
8. A synopsis of the selected project work should be submitted
9. At the end of semester a comprehensive phase I report should be submitted.

Course Evaluation:

The evaluation of the project work will be done considering the performance of students in progress 1, 2, & the final SEE examination.

Progress 1: For continuous assessment I students are expected to present their synopsis and submit final draft of synopsis. The following points can be considered for the preparation of the review 1 presentation synopsis report:

- Title Page: (Title of Project, Names of Students, Name of Guide)
- Introduction
- Need of the project
- Objectives




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- Scope
- Problem Definition
- Proposed Initial Design
- Literature referred
- Methodology Planned for achieving the Aim and objectives of the project
- Expenditure
- Time Activity Chart
- References

Progress 2: For continuous assessment II, students are expected to present their 50 percent of project work and has to submit a comprehensive report of the same. The following points can be considered for the Review 2 presentation:

- Study of data
- Modeling/System Design
- Design calculations
- Numerical Simulation /Mathematical model
- Finalization of design

Final semester end examination (SEE): For final SEE students are evaluated by panel of one industrial expert, one departmental internal examiner, and project guide for their 50 percent project work completion.




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Strategic Management

23MEMDA4	MDM	Strategic Management	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA-I:10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Fundamentals of Project Management, Operation research and Management.

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

CO1	Explain different strategies used in organization.
CO2	Illustrate strategic management principles for corporate sustainability.
CO3	Apply concepts of competitive advantage to identify industry evolution, globalization, and national competitive advantages.
CO4	Identify strategic alternatives and frameworks such as ETOP, OCP, and balanced scorecard to improve organizational effectiveness.
CO5	Plan strategies for implementation, resource allocation, and strategic control
CO6	Analyze digital marketing strategies, transformation elements, and emerging trends for competitive advantage.

Course Outcomes	Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2									1	3	
CO2	3	3									2	3	
CO3	3	3									1	3	



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CO4	2	2									2	2	
CO5	3	3									3	3	
CO6	3	2									3	3	

Course Contents:

Unit 1: Strategy and Processes: Concept of Strategy, Strategic Management, objectives, Levels of strategy, Elements in strategic management process, basic model of strategic management, Strategic Formation Process, Alignment of strategy with vision, mission and culture.	[6]
Unit 2: Strategic management for Sustainability: Corporate sustainability, Stakeholders and strategic management, Corporate Governance, Board of directors and strategic management, Corporate social responsibility, Risk management.	[6]
Unit 3: Competitive Advantage: Environmental Appraisal: Internal and External, factors and process, Porter's five forces model, SWOT analysis, Strategic groups, Competitive changes during industry evolution- Globalization, National Competitive advantages- Capabilities and competencies.	[6]
Unit 4: Strategies: The generic strategic alternatives- Stability, Expansion, Retrenchment and Combination strategies, Business level strategy, Building and Restructuring the corporation, Environment Threat and Opportunity Profile (ETOP) , Organizational capability Profile (OCP), Mc Kinssey's 7s Framework, GE 9 Cell model, Balanced Score card.	[6]
Unit 5: Strategy Implementation and Evaluation: Nature and barriers of strategy Implementation, Model, Resource allocation, Designing organizational structure, Designing strategic control systems-Matching structure and control to strategy, Implementing strategic change: politics, power and conflict, Techniques for strategic evaluation and control.	[6]
Unit 6: Digital Strategy: Introduction, Types of digital marketing strategies, Digital Transformation for competitive advantages, Elements of digital strategy, Innovations and disruptive business models, layers of digital transformation, Emerging trends in digital and social marketing strategies-Artificial Intelligence, Blockchain, Robotic process Automation, Digitalization of sports, Internet of things.	[6]
Text Books: 1. "Strategic Management: Concepts and Cases", Fred R. David, Pearson, 16th Edition, 2016 2. "Strategic Management: A Competitive Advantage Approach", David Besanko, David Dranove, Mark Shanley, Scott Schaefer, , Pearson, 7th Edition, 2012. 3. "Corporate Social Responsibility: A Strategic Perspective", David Chandler, Sage Publications, 1st Edition, 2015 4. "Competitive Strategy: Techniques for Analyzing Industries and Competitors", Michael E. Porter, 1st Edition, 1980 5. "Strategic Management: Formulation, Implementation, and Control", Authors: John A. Pearce,	



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Richard B. Robinson, McGraw-Hill Education, 13th Edition, 2011

6. "Digital Business and E-Commerce Management", Dave Chaffey, Pearson, 7th Edition, 2019
7. "Digital Marketing: Strategy, Implementation, and Practice", Dave Chaffey, Fiona Ellis-Chadwick, Pearson, 7th Edition, 2019

Reference Books:

1. Hill. Strategic Management: An Integrated approach, 2009 Edition Wiley, 2012.
2. "Strategic Management, Theory and practice", John A. Parnell, Biztantra, 2012.
3. "Strategic Management and Business Policy", Azhar Kazmi, 3rd Edition, Tata McGraw Hill, 2008
4. "Strategic Management Theory & Application", Adriaan H. Aberberg and Alison Rieple, Oxford University Press, 2008.
5. "Making strategy work", Lawrence G. Hrebiniak, Pearson, 2nd edition, 2013.
6. "Business Policy and Strategic Management – Concepts and Application", Gupta, Gollakota and Srinivasan, Prentice Hall of India, 2005.
7. "Strategic Management & Business Policy", Dr. Dharma Bir Singh, KoGent Learning Solutions Inc., Wiley, 2012.
8. "Strategic Management", John Pearce, Richard Robinson and Amitha Mittal, McGraw Hill, 12th Edition, 2012




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Introduction to Air Breathing Propulsion

23MEMDB4	MDM	Introduction to Air Breathing Propulsion	3-0-0	3 Credits
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Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Engineering Thermodynamics, Fluid Mechanics, IC Engines, Jet engine and propulsion

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

CO1	Classify different types of propulsion systems and differentiate between air-breathing and non-air-breathing engines.
CO2	Compare axial and centrifugal compressors based on their performance characteristics.
CO3	Illustrate the working principles of turbojet, turboprop, ramjet, and pulsejet engines.
CO4	Explain the theory of operation and performance characteristics of axial turbines.
CO5	Evaluate fuel consumption, specific impulse, and specific fuel consumption for performance analysis.
CO6	Discuss emerging propulsion technologies, including supersonic and hypersonic propulsion.

Course Outcomes	Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3											3	
CO2	3											3	
CO3	3											3	
CO4	3											3	
CO5	3	2										3	
CO6	3											3	



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Course Contents:

Unit 1: Fundamental of Air Breathing Propulsion Introduction to propulsion systems; Classification of propulsion systems; Air-breathing vs. non-air breathing engines; Efficiency and operational characteristics	[6]
Unit 2: Components of Air-Breathing Engines Inlet types, functions, and performance; Axial and centrifugal compressor; Combustion chamber; Types of Nozzles and Introduction of turbines	[6]
Unit 3: Types of Air-Breathing Engines Working principle of turbojet; Turbo prop, Ram jet, Pulse jet engine; Performance study; Advantages and limitations.	[6]
Unit 4: Axial Turbines Theory of operation, Stage and overall performances, Turbine and compressor matching, turbine blade cooling; Radial Flow Turbine, Module Matching.	[6]
Unit 5: Performance and Design Considerations Engine thrust; Power and efficiency calculations; Fuel consumption and range considerations; Specific impulse and specific fuel consumption	[6]
Unit 6: Advanced Propulsion Technologies and Applications Supersonic and hypersonic propulsion; Environmental impact and emissions control; Hybrid and electric propulsion trends; Case studies of modern propulsion systems	[6]
Text Books: 1. Mechanics and Thermodynamics of Propulsion- Hill & Peterson 2. Gas Turbine Theory – Cohen, Rogers, Saravanamuttoo 3. Modern compressible Flow – Anderson	
Reference Books: 1. Aircraft Propulsion- Saeed Farokhi 2. Thermodynamics – Cengel & Boles 3. Rocket Propulsion Elements - Sutton and Ross/Biblarz	




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Mechatronics in Automotive Systems

23MEMDC4	MDM	Mechatronics in Automotive Systems	3-0-0	3 Credits
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Teaching Scheme:	Evaluation Scheme:
Lecture: 3 hrs/week	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites:

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

CO1	Illustrate the automotive transmission system
CO2	Explain the different systems used in Automotive Vehicles
CO3	Identify different sensors and actuators used in Automotive system
CO4	Illustrate different structures used for Safety and comfort in automotive system
CO5	Construct a design for Electrical Vehicle
CO6	Identify different data analytical platforms

Course Contents:

Unit 1: Fundamentals of Automotive Systems Overview of automobile systems, Internal Combustion engine – two stroke and four stroke engines, Fuel system, Ignition system, Transmission system – Clutch, Gear box, Propeller shaft, Rear axle and differential, Suspension, Steering, Basic instrumentation, Introduction to Automotive control systems	[6]
Unit 2: Mechanical, Electrical and Electronic Systems in Automotive Vehicles Basic electrical and electronic principles for automotive technology Charging systems, Starting systems, Ignition systems, Electronic fuel control and engine management	[6]
Unit 3: Sensors and Actuators in Automotive systems Overview of automotive sensors, Features of vehicle sensors, classification, Sensor measuring principles – Position sensors, Speed and rpm sensors, Acceleration sensors, pressure sensors, Force and torque sensors, Flow meters, Gas sensors, temperature sensors, Actuators - Electromechanical Actuators and Fluid mechanical actuators	[6]




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Unit 4: Safety and comfort of automotive Systems Antilock braking system, Traction control system, Power assisted steering system, Electronic Stability Program, Active safety, structural safety, Air bags and belt tensioners, Drive adjustment systems, Heating ventilation and air conditioning, vehicle security systems	[6]
Unit 5: Electrical Vehicles Introduction to Electric and Hybrid vehicles, Vehicle Architectures and design, Battery energy storage, Alternate energy storage, Overview of electrical machines	[6]
Unit 6: Self Propelling vehicles Levels of Autonomous driving, Autonomous vehicle functional architecture, Software stack – perception, localization, path planning and control, Introduction to open vehicular data analytics platform	[6]
Text Books: 1. Kirpal Singh, “ Automobile Engineering Vol 1 & 2 “, Standard Publishers, Seventh Edition, New Delhi 2. Tom Denton, Automobile electrical and electronic systems, BH Publication, Third edition. 2004 3. Konrad Reif, Automotive Mechatronics, Automotive -Networking, Driving, Stability Systems – Springer , 2015 4. Iqbal Hussian, Electric and Hybrid Vehicles – Design fundamentals, 3rd edition, CRC Press 2021	
Reference Books: 1. Ali G Ulsoy, Hui Peng, Melih Cakmakci, Automotive Control Systems, Cambridge University Press, 2012 2. William B. Ribbens “Understanding Automotive Electronics”, 5th edition - Butter worth Heinemann Woburn, 1998.	




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Language Skill- IV

23HSSM07	VEC	Language Skill- IV	0-0-2	Audit
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Teaching Scheme:	Evaluation Scheme:
Lecture: NA	CA-I: 25 Marks
Practical: 2 hrs/week	CA-II: 25 Marks

Pre-Requisites: Language Skill I, II and III

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

CO1	Make use of Function in Python Programming.
CO2	Make use of Python collections.
CO3	Make use of classes and its objects in python.
CO4	Make use of file and it's handling functions.

Mapping of CO's with PO's:

CO's\ PO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PSO1	PSO2
CO1	2	1			1		1	1			1		
CO2	2	1			1		1	1			1		
CO3	2	1			1		1	1			1		
CO4	2	1			1		1	1			1		
Course Code	2	1			1		1	1			1		



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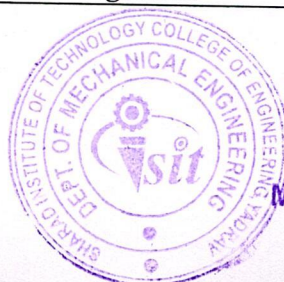
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1. Write a Python program to define a user-defined function that takes a number as input and returns whether it is even or odd. Call the function and display the result. ○ Concepts: Function definition, arguments, return value.	[2]
2. Create a Python program to define and call a function with default arguments and keyword arguments. ○ Concepts: Function calling, argument types.	[2]
3. Write a Python program using a lambda function to compute the square, cube, and factorial of a given number. ○ Concepts: Lambda function basics	[2]
4. Write a Python program to demonstrate list operations such as creation, adding items, removing an item, slicing, and sorting. ○ Concepts: List constructor, change, remove, sort, list comprehension	[2]
5. Write a Python program to demonstrate the use of tuples and sets. Perform operations such as checking membership, adding/removing elements (set), and iterating. ○ Concepts: Tuple immutability, set operations.	[2]
6. Write a Python program to create a dictionary of employees with their ID as key and name as value. Perform operations like adding a new entry, updating existing, and deleting one. ○ Concepts: Dictionary operations, loop through dictionary.	[2]
7. Write a Python program to create a class Student with attributes name, roll_no, and a method display(). Create an object and access its members. ○ Concepts: Class, object, method access.	[2]
8. Create a class with an __init__() constructor to initialize data members and a destructor to display a message when the object is deleted. ○ Concepts: Constructor, destructor.	[2]
9. Write a program to demonstrate single inheritance where a class Vehicle is inherited by a class Car. Use super() to access base class methods. ○ Concepts: Inheritance, super().	[2]
10. Write a Python program to open a text file in write mode and write your personal information (name, age, department). Then, read and display the content of the file. ○ Concepts: File open, write, read, file modes.	[2]
11. Write a program to read a file line by line using readline() and count the number of characters in each line. ○ Concepts: File reading, character offset.	[2]
12. Create a program to open a file in append mode and add new content. Use exception handling to manage file not found or access errors. ○ Concepts: File handling with exception management.	[2]




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Text Books:

3. Python Projects (Author: Laura Cassell, Alan Gauld) Wrox publication
4. Murach's Python Programming. Aut.:Michael Urban, Joel Murach, murach's Publication.

Reference Books:

2. Fundamentals of Python (First Program) Cengage MINDTAP Publication 2nd Edition. Author: K.A. Kambert




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Aptitude Skill-IV

(Verbal Ability)

23HSSM08	VEC	Aptitude Skills- IV	1-0-0	Audit
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Teaching Scheme:	Evaluation Scheme:
Lecture: 1hr/week	CA-I: 25 Marks CA-II: 25 Marks

Pre-Requisites: Aptitude Skills-I, II and III

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

1	Solve the problems on system of equation
2	Solve the problems on seating arrangement
3	Solve the logical reasoning problems
4	Solve the critical analysis problems
5	Solve the problems of Data interpretation
6	Solve the problems permutations and combinations

CO PO Mapping:

CO's\ PO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PSO1	PSO2
CO1	2	1					1				1		
CO2	2	1					1				1		
CO3	2	1					1				1		
CO4	2	1					1				1		
CO5	2	1					1				1		
CO6	2	1					1				1		
Course Code	2	1					1				1		



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Course Contents:

Unit 1: System of equations Quadratic equations, Surds and indices, solution of equations, Ages,	[2]
Unit 2: Seating Arrangements Linear seating Arrangement, Circular seating arrangement, Complex seating arrangement	[2]
Unit 3: Logical Reasoning Numerical based on sense of direction, Blood relations, Odd man Out	[2]
Unit 4: Critical analysis Clocks and Calendar based problems, Cryptarithmic, heights and distances	[2]
Unit 5: Data Interpretation Table form, Bar form, Line for Pi chart form	[2]
Unit 6: Permutation and combination Permutation and combinations	[2]
Text Books: 1. RS Aggarwal, "Quantitative Aptitude for Competitive Examinations ", S. Chand Publisher; 2016 edition. 2. Quantitative Aptitude for CAT TMH Publications 3. Vedic Maths Made Easy By Dhaval Bhatiya Jaico Publication House.	
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