



GIET UNIVERSITY, GUNUPUR

(Established Vide Odisha Act 23 of 2018, Included by UGC, New Delhi)

Gunupur - 765 022, Dist.- Rayagada, Odisha, INDIA

www.giet.edu

SEMESTER WISE COURSES STRUCTURE

MECHANICAL ENGINEERING

ACADEMIC REGULATION -2023



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VISION

To develop globally competent Mechanical Engineers with innovation and research culture leading to entrepreneurship and successful in advanced fields of Engineering and Technology towards a societal change.

MISSION

- M1:** To impart quality education by experimental learning to enhance their professional skills.
- M2:** To provide state-of-the-art facilities and training programs to the faculty, staff and student with latest technology.
- M3:** To provide research and intellectual resources to address contemporary and complex problems of industry and research.
- M4:** To develop linkages with reputed R&D organizations and educational institutions in India for excellence in teaching, research and consultancy practices.

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PROGRAM OUTCOMES

- PO1 (Engineering Knowledge):** Apply the knowledge of mathematics, natural sciences, computing, engineering fundamentals, and specialised engineering concepts to solve complex engineering problems effectively.
- PO2 (Problem Analysis):** Identify, formulate, investigate, and analyse complex engineering problems using appropriate theoretical and practical approaches, and reach well-supported conclusions considering the holistic nature of the problem.
- PO3 (Design/Development of Solutions):** Design innovative and sustainable solutions for complex engineering problems, and develop systems, components, or processes that meet specified requirements while considering public health, safety, cultural, societal, and environmental factors.
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- PO5 (Engineering Tool Usage):** Select, create, and apply appropriate modern engineering techniques, computational methods, resources, and IT tools, including modelling and simulation, while understanding their capabilities and limitations in solving complex engineering problems.
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SEMESTER WISE COURSES(AR-2023)

Structure of Undergraduate Engineering Program

SL. NO.	COURSE WORK - SUBJECTS AREA	CREDITS / SEMESTER								TOTAL CREDITS
		I	II	III	IV	V	VI	VII	VIII	
1	Humanities and Social Sciences including Management Courses	4	4	2	2	2	2	3		19
2	Basic Science Courses	8	8	4						20
3	Engineering Science Courses including workshop, drawing, basics of electrical mechanical/computer etc.	10	10	4	3					27
4	Professional Core Courses			11	15	15	11			52
5	Professional Elective Courses relevant to chosen specialization / branch					3	3	9	3	18
6	Open subjects - Electives from other technical and/or emerging Subjects						3	3	6	12
7	Project work, Seminar and Internship in industry or elsewhere			1	1	2	1	5	6	16
8	Mandatory Courses [Environmental Sciences, Sports and Yoga, NCC/NSS, Induction Training, Indian Constitution, Essence of Indian Traditional Knowledge]	0	0	0	0					0
	TOTAL	22	22	22	21	22	20	20	15	164

Signed _____



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I Semester [First Year]

B. Tech in Mechanical Engineering

Sl. No.	Course Category	Course Code	Course Title	Hours per week			Credits	CIA	ESE
				L	T	P			
THEORY									
1	BS	23BBSBS11001	Engineering Mathematics-I	3	1	0	4	40	60
2	BS	23BBSBS10002	Engineering Physics	3	0	0	3	40	60
		23BBSBS10003	Engineering Chemistry						
3	ES	23BBSES10001	Basic Electrical and Electronics Engineering	3	0	0	3	40	60
		23BBSES10002	Elements of Mechanical Engineering	3	1	0	4		
4	ES	23BBSES11003	Programming for Problem Solving	2	0	0	2	40	60
5	HS	23BBSHS11001	Communicative English and Soft Skills	2	0	0	2	40	60
6	HS/ES	23BBSHS10002	Human Value and Professional Ethics	1	0	0	1	Project Evaluation	
		23BBSES10004	Dietetics and Nutrition						
PRACTICAL / SESSIONAL									
1	BS	23BBSBS10102	Engineering Physics Laboratory	0	0	2	1	50	-
		23BBSBS10103	Engineering Chemistry Laboratory						
2	ES	23BBSES10101	Basic Electrical and Electronics Engineering Laboratory	0	0	2	1	50	-
3	ES	23BBSES11103	Programming for Problem Solving Laboratory	0	0	4	2	100	-
4	HS	23BBSHS11101	Communicative English and Soft Skills Laboratory	0	0	2	1	50	-
5	ES	23BBSES10105	Engineering Graphics and Design	1	0	2	2	100	-
		23BBSES10106	Engineering Workshop						
6	MC	23BBSMC11101	Induction Program (3 weeks)	-	-	-	0	-	-
TOTAL CREDITS							22		

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II Semester [First Year]

B. Tech in Mechanical Engineering

Sl. No.	Course Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE
				L	T	P			
THEORY									
1	BS	23BBSBS12001	Engineering Mathematics-II	3	1	0	4	40	60
2	BS	23BBSBS10002	Engineering Physics	3	0	0	3	40	60
		23BBSBS10003	Engineering Chemistry						
3	ES	23BBSES10001	Basic Electrical and Electronics Engineering	3	0	0	3	40	60
		23BBSES10002	Elements of Mechanical Engineering	3	1	0	4		
4	ES	23BBSES12003	Data Structure and Algorithms	2	0	0	2	40	60
5	HS	23BBSHS12001	Communicative English and Technical Communication	2	0	0	2	40	60
6	HS/ES	23BBSHS10002	Human Value and Professional Ethics	1	0	0	1	Project Evaluation	
		23BBSES10004	Dietetics and Nutrition						
PRACTICAL / SESSIONAL									
1	BS	23BBSBS10102	Engineering Physics Laboratory	0	0	2	1	50	-
		23BBSBS10103	Engineering Chemistry Laboratory						
2	ES	23BBSES10101	Basic Electrical and Electronics Engineering Laboratory	0	0	2	1	50	-
3	ES	23BBSES12103	Data Structure and Algorithms Laboratory	0	0	4	2	100	-
4	HS	23BBSHS12101	Communicative English and Technical Communication Laboratory	0	0	2	1	50	-
5	ES	23BBSES10105	Engineering Graphics and Design	1	0	2	2	100	-
		23BBSES10106	Engineering Workshop						
6	MC	23BBSMC12201	Sports and Yoga or NSS/NCC	-	-	-	0	-	-
TOTAL CREDITS							22		



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III Semester [Second Year]

B. Tech in Mechanical Engineering

Sl. No.	Course Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE
				L	T	P			
THEORY									
1	BS	23BBSBS23001	Engineering Mathematics-III	3	1	0	4	40	60
2	PC	23BMEPC23001	Engineering Thermodynamics	3	0	0	3	40	60
3	PC	23BMEPC23002	Mechanics of Solids	3	0	0	3	40	60
4	PC	23BMEPC23003	Material Science	3	0	0	3	40	60
5	ES	23BCSES23001	Object-Oriented Programming using JAVA	3	0	0	3	40	60
6	HS	23BBSHS23001	Intermediate Communication Skills And Critical Thinking	1	0	0	1	40	60
7	MC	23BMEMC20001/ 23BMEMC20002	Constitution of India / Essence of Indian Traditional Knowledge	2	0	0	0	-	-
PRACTICAL / SESSIONAL									
1	PC	23BMEPC23102	Mechanics of Solids Laboratory	0	0	2	1	50	-
2	PC	23BMEPC23103	Material Science Laboratory	0	0	2	1	50	-
3	ES	23BCSES23101	Object-Oriented Programming using JAVA Laboratory	0	0	2	1	50	-
4	HS	23BBSHS23101	Intermediate Communication Skills And Critical Thinking - Laboratory	0	0	2	1	50	-
5	PST	23BMEPW23001	Summer Internship-I	-	-	-	1	50	-
TOTAL CREDITS							22		

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IV Semester [Second Year] B. Tech in Mechanical Engineering

Sl. No.	Course Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE
				L	T	P			
THEORY									
1	PC	23BMEPC24001	Fluid Mechanics and Hydraulic Machines	3	0	0	3	40	60
2	PC	23BMEPC24002	Manufacturing Science	3	0	0	3	40	60
3	PC	23BMEPC24003	Kinematics of Machinery	3	0	0	3	40	60
4	PC	23BMEPC24004	Quality Control and Reliability	3	0	0	3	40	60
5	ES	23BCSES24001	Database Management Systems	3	0	0	3	40	60
6	HS	23BBSHS24001	Advanced Communication Skills And Professional Ethics	1	0	0	1	40	60
7	MC	23BMEMC20003	Environmental Science	2	0	0	0	-	-
PRACTICAL / SESSIONAL									
1	PC	23BMEPC24101	Fluid Mechanics and Hydraulic Machines Laboratory	0	0	2	1	50	-
2	PC	23BMEPC24102	Manufacturing Science Laboratory	0	0	2	1	50	-
3	PC	23BMEPC24103	Kinematics of Machinery Laboratory	0	0	2	1	50	-
4	HS	23BBSHS24101	Advanced Communication Skills And Professional Ethics - Laboratory	0	0	2	1	50	-
5	PST	23BMEPW24001	Mini Project-I	0	0	2	1	50	-
TOTAL CREDITS							21		

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V Semester [Third Year]

B. Tech in Mechanical Engineering

Sl. No.	Course Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE
				L	T	P			
THEORY									
1	PC	23BMEPC35001	Dynamics of Machinery	3	0	0	3	40	60
2	PC	23BMEPC35002	Advanced Manufacturing Science	3	0	0	3	40	60
3	PC	23BMEPC35003	Internal Combustion Engines	3	0	0	3	40	60
4	PC	23BMEPC35004	Design of Machine Elements	3	0	0	3	40	60
5	PE	23BMEPE35011	Advanced Mechanics of Solid	3	0	0	3	40	60
		23BMEPE35012	Automobile Engineering						
		23BMEPE35013	Modern Manufacturing Processes						
		23BMEPE35014	Advanced Fluid Mechanics						
6	HS	23BMGMG30001	Organizational Behaviour	2	0	0	2	40	60
		23BMGMG30002	Engineering Economics and Costing						
PRACTICAL / SESSIONAL									
1	PC	23BMEPC35101	Dynamics of Machinery Laboratory	0	0	2	1	50	-
2	PC	23BMEPC35102	Advanced Manufacturing Science Laboratory	0	0	2	1	50	-
3	PC	23BMEPC35103	Internal Combustion Engines Laboratory	0	0	2	1	50	-
4	PST	23BMEPW35101	Mini Project-II	0	0	2	1	50	-
5	PST	23BMEPW35102	Summer Internship-II	-	-	-	1	50	-
TOTAL CREDITS							22		



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VI Semester [Third Year]

B. Tech in Mechanical Engineering

Sl. No.	Course Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE
				L	T	P			
THEORY									
1	PC	23BMEPC36001	Heat Transfer	3	0	0	3	40	60
2	PC	23BMEPC36002	Design of Machine Members	3	0	0	3	40	60
3	PC	23BMEPC36003	Mechanical Measurement and Metrology	3	0	0	3	40	60
4	PE	23BMEPE36011	CAD / CAM	3	0	0	3	40	60
		23BMEPE36012	Refrigeration and Air Conditioning						
		23BMEPE36013	Fatigue, Creep and Fracture						
		23BMEPE36014	Product Design and Product Tooling						
5	OE	23BMEOE36011	Optimization Engineering	3	0	0	3	40	60
		23BMEOE36012	Research Methodology						
		23BMEOE36013	Principles and Practices of Management						
		23BMEOE36014	Soft Computing						
6	HS	23BMGMG30001	Organizational Behaviour	2	0	0	2	40	60
		23BMGMG30002	Engineering Economics and Costing						
PRACTICAL / SESSIONAL									
1	PC	23BMEPC36101	Heat Transfer Laboratory	0	0	2	1	50	-
2	PC	23BMEPC36102	Machine Design Laboratory	0	0	2	1	50	-
3	PST	23BMEPW36101	Mini Project-III	0	0	2	1	50	-
TOTAL CREDITS							20		

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VII Semester [Fourth Year] B. Tech in Mechanical Engineering

Sl. No.	Course Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE
				L	T	P			
THEORY									
1	PE	23BMEPE47011	Finite Element Method	3	0	0	3	40	60
		23BMEPE47012	Gas Dynamics and Jet Propulsion						
		23BMEPE47013	Advanced Welding Technology						
		23BMEPE47014	Tribology						
2	PE	23BMEPE47021	Design and Analysis of Heat Exchanger	3	0	0	3	40	60
		23BMEPE47022	Production & Operation Management						
		23BMEPE47023	Non-Destructive Evaluation and Testing						
		23BMEPE47024	Total Productive Maintenance						
3	PE	23BMEPE47031	Computational Fluid Dynamics	3	0	0	3	40	60
		23BMEPE47032	Additive Manufacturing						
		23BMEPE47033	Mechanical Vibration						
		23BMEPE47034	Hydraulics and Pneumatics						
4	OE	23BMEOE47011	Renewable Energy Sources	3	0	0	3	40	60
		23BMEOE47012	Corrosion Engineering						
		23BMEOE47013	Internet of Things						
		23BMEOE47014	Industrial Instrumentation						
5	HS	23BHSHS47001	Entrepreneurship Development	3	0	0	3	40	60
PRACTICAL / SESSIONAL									
1	PST	23BMEPW47101	Technical Seminar	0	0	2	1	50	-
2	PST	23BMEPW47102	Project Work-I	0	0	6	3	150	-
3	PST	23BMEPW47103	Summer Internship-II	-	-	-	1	50	-
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VIII Semester [Fourth Year] B. Tech in Mechanical Engineering

Sl. No.	Course Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE
				L	T	P			
THEORY									
1	PE	23BMEPW48011	Power Plant Engineering	3	0	0	3	40	60
		23BMEPW48012	Composite Materials						
		23BMEPW48013	Mechatronics						
		23BMEPW48014	Cryogenics						
2	OE	23BMEOE48011	Integrated Solid Waste Management	3	0	0	3	40	60
		23BMEOE48012	Pollution and Its Control						
		23BMEOE48013	Modern Construction Materials						
		23BMEOE48014	Hybrid Electric Vehicles						
3	OE	23BMEOE48011	Industrial Robotics	3	0	0	3	40	60
		23BMEOE48012	Green Technology						
		23BMEOE48013	Intellectual Property Rights						
		23BMEOE48014	Industrial Automation and Control						
PRACTICAL / SESSIONAL									
1	PST	23BMEPW48101	Project Work-II and Dissertation	0	0	12	6	300	-
TOTAL CREDITS							15		

17/04/2023
Date of BoS Approval

Chairman BoS



ACADEMIC REGULATION -2023





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- ❖ WK9 - Ethics, inclusive behaviour and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability, etc. with mutual understanding and respect, and inclusive attitudes.

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S Datta Lx E SK Sanda Vg

M.P. Gandhi Seal Ponparly



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	TOTAL	22	22	22	21	22	20	20	15	164



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III Semester [Second Year]
B. Tech in Mechanical Engineering

Sl. No.	Course Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE
				L	T	P			
THEORY									
1	BS	23BBSBS23001	Engineering Mathematics-III	3	1	0	4	40	60
2	PC	23BMEPC23001	Engineering Thermodynamics	3	0	0	3	40	60
3	PC	23BMEPC23002	Mechanics of Solids	3	0	0	3	40	60
4	PC	23BMEPC23003	Material Science	3	0	0	3	40	60
5	ES	23BCSES23001	Object-Oriented Programming using JAVA	3	0	0	3	40	60
6	HS	23BBSHS23001	Intermediate Communication Skills And Critical Thinking	1	0	0	1	40	60
7	MC	23BMEMC20001/ 23BMEMC20002	Constitution of India / Essence of Indian Traditional Knowledge	2	0	0	0	-	-
PRACTICAL / SESSIONAL									
1	PC	23BMEPC23102	Mechanics of Solids Laboratory	0	0	2	1	50	-
2	PC	23BMEPC23103	Material Science Laboratory	0	0	2	1	50	-
3	ES	23BCSES23101	Object-Oriented Programming using JAVA Laboratory	0	0	2	1	50	-
4	HS	23BBSHS23101	Intermediate Communication Skills And Critical Thinking - Laboratory	0	0	2	1	50	-
5	PST	23BMEPW23001	Summer Internship-I	-	-	-	1	50	-
TOTAL CREDITS							22		

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BBSBS23001	ENGINEERING MATHEMATICS – III	3	1	0	4
Pre -Requisite: Fundamentals of complex numbers, series					
Course Educational Objectives					
CEO1	To test the nature of complex function				
CEO2	To identify the different methods for complex integration				
CEO3	To analyze error by using different methods.				
CEO4	To know about different types of probability distributions.				
SYLLABUS					
UNIT :1 (10 Hours)					
Complex Analysis: Analytic function, Cauchy-Riemann equations, Harmonic Function, Properties of analytic functions, Conformal Mapping ($W = C Z, C+Z, &1/Z$), Bilinear Transformation.					
UNIT:2 (12Hours)					
Complex integration: Line integral, Cauchy's integral theorem, Cauchy's integral formula. Taylor's series, Laurent's series, Singularities and zeros, Residues, Cauchy Residue theorem, Evaluation of real integrals.					
UNIT:3 (14 Hours)					
Numerical Methods: Solution of algebraic and transcendental equations by using fixed point iteration method and Newton-Raphson's method, regula-falsi method Newton's Forward and Backward Difference Interpolation, Newton divided Difference interpolation formula, Lagrange's interpolation					
UNIT:4 (12 Hours)					
Numerical Differentiation and Integration: Numerical Differentiation, Numerical integration: The trapezoidal rule, The Simpsons(1/3rd, 3/8th) rules, solution of Ordinary differential equation -Taylor's Series, Euler's method, Modified Euler's method, Runge-Kutta methods.					
UNIT:5 (12 Hours)					
Statistics: Correlation and Regression analysis, fitting of a straight line by the least square method, Random sampling, Estimation of Parameters (maximum likelihood method), Confidence intervals, Testing of hypothesis, hypothesis (small sample tests –t, F and chi-square test).					
Course Outcomes: Upon successful completion of this course, students should be able to:					
CO1	Understanding the concept of Analytical function and to construct the harmonic conjugate of the function..				
CO2	Understand the concept of elementary function and evaluate complex integral using Cauchy's theorem and formula				
CO3	Evaluating Integral by using the concept of Residues. And numerical differentiation, integration by using some numerical methods				
CO4	Apply the concept of interpolation and evaluate the interpolation polynomials				
CO5	Apply the concept of numerical differentiation and integration and solve differential equations				



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CO6	Investigate Probability distribution problems and Evaluate the correlation and regression												
Teaching Methods: Chalk& Board													
Ref. Books:													
1. Advanced Engineering Mathematics by E. Kreyszig, Tenth Edition, Willey													
2. Numerical Methods by Jain and Iyengar.													
3. Higher Engineering Mathematics by BS Grewal: Khanna Publishers, New Delhi.													
4.Higher Engineering Mathematics by B.V.Ramana, McGraw Hills Education													
5. Numerical Methods by Dutta and Jena.													
CO-PO & PSO Mapping													
COs	PROGRAMME OUTCOMES											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	2											
CO2	2	3											
CO3	2	3											
CO4	2	3											
CO5	3	2											
CO6	2	3											
Avg.	2.33	2.66											

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPC23001	ENGINEERING THERMODYNAMICS	3	0	0	3
Pre-Requisite: Fundamentals of Thermodynamics, Mathematics & Chemistry					
Course Educational Objectives					
CEO1	Students can understand the principle and law of thermodynamics to analyze different systems such as IC Engines, steam & Gas power plant, Refrigeration system and capable to analyze the parameters in various cycle etc.				
CEO2	Students can understand the basics of properties of pure substance like steam and its conditions in vapour power cycles				
CEO3	Students can analyze the availability for open and closed systems, Maxwell and TDS equation in ideal gases.				
CEO4	Students can apply the laws of thermodynamics to refrigerators, heat engines, heat pumps compressors and nozzles etc.				
SYLLABUS					
UNIT:1		[12 Hours]			
Entropy Entropy as a property, Clausius inequality, Principle of increase of entropy, entropy change for an open and closed system. Change of entropy for an Ideal gas and pure substance, concept of entropy generation.					
Availability Available and unavailable energy, Quality of energy, Availability for non-flow and flow process, Irreversibility, Second law efficiency.					
UNIT:2		[08 Hours]			
Pure substance Properties of pure substance, P-v, T-s, h-s diagram for steam, Steam properties, Introduction to steam table with respect to specific volume, pressure, temperature, enthalpy & entropy, Mollier Diagram. Non-flow and vapour flow problems, changes of properties and work and heat transfer.					
UNIT:3		[12 Hours]			
Vapour Power Cycles: The Carnot vapor cycle and its limitations, The Rankine cycle, Means of increasing the Rankine cycle efficiency, The reheat cycle, The regenerative feed heating cycle, Cogeneration (Back pressure and Pass-out turbines), Combined cycle power generation systems, Binary vapour cycles.					
UNIT:4		[14 Hours]			
Gas Power Cycles: Air standard cycles- Otto, Diesel, Dual Combustion and Brayton cycles, The Brayton cycle with non-isentropic flow in compressors and turbines, The Brayton cycle with regeneration, reheating and intercooling.					
Refrigeration cycles: Reversed Carnot cycle, Reversed Brayton cycle (Gas refrigeration system), The vapour compression cycle, The vapour absorption cycle.					



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UNIT:5

[10 Hours]

Reciprocating Air Compressors:

Introduction (Uses of compressed air), The reciprocating cycle neglecting and considering clearance volume, Volumetric efficiency and its effect on compressor performance, Limitations of single stage compression, Multistage compression and intercooling, Optimum intercooler pressure, Performance and design calculations of reciprocating compressors, Air motors

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

CO1	Understand the thermodynamic principles including entropy, Clausius inequality and entropy change in open and closed systems
CO2	Analyze energy availability, efficiency and irreversibility in engineering processes.
CO3	Apply thermodynamic concepts to analyse entropy generation and ideal gas behaviour
CO4	Understand steam properties, optimize vapor power cycles and explore efficiency enhancements.
CO5	Evaluate the gas power cycles including variations and efficiency improvements.
CO6	Analyze refrigeration cycles, reciprocating air compressors and energy systems for practical applications

Teaching Methods: Chalk& Talk, PPT, Video Lectures, Demonstrative models

REFERENCE BOOK:

1. Cengel. Y and M.Boles, "Thermodynamics - An Engineering Approach", 7th Edition, Tata McGraw Hill, 2016.
2. Rogers Gordon and Mayhew Yon, Engineering Thermodynamics, Pearson Education Ltd, 4th Edition.
3. Nag.P.K., "Engineering Thermodynamics", 4thEdition, Tata McGraw-Hill, New Delhi, 2008.
4. Rathakrishnan. E., "Fundamentals of Engineering Thermodynamics", 2nd Edition, Prentice-Hall of India Pvt. Ltd, 2006.
5. Holman.J.P., "Thermodynamics", 3rd Edition, McGraw-Hill, 2012.
6. Ballaney P.L., Applied Thermodynamics, Khanna Publishers
7. Ramalingam, Steam Tables in SI Units , Scitech publication.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	2	3	1		1							
CO2	2	3	2	1		1							
CO3	2	2	3	2		1							
CO4	2	3	3	2		1							
CO5	2	3	3	1		1							
CO6	2	2	2	2		2							
Avg.	2.1	2.5	2.6	1.5		1.1							

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPC23002	MECHANICS OF SOLIDS	3	0	2	4
Pre -Requisite: Basic mathematics and Engineering Mechanics					
Course Educational Objectives					
CEO1	To define the concept of load, stress, strain, stress vs strain diagram and elastic constant relationship.				
CEO2	To Solve engineering problems through the relationship between stress and strain.				
CEO3	To determine shear force and bending moment diagrams for variously loading conditions				
CEO4	Learn to solve problems for calculation of torsion and Twisting moment in solid and hollow circular shafts.				
SYLLABUS					
UNIT:1		[14 Hours]			
Concept of stress: Load, Stress, Hook's law, poisson's ratio, Stress-strain diagram, working stress, Factor of safety, Principle of St. Venant, Principle of Superposition, Shear stress, Complimentary shear stress, concept of statically indeterminate problems. Compound Bars, Shear strain, Modulus of rigidity, Modulus of elasticity, Relationship among elastic constants. Strain energy, Resilience, Impact load. Temperature stresses in composite rods					
UNIT:2		[10 Hours]			
Biaxial state of stress: Plane stress, principal plane, principal stress, Mohr's circle for biaxial stress, Calculation of Principal stresses from principal strain. Thin Cylinders: Thin Cylinders and Shells under internal pressure, stresses & strain induced in thin cylinders, wire winding of thin cylinder.					
UNIT:3		[10 Hours]			
Shear force and Bending moment diagram : Concept of Shear Force and Bending Moment, Types of load and types of support, Support reactions, Relationship between bending moment and shear force, point of inflection, Shear force and bending Moment Diagram.					
UNIT:4		[10 Hours]			
Bending of Beams: Theory of simple bending, Bending stress, Shear stresses in beams, Distribution of shearing stress over a rectangular section, triangular section, I- section and T- section. Deflection of Beams: Differential equation of the elastic line, slope and deflection of beams by integration method					
UNIT:5		[8 Hours]			
Torsion : Torsion in solid and hollow circular shafts, Twisting moment, Strain energy in shear and torsion, Strength of solid and hollow circular shafts, Strength of shafts in combined bending and twisting.					
Course Outcomes: Upon successful completion of this course, students should be able to:					
CO1	Analyze the behavior of the solid bodies subjected to various types of loading.				
CO2	Find the basic mechanical properties of material, tension, compression, and combined stress using the fundamental concepts of stress, strain and elastic behavior.				
CO3	Apply the stress- strain distributions concept by diagrammatically representation of shear force & bending moment for different beams.				
CO4	Analyze the bending, slope and deflections for different cross sectional beams and columns.				
CO5	Analyze the torsion effect for shaft under twisting and combined loading conditions.				



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CO6	Evaluate the stress and strain developed on thin walled cylinders subjected to internal loading.												
Teaching Methods: Chalk& Board													
REFERENCE BOOK:													
1. Timoshenko S.P. and Young D.H., Elements of Strength of Materials, Affiliated East West Press.													
2. Rattan S.S., Strength of Materials, Tata Mc Graw Hill													
3. Beer and Johnston, Mechanics of Materials, Tata McGraw Hill.													
4. Hibbeler R.C., Mechanics of Materials, Pearson Education													
5. Riley William F., Sturges Leroy D and Morris Don H., Mechanics of Materials, Wiley Student Edition													
CO-PO & PSO Mapping													
COs	PROGRAMME OUTCOMES											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	1									2		
CO2	2	2									2		1
CO3	2	3									1		
CO4	2	3									1		
CO5	2	3									1		
CO6	2	2									1		1
Avg.	2.17	2.33									1.33		1

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPC23003	MATERIAL SCIENCE	3	0	0	3
Pre -Requisite: Solid physics					
Course Educational Objectives					
CEO1	To familiarize with the concept crystal structures, bonding of solids and their influence on properties of materials.				
CEO2	To acquaint with the construction of phase diagrams and describe the phase relationship with variables i.e. chemical composition, pressure, temperature etc.				
CEO3	To develop a fundamental understanding of the relationships between Composition-Structure-property –performance and processing of material.				
CEO4	To develop an understanding of the processes occurring in metals during heating that influences the microstructure and properties.				
SYLLABUS					
UNIT:1		[8 Hours]			
Mechanical behavior: Classification of Engineering Materials, Characteristic property of metals, Stress- Strain diagram showing ductile and brittle behavior of materials, bonding in solids, ionic, covalent and metallic bond. Crystal systems, atomic packing efficiency, crystallographic planes and directions, voids and crystal imperfections in common crystal systems. Solidification of pure metal, Homogeneous and heterogeneous nucleation processes, cooling curve, concept of super cooling. Concept of plastic deformation of metals: Mechanism: Slip and twinning; CRSS, factors affecting CRSS, yield point phenomena, Work hardening, concept of hot work and cold work, Recovery recrystallization and grain growth.					
UNIT 2:		[12 Hours]			
Concept of alloy formation, types of alloys, solid solutions, factors governing solids solubility viz. size factor, valence factor, crystal structure factor and chemical affinity factor; order-disorder transformation. Binary phase diagrams a) Isomorphism system, (b) Eutectic system, (c) Peritectic system, (d) Eutectoid system and (e) Peritectoid system. (f)Allotropic transformation. Lever rule and its application, Interpretation of solidification behaviors and microstructure of different alloys belonging to those systems, Effect of non-equilibrium cooling, coring and homogenization. Iron-cementite and iron-graphite phase diagrams					
UNIT 3:		[12 Hours]			
Equilibrium cooling behaviour of hypo, eutectoid, hyper eutectoid steels. microstructure and properties of different alloys. Heat treatment of steels, i.e. annealing, normalizing, hardening and tempering; microstructural effects brought about by these processes and their influences on mechanical properties; Concept of T.T.T diagram, factor affecting hardenability. Alloy steels: Stainless steel, tool steel, HSS, high strength low alloy steel, heat treatment, properties, microstructure and applications. Types of cast irons, their microstructures and typical uses. Concept of plastic deformation of metals, yield point phenomena, CRSS, Recovery recrystallization and grain.					

LA
Important

Expected

Dr. S. S.

Dr. S. S.

Dr. S. S.

Dr. S. S.

Dr. S. S.

Dr. S. S.



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UNIT 4: [08 Hours]
Optical properties of Materials: Scattering, Refraction, Atomic Theory of optical properties. Lasers: Construction and working on Ruby Laser and Helium-Neon Laser, Optical fibers- Principle, structure, application of optical fibres. Plastic-: Thermosetting and thermoplastics. Ceramics: Types, structure, Mechanical properties, application.

UNIT 5: [08 Hours]
Composite materials: Definition, classification, type of matrix materials and reinforcements, advantages and application of composites.
Metal Matrix Composites: Reinforcement materials, types, characteristics and selection, base metals selection. Need for MMC's and its application.

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

CO1	Appreciate the necessity of engineering materials, and its applications in various fields.
CO2	Identify possible cause of failure mechanisms of Engineering Materials and alloy formation.
CO3	Demonstrate the knowledge of nucleation, Crystal growth, Solid solution and Phase diagrams.
CO4	Appreciate the significance and applications of Various heat treatment processes.
CO5	Understand the properties and potentialities of various materials available and material selection procedures.
CO6	Acquire the Knowledge of composite materials and their production process as well as applications.

Teaching Methods: Chalk& Talk, PPT, Video Lectures, Demonstrative models

REFERENCE BOOK:

1. Avner Sydney, Introduction to physical metallurgy
2. Callister W., Fundamentals of Materials Science and Engineering
3. Dieter, Mechanical Metallurgy, Tata MacGraw Hill
4. Lakhtin Y., Engineering Physical Metallurgy and Heat Treatment, Mir Publisher, Moscow.
5. Singh Vijayendra, Physical Metallurgy
6. Materials Science and Engineering V.Raghavan PHI 2002

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	2										1	
CO2	3	2										1	
CO3	3												
CO4	2											1	
CO5	2											2	
CO6	2											2	
Avg.	2.5	2										1.4	

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BCSES23001	OBJECT-ORIENTED PROGRAMMING USING JAVA	3	0	0	3
Pre -Requisite:					
Course Educational Objectives					
CEO1	The model of object oriented programming: abstract data types, encapsulation, inheritance and polymorphism				
CEO2	Fundamental features of an object oriented language like Java: object classes and interfaces, exceptions and libraries of object collections				
CEO3	How to take the statement of a business problem and from this determine suitable logic for solving the problem; then be able to proceed to code that logic as a program written in Java				
CEO4	Develop robust, interactive, and user-friendly Java applications by applying advanced programming concepts such as exception handling, multithreading, file and stream handling, packages, GUI development using AWT/Swing, event-driven programming, and applets.				
SYLLABUS					
UNIT:1		[13Hours]			
An introduction to Object Oriented Programming, Features of Object Oriented Programming Introduction to Java. Difference between C/C++ and Java, Features of Java, First Java Program, Writing the java program, Compiling the program, JVM and its significance in executing a program, Architecture of JVM. Taking Input from keyboard, Command Line Arguments, Using Scanner Class, Using Buffered Reader class. Java Tokens, Datatypes, Operators, Control Structures, Conditional Statements, Iteration Statement/Loops, Jumping Statements, Java Arrays, 1-dimensional arrays, 2-dimensionanl arrays.					
UNIT 2:		[15 Hours]			
Introduction to Classes and Objects. Constructors, static Keyword, this Keyword, Array of Objects, Access Modifiers (Public, Private, Protected, Default). Inheritance, Types of Inheritance and Java-supported Inheritance, super, Polymorphism, Method Overloading, Constructor Overloading, Method Overriding, Dynamic Method Dispatching. Interfaces, Multiple Inheritance Using Interfaces, abstract classes.					
UNIT 3:		[12 Hours]			
String Handling in Java: String, StringBuffer, StringBuilder, StringTokenizer Wrapper classes, Auto boxing and unboxing. Java API Packages, User-Defined Packages, Accessing Packages. Error and Exception Handling, Types of exceptions Hierarchy of Exception classes, try, catch, finally, throw, throws, Commonly used Exceptions and their details ,User defined exception classes.					
UNIT 4:		[12 Hours]			
Multithreading, Thread in Java, Thread execution prevention methods. (yield(), join(), sleep()), Concept of Synchronization, Inter Thread Communication, Basics of Deadlock, Demon Thread. IO Streams (java.io package), Byte Stream and Character Stream, Files and Random Access Files, Serialization. Applet Introduction, Life Cycle of an Applet, GUI with an Applet.					



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UNIT 5:

[12 Hours]

AWT: The AWT class hierarchy, user interface components- Labels, Button, Text Components, Check Box, Check Box Group, Choice, List Box, Panels – Scroll Pane, Menu, Scroll Bar. Working with Frame class, Colour, Fonts and layout managers. Event Handling: Events, Event sources, Event Listeners, Event Delegation Model (EDM), Handling Mouse and Keyboard Events, Adapter classes SWINGS: Introduction to Swings, Hierarchy of swing components. Containers, Top level containers –J Frame, J Window, J Dialog, J Panel, J Button, J Toggle Button, J Check Box, J Radio Button, J Label, J Text Field, J Text Area, J List, J Combo Box, J Scroll Pane.

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

CO1	Knowledge of the structure and model of the Java programming language
CO2	Use the Java programming language for various programming technologies.
CO3	Develop software in the Java programming language
CO4	Evaluate user requirements for software functionality required to decide whether the Java programming language can meet user requirements.
CO5	Propose the use of certain technologies by implementing them in the Java programming language to solve the given problem.
CO6	Choose an engineering approach to solving problems, starting from the acquired knowledge of programming.

Teaching Methods: Chalk& Talk, PPT, Video Lectures, Demonstrative models

REFERENCE BOOK:

1. E Balaguruswamy, 6th Edition, Programming with Java, McGraw Hill Education
2. R Nageswara Rao(2016), Core Java: An Integrated Approach, Dreamtech Press.
3. Heribalt Schelidt(2017), Java: The Complete Reference, McGraw Hill Education.
4. SachinMalhotra/ SauravChoudhary, Second Edition, Programming in Java, Oxford Higher Education,
5. RashmiKanta Das, Core Java For Beginners, Vikas Publication.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	1											
CO2	3	2											
CO3	2	2	2										
CO4	2	1	2										
CO5	2	1	3										
CO6	1	3	3										
Avg.	2.16	1.66	1.66										

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BBSHS23001	INTERMEDIATE COMMUNICATION SKILLS AND CRITICAL THINKING.	1	0	0	1
Pre -Requisite:					
Course Educational Objectives					
CEO1	To develop the communication skills and soft skills of the students.				
CEO2	To enhance employability and entrepreneurial skills.				
CEO3	To promote critical thinking.				
CEO4	To apply effective communication and critical thinking skills in academic and professional life.				
SYLLABUS					
UNIT-1 Comprehensive Listening Skills		(4hours)			
1.1 What and why					
1.2 Techniques for improving listening skills					
UNIT-2. Public Speaking Skills		(4hours)			
2.1 Public speaking; what and why					
2.2 Overcoming stage fear					
2.3 Techniques for effective speaking skill					
UNIT- 3. Stages of Writing		(4hours)			
3.1Pre-Writing- selecting a topic					
3.2 Writing- Free Writing, Drafting					
3.3 Re-writing- Revision, editing, proof Reading.					
UNIT- 4 Effective Reading Skills		(3 hours)			
4.1 What is Reading Comprehension;					
4.2 Tips for effective reading;					
4.3Techniques and types.					
UNIT-5 Critical Thinking Skills		(4 hours)			
5.1 What and Why					
5.2 Critical thinking vs. Lateral thinking					
5.3 Ways to improve Critical Thinking					
Course Outcomes: Upon successful completion of this course, students should be able to:					
CO1	Recognize the importance of LSRW skills.				
CO2	Develop effective listening skills.				
CO3	Demonstrate public speaking skills.				
CO4	Distinguish professional writing from general writing.				
CO5	Develop effective reading skills.				
CO6	Execute critical thinking.				

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SUBJECT CODE		COURSE TITLE										L	T	P	C
23BMEPC23102		MECHANICS OF SOLIDS LABORATORY										0	0	2	1
Pre -Requisite: Mechanics of Solid															
Course Educational Objectives															
CEO1	Students will have the opportunity to apply loads to various materials under different equilibrium conditions														
CEO2	Student will perform tests on materials in tension, compression, torsion, bending, and impact														
CEO3	The machines and equipment used to determine experimental data include universal testing machines, torsion equipment, spring testing machine, compression testing machine, impact tester, hardness tester, etc														
CEO4	Data will be collected using Dial indicators, extensometers, strain gages and strain indicator equipment, as well as load and strain readouts on the machinery and graphing capabilities to print relevant plots for analysis														
LIST OF EXPERIMENTS															
List of Experiment: (Minimum 8 Experiments)															
1. Determination of tensile strength of materials by Universal Testing Machine															
2. Determination of compressive strength of materials by Universal Testing Machine															
3. Determination of bending strength of materials by Universal Testing Machine															
4. Double shear test in Universal Testing Machine															
5. Determination of Impact strength of material (Charpy and Izod)															
6. Determination of Hardness strength of materials (Brinell, Rockwell and Vickers)															
7. Determination of Rigidity modulus of material															
8. Determination of Fatigue strength of material															
9. Estimation of Spring Constant under Tension and Compression.															
10. Strain measurement using Strain Gauge.															
11. Stress measurement using strain rosette.															
Course Outcomes: Upon successful completion of this course, students should be															
CO1	Understand the behavior of different materials under diverse loading conditions														
CO2	Conduct tension, compression,shear& bending test on UTM.														
CO3	Perform impact & fatigue test of mild steel specimen.														
CO4	Determine the Brinell, Rockwell and Vicker's hardness of different material.														
CO5	Measure strain by using strain gauge and strain rosette.														
CO6	Determine the fatigue strength of material under variable loading														
CO-PO & PSO Mapping															
PROGRAMME OUTCOMES												PSOs			
COs	1	2	3	4	5	6	7	8	9	10	11	1	2		
CO1	3			3							2	2			
CO2	3			3							2				
CO3	2			3							2	2			
CO4	2		2	3							2				
CO5	2		2	2							1				
CO6	2			2							1				
Avg.	2.34		2	2.5							1.67	2.0			



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SUBJECT CODE		COURSE TITLE										L	T	P	C
23BMEPC23103		MATERIAL SCIENCE LABORATORY										0	0	2	1
Pre -Requisite: Solid physics															
Course Educational Objectives															
CEO1	Project an introductory view of the field of materials science within the framework of science and engineering disciplines.														
CEO2	Provide a smooth link between the basic knowledge of science and engineering courses.														
CEO3	Better prepare would-be materials engineers on ways to tackle day-to-day materials problems in professional engineering careers.														
CEO4	Able to operate as effective engineers or scientists in metallurgical and materials industries or related fields.														
LIST OF EXPERIMENTS															
List of Experiment: (Minimum 8 Experiments)															
1. Preparation of crystal models SC, BCC, FCC, CPH crystals															
2. Preparation and study of the Micro Structure of pure metals like Iron, Cu and Al.															
3. Preparation and study of the Microstructure of Mild steels, low Carbon steels, high Carbon steels.															
4. Study of Iron-Carbon Phase diagram.															
5. Study of the Micro Structures of White cast iron, Grey Cast Irons, Malleable cast iron, Nodular cast iron etc.															
6. Study of the Micro Structures of Non-Ferrous alloys, Brass, Bronze, aluminum alloys.															
7. Study of the Micro structures of Heat treated steels Annealed Normalized, Hardened.															
8. Hardeneability of steels by Jominy End Quench Test.															
9. To find out the hardness of various treated and untreated steels.															
10. Standard test Methods for Estimation of Grain Size.															
Course Outcomes: Upon successful completion of this course, students should be															
CO1	Identify the types of crystal models and micro structures.														
CO2	Understand the properties of steel and cast iron with its phase diagram..														
CO3	Classify steels and cast iron based on microstructure.														
CO4	Evaluate the grain size, hardness and hardeneability of various treated and untreated steels.														
CO5	Understanding heat treatment procedures and the change of properties.														
CO6	Ability to select metals and alloys for industrial applications.														
CO-PO & PSO Mapping															
PROGRAMME OUTCOMES												PSOs			
COs	1	2	3	4	5	6	7	8	9	10	11	1	2		
CO1	2			3						2		1			
CO2	3											3			
CO3	2			2						2		2			
CO4	2			3								2			
CO5	2			2						2		2			
CO6	2			2						2		2			
Avg.	2.16			2.4						2		2			



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SUBJECT CODE	COURSE TITLE	L	T	P	C
23BCSES23101	OBJECT ORIENTED PROGRAMMING THROUGH JAVA LAB	0	0	2	1
Pre -Requisite: Basic knowledge of C language					
Course Educational Objectives					
CEO1	The model of object oriented programming: abstract data types, encapsulation, inheritance and polymorphism.				
CEO2	Fundamental features of an object oriented language like Java: object classes and interfaces, exceptions and libraries of object collections.				
CEO3	How to take the statement of a business problem and from this determine suitable logic for solving the problem; then be able to proceed to code that logic as a program written in Java.				
CEO4	Develop robust, interactive, and user-friendly Java applications by applying advanced programming concepts such as exception handling, multithreading, file and stream handling, packages, GUI development using AWT/Swing, event-driven programming, and applets.				
LIST OF EXPERIMENTS					
List of Experiment:					
Experiment-1(I/O in Java)					
Q 1. Write a Program that accepts two Strings as command line arguments and generate the output in the required format					
Q 2. Write a Java program to find if the given number is prime or not.					
Q 3. Write a program to print the sum of all the digits of a given number.					
Q 4. Write a Java program to find if the given number is palindrome or not					
Experiment 2: (Array)					
Q 1. Write a program to initialize an integer array and find the maximum and minimum value of the array.					
Q 2. Write a program to initialize an integer array with values and check if a given number is present in the array or not.					
Q 3. Write a program to find the largest 2 numbers and the smallest 2 numbers in the given array.					
Q 4. Write a program to remove the duplicate elements in an array and print the same					
Experiment 3:(Class, Object, Static method, Constructor)					
Q 1 Create a class Box that uses a parameterized constructor to initialize the dimensions of a box. The dimensions of the Box are width, height, depth. The class should have a method that can return the volume of the box. Create an object of the Box class and test the functionalities.					
Q 2. Create a new class called Calculator with the following methods:					
1. A static method called power Int (int num1, int num2)					
This method should return num1 to the power num2.					
2. A static method called power Double (double num1, int num2).					
This method should return num1 to the power num2.					



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3. Invoke both the methods and test the functionalities.

Hint: Use `Math.pow(double, double)` to calculate the power.

Q 3 Design a class that can be used by a health care professional to keep track of a patient's vital statistics. The

following are the details.

Name of the class - Patient

Member Variables -

Patient Name(String), height (double), width(double)

Member Function - double compute BMI ()

The above method should compute the BMI and return the result. The formula for computation of BMI is weight

(in kg) ÷ height*height (in meters).

Create an object of the Patient class and check the results.

Q 4 Create a class Author with the following information.

Member variables: name (String), email (String), and gender (char)

Parameterized Constructor: To initialize the variables

Create a class Book with the following information.

Member variables: name (String), author (of the class Author you have just created), price (double), and

Qty In Stock (int)

[Assumption: Each book will be written by exactly one Author]

Parameterized Constructor: To initialize the variables

Getters and Setters for all the member variables

In the main method, create a book object and print all details of the book (including the author details)

Experiment 4: (Inheritance and polymorphism)

Q 1. Create a class named 'Animal' which includes methods like eat () and sleep (). Create a child class of Animal named 'Bird' and override the parent class methods. Add a new method named fly (). Create an instance of Animal class and invoke the eat and sleep methods using this object. Create an instance of Bird class and invoke the eat, sleep and fly methods using this object.

Q 2. Create a class called Person with a member variable name. Save it in a file called Person.java

Create a class called Employee that will inherit the Person class. The other data members of the Employee class are annual salary (double), the year the employee started to work, and the national insurance number which is a String. Save this in a file called Employee.java

Your class should have the necessary constructors and getter/setter methods. Write another class called Test Employee, containing a main method to fully test your class definition.

Q 3. Create a school application with a class called Person. Create name and date of Birth as member variables.

Create a class called Teacher that inherits from the Person class. The teacher will have additional properties like salary, and the subject that the teacher teaches.

Create a class called Student that inherits from Person class. This class will have a member variable called student Id.

Create a class called College Student that inherits from Student class. This class will have college Name, the year in which the student is studying (first/second/third/fourth) etc.

Create objects of each of this classes, invoke and test the methods that are available in these classes.

Q 4. Create a base class Fruit with name, taste and size as its attributes.

Create a method called eat () which describes the name of the fruit and its taste.

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Inherit the same in 2 other classes Apple and Orange and override the eat () method to represent each fruit taste.

Q 5. Write a program to create a class named shape. It should contain 2 methods, draw () and erase () that prints

“Drawing Shape” and “Erasing Shape” respectively.

For this class, create three sub classes, Circle, Triangle and Square and each class should override the parent class

functions - draw () and erase ().

The draw () method should print “Drawing Circle”, “Drawing Triangle” and “Drawing Square” respectively.

The erase () method should print “Erasing Circle”, “Erasing Triangle” and “Erasing Square” respectively.

Create objects of Circle, Triangle and Square in the following way and observe the polymorphic nature of the class

by calling draw () and erase () method using each object.

Shape c=new Circle ();

Shape t=new Triangle ();

Shape s=new Square ();

Experiment 5: (String and String Buffer)

Q 1. Write a Program to check whether a given String is Palindrome or not.

Q 2. Write a java program that will concatenate 2 strings and return the result. The result should be in lowercase.

Q 3 Given a string, return a new string made of 'n' copies of the first 2 chars of the original string where 'n' is the length of the string.

Q 4. Write a java program that will return the first half of the string, if the length of the string is even. It should return null for odd length string.

Q 5. Write a java program that accepts a string and returns a new string without the first and last character of the input string.

Experiment 6: (Abstract class and Interface)

Q 1. Create a class called General Bank that acts as base class for all banks. This class has get Savings Interest Rate and get Fixed Deposit Interest Rate methods, which returns the savings account interest rate and fixed deposit account interest rate that the specific bank gives. Since General Bank cannot say what percentage which bank would give, make these methods abstract.

Create two subclasses of General Bank called ICICI Bank and KotM Bank. Override the inherited methods from the base class. The following are the interest rates of these banks.

ICICI Bank - Savings 4% Fixed 8.5% and

KotM Bank - Savings 6% Fixed 9%.

Create a main method to test the above classes and their methods. Try one by one and observe your findings

a) ICICI Bank i=new ICICI Bank ();

b) KotM Bank k=new KotM Bank ();

c) General Bank g=new KotM Bank ();

d) General Bank g=new ICICI Bank ();

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Q 2. Create an abstract class Compartment to represent a rail coach. Provide an abstract function notice in this class.

public abstract String notice ();

Derive First Class, Ladies, General, Luggage classes from the compartment class. Override the notice function in

each of them to print notice message that is suitable to the specific type of compartment.

Create a class Test Compartment. Write main function to do the following:

Declare an array of Compartment of size 10.

Create a compartment of a type as decided by a randomly generated integer in the range 1 to 4.

Check the polymorphic behavior of the notice method. [i.e. based on the random number generated, the first compartment can be Luggage, the second one could be Ladies and so on.

Experiment 7: (Exception Handling)

Q 1. Get an input String from user and parse it to integer, if it is not a number it will throw number format exception Catch it and print "Entered input is not a valid format for an integer." or else print the square of that number. (Refer Sample Input and Output).

Q 2. Write a program that takes as input the size of the array and the elements in the array. The program then asks the user to enter a particular index and prints the element at that index.

This program may generate Array Index Out of Bounds Exception. Use exception handling mechanisms to handle this exception. In the catch block, print the class name of the exception thrown.

Q 3. Write a program that takes as input the size of the array and the elements in the array. The program then asks the user to enter a particular index and prints the element at that index. Index starts from zero.

This program may generate Array Index Out of Bounds Exception or Number Format Exception. Use exception handling mechanisms to handle this exception.

Q 4. Write a program to accept name and age of a person from the command prompt (passed as arguments when you execute the class) and ensure that the age entered is ≥ 18 and < 60 . Display proper error messages

Experiment-8: (Wrapper class and file handling)

Q 1. Write a program to receive an integer number as a command line argument, and print the binary, octal and hexadecimal equivalent of the given number.

Q 2. Write a Java program that reads an integer number (between 1 and 255) from the user and prints the binary representation of the number. The answer should be printed as a String.

Q 3. Create an employee class with properties of your choice. Create an object of this class and also create a clone of the same. After making the clone, change the properties of the original employee object and print the properties of both the original and clone object and note down your observation.

Q 4. Write a program to count the number of times a character appears in a File.

Q 5. Write a program to copy contents from one file to another and check the output.

Experiment 9: (AWT and Swing)

Q 1. Write a java program to create a frame containing three buttons (Yes, No, Close). When button yes or no is pressed, the message "Button Yes/No is pressed" gets displayed in label control. On pressing CLOSE button frame window gets closed.

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Lab Code		Name of the Lab (1 st Sem)										L	T	P	C
23BBSHS23101		INTERMEDIATE COMMUNICATION SKILLS AND CRITICAL THINKING LABORATORY										0	0	2	1
Course Educational Objectives															
CEO1	To develop communication skills and soft skills of the students.														
CEO2	To enhance employability and entrepreneurial skills.														
CEO3	To promote critical thinking.														
CEO4	To apply effective communication and critical thinking skills in academic and professional life.														
Course Outcomes: <i>The students will be able to:</i>															
CO1	Recognise the importance of LSRW skills														
CO2	Develop effective listening skills														
CO3	Demonstrate public speaking skills														
CO4	Distinguish professional writing from general writing														
CO5	Develop effective reading skills														
CO6	Execute critical thinking														
CO-PO Mapping															
COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11		1	2	
CO1							2	1	2		3				
CO2									2		3				
CO3							3	1	2		3				
CO4							3		3		3				
CO5									2		3				
CO6							3	2	3		3				
Avg.							2.75	1.33	2.8		3				
SYLLABUS															
Comprehensive Listening													(2 hours)		
Activity- Summarizing a Passage															
Comprehensive Listening													(2 hours)		
Activity- Listening to a short video/ Ted Talk and giving a brief.															
Oral Presentation													(2 hours)		
Activity- Presenting seminar paper in a team and presenting to the class															
Individual Oral Presentation													(2 hours)		
Activity- Preparing a seminar paper individually and presenting.															
Persuasive Speaking													(2 hours)		
Activity- Individual/ Group Debate.															
Situational Interviews													(2 hours)		
Activity- Answering hypothetical question in a mock interview															

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Signature of the Head of the Institute
 Signature of the Head of the Department
 Signature of the Head of the Section
 Signature of the Head of the Laboratory
 Signature of the Head of the Workshop
 Signature of the Head of the Library
 Signature of the Head of the Hostel
 Signature of the Head of the Sports
 Signature of the Head of the Cultural
 Signature of the Head of the Social Service



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Video Resume	(2 hours)
Activity- Preparing a digital resume	
Professional e-mail	(2 hours)
Activity- Writing e-mail for professional purpose	
Minutes of the Meeting	(2 hours)
Activity- Preparing minutes of mock meetings.	
Memo Writing	(2 hours)
Writing Memos for internal organization	
Vocabulary Exercise	(2 hours)
Activity- Playing word games in small groups.	
Intermediate Reading Comprehension	(2 hours)
Activity-Reading an Intermediate level passage/ poems and answer questions.	
Preparing a Sales Pitch	(2 hours)
Activity- Prepare a presentation on any product (real/imaginary) of choice and present a sales pitch	
Critical Thinking Activity	(2 hours)
Activit- critically analysis of Kabuliwala by Rabindranath Tagore OR The Gift of Magi by O Henry	
Critical Thinking	(2 hours)
Activity 2- Critically Analyze Stopping by the Woods in a Snowy Evening by Robert Frost or Ozymondias by P.B Shelly.	
Teaching Methods: Chalk & Board/ PPT/ Video Lectures	
Text/ Reference Books:	
1. An Introduction to Professional English and Soft Skills by B. K. Das et al., Cambridge University Press, 2009.	
2. Communicative English for Engineers and Professionals by Nitin Bhatnagar and Mamta Bhatnagar. Published by DK/Pearson, 2010.	
3. PracticalEnglishUsage.MichaelSwan,OUP,1995	














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IV Semester [Second Year]
B. Tech in Mechanical Engineering

Sl. No.	Course Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE
				L	T	P			
THEORY									
1	PC	23BMEPC24001	Fluid Mechanics and Hydraulic Machines	3	0	0	3	40	60
2	PC	23BMEPC24002	Manufacturing Science	3	0	0	3	40	60
3	PC	23BMEPC24003	Kinematics of Machinery	3	0	0	3	40	60
4	PC	23BMEPC24004	Quality Control and Reliability	3	0	0	3	40	60
5	ES	23BCSES24001	Database Management Systems	3	0	0	3	40	60
6	HS	23BBSHS24001	Advanced Communication Skills And Professional Ethics	1	0	0	1	40	60
7	MC	23BMEMC20003	Environmental Science	2	0	0	0	-	-
PRACTICAL / SESSIONAL									
1	PC	23BMEPC24101	Fluid Mechanics and Hydraulic Machines Laboratory	0	0	2	1	50	-
2	PC	23BMEPC24102	Manufacturing Science Laboratory	0	0	2	1	50	-
3	PC	23BMEPC24103	Kinematics of Machinery Laboratory	0	0	2	1	50	-
4	HS	23BBSHS24101	Advanced Communication Skills And Professional Ethics - Laboratory	0	0	2	1	50	-
5	PST	23BMEPW24001	Mini Project-I	0	0	2	1	50	-
TOTAL CREDITS							21		



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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPC24001	FLUID MECHANICS & HYDRAULICS MACHINES	3	0	0	3
Pre -Requisite: Physics, Thermodynamics, Mechanics, Mathematics					
Course Educational Objectives					
CEO1	To know the concept of fluid and its properties, manometer, hydrostatic forces acting on different surfaces and also problem solving techniques.				
CEO2	To relate the basic laws of fluids, flow patterns, viscous flow through pipes and their corresponding problems.				
CEO3	To analyze the hydrodynamic forces acting on vanes and their performance evaluation				
CEO4	To evaluate of the importance, function and performance characteristics of hydro machinery				
SYLLABUS					
UNIT:1		(8 Hours)			
Scope of fluid mechanics and its development as a science, Physical property of Fluid: Density, specific gravity, specific weight, specific volume, surface tension and capillarity, viscosity, compressibility and bulk modulus, Fluid classification. Fluid statics: Pressure, Pascal's Law, Pressure variation for incompressible fluid, atmospheric pressure, absolute pressure, gauge pressure and vacuum pressure, manometer, and its classification. Hydrostatic process on submerged surface, force on a horizontal submerged plane surface, force on a vertical submerged plane surface. Buoyancy and floatation, Archimedes' principle, stability of immersed and floating bodies, determination of metacentric height.					
UNIT:2		(8 Hours)			
Fluid kinematics: Introduction, description of fluid flow, classification of fluid flow. Reynolds number, Acceleration of fluid particles, flow rate and continuity equation, differential equation of continuity, Mathematical definitions of irrotational and rotational motion. Circulation, potential function and stream function. Flow net					
UNIT:3		(8 Hours)			
Fluid dynamics: Introduction, Euler's equation along a streamline, energy equation, Bernoulli's equation and its application to siphon, venturimeter, orifice meter, pitot tube. Flow through pipes: Major and minor energy losses, hydraulic gradient and total energy lines, pipes in series and parallel, equivalent pipes, water hammer in pipes					
UNIT: 4		(8 Hours)			
Impact of Jet: Introduction, Force exerted by the jet on a stationary and movable plate (vertical, inclined, curved) Hydraulic turbines: Classification, Impulse and Reaction turbine; Tangential, Radial and axial turbine. Impulse turbine, Pelton wheel, bucket dimensions, number of buckets in pelton wheel, efficiency and performance curves. Reaction Turbines: Francis turbine and Kaplan turbine, velocity triangle and efficiencies, performance curve. Function of draft tube and casing cavitation					
UNIT:5		(8 Hours)			
Centrifugal Pump: Constructional features, vane shape, velocity triangles, Efficiencies, Pump					

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPC24002	MANUFACTURING SCIENCE	3	0	1	3
Pre -Requisite: Metallurgy					
Course Educational Objectives					
CEO1	To study basic definitions associated with casting terminology, its classification and various steps involved in it.				
CEO2	To understand the application of the different joining techniques, and be able to select an appropriate technique according to a specific requirement.				
CEO3	To understand the fundamentals of metal working process.				
CEO4	To give the basic concept of the powder metallurgy processing and also the theory and technology of powder production, consolidation and sintering.				
SYLLABUS					
UNIT:1		[12 Hours]			
Metal Casting Processes: sand mold making procedure. Patterns: Pattern materials, pattern allowances, types of pattern. Molding materials: Molding sand composition, sand preparation, sand properties and testing, Sand molding processes. Cores: Types of cores, core prints, chaplets, and chills. Design of Gating systems: Melting practice: Cupola furnace, solidification, defects in castings and their remedies, Shell molding, precision investment casting, permanent mold casting, die casting, centrifugal casting, continuous casting, Advantages and limitations.					
UNIT:2		[10 Hours]			
Welding Process: Principles of welding, brazing and soldering, Classification of Welding Processes, gas welding and cutting process, equipment. Arc welding power source and consumables. Resistance welding: Principle and equipment, resistance spot welding, resistance seam welding, electro slag welding, forge welding. Modern welding methods like plasma arc, laser beam, Electron beam, Ultrasonic, Explosive and friction welding. Destructive and Nondestructive testing of casting and welding.					
UNIT:3		[10 Hours]			
Bulk Deformation Processes: Hot working and cold working of metals Forging processes: Open, closed die forging, types of forging, Cold forging and Hot forging. Rolling of metals: Types of Rolling, Flat strip rolling, shape rolling operations, Defects in rolled parts. Principle of rod and wire drawing, Tube drawing. Principles of Extrusion, Types, Hot and Cold extrusion.					
UNIT:4		[8 Hours]			
Sheet metal operations: Sheet metal characteristics: Press tools operations, shearing action, drawing dies, spinning, bending, embossing and coining.Stretch forming operations:Hydro forming – Rubber pad forming.					
UNIT:5		[8 Hours]			
Powder Metallurgy: Powder manufacturing, compaction and sintering processes. Advantages and applications of Powder Metallurgy. Brief introduction to explosive forming, coating and deposition methods. Plastics: Introduction, Raw material for plastics, Properties of plastics, types, Thermosetting plastics, Thermoplastics, Moulding compounds.					
Course Outcomes: Upon successful completion of this course, students should be able to:					
CO1	Select materials, types and allowances of patterns used in-casting and analyze the components of moulds.				
CO2	Design core, core print and gating system in metal casting processes				
CO3	Analyze and access the importance of welding processes in manufacturing.				

C.A.  
 Date 
 C.A. 
 



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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPC24003	KINEMATICS OF MACHINERY	3	0	0	3
Pre -Requisite: Basic of Mechanics (Statics) topics like: Equilibrium of forces, Free body diagram, friction and D'Alemberts principle					
Course Educational Objectives					
CEO1	To obtain an idea of Mechanisms, basic of methodology of machines				
CEO2	Apply knowledge to the selection of proper techniques and processes for velocity and acceleration using graphical techniques				
CEO3	To develop skills for designing and analyzing linkages, cams, gears and other mechanisms				
CEO4	To provide a foundation for the study of machine design				
SYLLABUS					
UNIT:1		(12Hours.)			
Basics of Mechanisms					
Mechanisms and machines, Rigid and resistant bodies, Link, Kinematic pair, Degrees of Freedom, Classifications of Kinematic pairs, kinematic-chain, Linkage, Mechanism, and structure, Classification of mechanisms, Equivalent Mechanisms, Four - Link (bar) Mechanism, Inversions of Slider - Crank Chain, Double – Slider Chain.					
Plane Motion of Body :Instantaneous centre, Notation, Number of I - Centres, Kennedy's theorem, Locating I - Centres, Angular velocity by I - Centre Method					
UNIT:2		(12 Hours)			
Velocity and Acceleration Analysis of Mechanisms (Graphical Method)					
Velocity Analysis: Introduction, Absolute and Relative Motion, Vectors, Addition and subtraction of Vectors, Motion of a Link, Four Link Mechanism, Angular Velocity of Links, Velocity of Rubbing, Slider - Crank Mechanism, Crank and Slotted Lever Mechanism.					
Acceleration Analysis: Four-Link Mechanism, slider-Crank Mechanism Angular acceleration of Links, Acceleration of Intermediate and offset points, Coriolis acceleration component, Crank and slotted lever Mechanism.					
UNIT:3		(12 Hours)			
Kinematics of Cam Mechanisms					
Definitions of cam and followers – their uses – Types of followers and cams – Terminology – Types of follower motion - Uniform velocity, Simple harmonic motion and uniform acceleration and retardation. Maximum velocity and maximum acceleration during outward and return strokes, Graphical synthesis of cam profile					
UNIT:4		(12Hours)			
Gears and Gear Trains					
Gears: Introduction, Classification, Terminology, Law of Gearing, Interferences, methods of avoiding interferences, path of contact, arc of contact.					
Gear Trains: Introduction, simple Gear Train, Compound Gear Train, Reverted Gear train, Planetary or Epicyclic Gear Train, Analysis of Epicyclic Gear Train, Torques in Epicyclic Trains. Tabular and Algebraic Methods					
UNIT:5		(12 Hours)			
Mechanisms with lower pairs: Motor Vehicle Steering Gears - Davis Steering Gear & Ackermann Steering Gear, Hooke's Joint.					
Synthesis of Mechanisms:					
Dimensional synthesis, function generation, path generation and motion generation, Synthesis of Four Bar linkage for specified Instantaneous conditions, Hirsch horn's method of components.					

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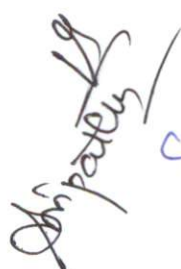
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Course Outcomes: Upon successful completion of this course, students should be able to:													
CO1	Understand the basics of mechanisms and their motion												
CO2	Understand the inversions of different mechanisms.												
CO3	Apply and analyze the concept of mechanism to interpret and examine the velocity and acceleration of different linkages in mechanisms												
CO4	Analyze cam & follower motion to design cams profiles for specified followers motion												
CO5	Evaluate gear tooth geometry and analyze the gear trains speed ratio to select appropriate gears for the required applications.												
CO6	Synthesize planar four bar mechanisms for specified kinematic conditions												
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert													
REFERENCE BOOK:													
1. Rattan S.S., Theory of Machines, Tata McGraw Hill Publishers.													
2. Ghosh and Mallik, Theory of Mechanisms and Machines													
3. RattanS.S.,Theory of Machines, Tata McGraw Hill Publishers.													
4. Ghosh and Mallik, Theory of Mechanisms and Machines													
5. KhurmiR. S. and GuptaJ K, Theory of Machines, S.Chand													
6. SinghSadhu, Theory of Machines, Pearson.													
7. Shigley, Theory of Machines, Oxford													
CO-PO & PSO Mapping													
COs	PROGRAMME OUTCOMES											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	2											2
CO2	3	2											2
CO3	3	3		2									3
CO4	3	3	3										3
CO5	3	3											3
CO6	3	2	2	2									2
Avg.	3	2.5	2.5	2									2.5











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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPC24004	QUALITY CONTROL AND RELIABILITY	3	0	0	3
Pre -Requisite: Basics of Probability and Statics					
Course Educational Objectives					
CEO1	Introduces students to concepts and methods of modern statistical quality control				
CEO2	To apply standard quality control tools. They learn the theoretical statistical concepts that justify the use of particular quality control tools in particular situations				
CEO3	To learn theory and methods for analyzing the performance of different quality control tools				
CEO4	Use of appropriate software for statistical and quality analysis is taught, and is necessary for successful completion of some homework assignments. Issues of ethics and professional responsibility and their relation to product quality are discussed				
SYLLABUS					
UNIT:1		[10 Hours]			
Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality control: Quality cost -Variation in process causes of variation –Theory of control chart- uses of control chart – Control chart for variables – X chart, R chart and chart -process capability – process capability studies and simple problems.					
UNIT:2		[10 Hours]			
Control chart for attributes –control chart for nonconforming– p chart and np chart – control chart for nonconformities– C and U charts, State of control and process out of control identification in charts, pattern study. Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producer’s Risk and consumer’s Risk. AQL, LTPD, AOQL concepts- standard sampling plans for AQL and LTPD- uses of standard sampling plans.					
UNIT:3		[10 Hours]			
Total Quality Management perspective, methodologies and procedures; Roadmap to TQM, ISO 9000, KAIZEN, Quality Circles, Six sigma concepts, JIT. Taguchi Loss function, Orthogonal Array, Linear Graphs, Parametric Design, S/N Ratio, ANOVA					
UNIT:4		[10 Hours]			
Life testing – Objective – failure data analysis, Mean failure rate, mean time to failure, mean time between failure, hazard rate – Weibull model, system reliability, series, parallel and mixed configuration – simple problems. Maintainability and availability					
UNIT:5		[10 Hours]			
Reliability improvements – techniques- use of Pareto analysis – design for reliability – redundancy unit and standby redundancy –Product design – Product analysis – Product development–Product life cycles.					
Course Outcomes: Upon successful completion of this course, students should be able to:					
CO1	Understand the fundamental principles and techniques of quality control and reliability, including statistical process control, root cause analysis, failure modes and effects analysis, and reliability testing.				
CO2	Describe different sampling plans				
CO3	Demonstrate and analyze data by using various control charts and interpret for variables and attributes to improve quality in manufacturing and service				



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	industries.
CO4	Apply the knowledge and critical thinking skills to evaluate, create and implement Total Quality Management methodologies and procedures, including ISO 9000, KAIZEN, Quality Circles, and Six Sigma concepts, as well as analyze and optimize product and process designs
CO5	Explain, analyze and evaluate product and system reliability
CO6	Apply quality control and Reliability improvement techniques to real-world scenarios and assess the impact of their application on process, product quality, reliability and performance.

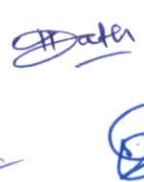
Teaching Methods: Chalk& Board/ PPT/Video Lectures

REFERENCE BOOK:

1. Douglas's. Montgomery, "Introduction to Statistical quality control", 4th edition, John Wiley 2001.
2. A.Mitra, Fundamentals of Quality Control and Improvement, Pearson Education, 2nd ed. 2005.
3. John's. Oakland. "Statistical process control", 5th edition, Elsevier, 2005
4. Connor, P.D.T.O., "Practical Reliability Engineering", John Wiley, 1993
5. Grant, Eugene .L "Statistical Quality Control", McGraw-Hill, 1996

CO-PO & PSO Mapping													
COs	PROGRAMME OUTCOMES											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	3	1										
CO2	2	2	1	1	1								
CO3	2	3	1										
CO4	3	2	2	2	2			1	1		1		
CO5	2	2	2										
CO6	2	1											
Avg.	2.33	2.16	1.4	1.5	1.5			1	1		1		










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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BCSES24001	DATABASE MANAGEMENT SYSTEM	3	0	0	3
Pre -Requisite: A student should have basic idea on programming and file systems.					
Course Educational Objectives					
CEO1	Gain a good understanding of the architecture and functioning of Database Management Systems as well as associated tools and techniques.				
CEO2	Understand and apply the principles of data modeling using Entity Relationship and develop a good database design				
CEO3	Understand the use of Structured Query Language (SQL) and its syntax				
CEO4	Apply Normalization techniques for effective database design				
SYLLABUS					
UNIT:1		(6 Hours)			
Introduction to database Systems: advantages of database system over traditional file system, Basic concepts & Definitions, Database users, Database Language, Database System Architecture, Schemas, Sub Schemas, & Instances, database constraints, 3-level database architecture, Data Abstraction, Data Independence, Mappings, Structure, Components & functions of DBMS, Data models. Entity-Relationship model: Basic concepts, Design process, Constraints, Keys, Design issues, E-R Diagrams, weak entity sets, Extended E-R features – generalization, specialization, aggregation, Reduction to E-R database schema					
UNIT:2		(10 Hours)			
Relational Query Languages: Relational Operations. Relational Algebra, Selection and projection set operations, renaming, Joins, Division, Examples of Algebra overviews, Relational calculus, Tuple relational Calculus, Domain relational calculus, Extended relation algebra operation					
UNIT:3		(10 Hours)			
Normalization: Introduction, non-loss decomposition and functional dependencies, First, Second, and third normal forms – dependency preservation, Boyce-Codd normal form. Higher Normal Forms - Introduction, Multi-valued dependencies and fourth normal form, Join dependencies and fifth normal form					
UNIT:4		(10 Hours)			
Transaction Concept: Transaction properties (ACID), Transaction State, Schedules, Serializability (Conflict Serializability and View Serializability), Need for Concurrency, Concurrency Control Lock based control, time stamping Protocol, Two Phase Locking, Dead lock in DBMS Recovery and Atomicity: Log Based Recovery, Transaction Logs and Shadow Paging, Types of Recovery Techniques in DBMS, Rollback/Undo Recovery Technique, Commit/Redo Recovery Technique, Checkpoint Recovery, Backup Techniques					

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UNIT:5

(6 Hours)

Detailed Storage Architecture: Storage Strategies: Detailed Storage Architecture, Storing Data, Magnetic Disk, RAID, Other Disks, Magnetic Tape, Storage Access, File & Record Organization, File Organizations & Indexes, Order Indices, B+ Tree Index Files, Hashing Data Dictionary

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

CO1	Identify and Classify the concepts of Database Management system, Data models and architecture of database, ER to Relational mapping concepts.
CO2	Applying The constraints in database using different query languages like:- relational algebra and calculus implementing the Data definition and data manipulate languages in Database.
CO3	Compare the different normal forms to Apply normalization process to construct consistent Database.
CO4	Design and Develop the Database with concurrency control and recovery strategies to make complete Database without confliction and anomalies in concurrent access environment.
CO5	Develop efficient storage scheme of saving and retrieving Records and Files
CO6	Apply the principles of database transaction management, database recovery and security.

Teaching Methods: Chalk& Board/ PPT/Video Lectures

REFERENCE BOOK:

- Sudarshan, Korth: Database System Concepts, 6th edition, McGraw-Hill Education
- Elmasari &Navathe: Fundamentals of Database System, Pearson Education.
Elmasari &Navathe: Fundamentals of Database System, Pearson Education.
- Ramakrishnan : Database Management Systems, McGraw-Hill Education.
- Andrew S. Tanenbaum: Modern Operating Systems, 3rd Edition, Pearson Education.
- Terry Dawson, Olaf Kirch: Linux Network Administrator's Guide, 3rd Edition O'Reilly

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	1	1										
CO2	3	2	1										
CO3	2	1	1										
CO4	2	1	2										
CO5	2	1	2										
CO6	3	2	1										
Avg.	2.5	1.33	1.33										



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SUBJECT CODE	COURSE TITLE										L	T	P	C
23BMEPC24101	FLUID MECHANICS AND HYDRAULICS MACHINES LABORATORY										0	0	2	1
Pre -Requisite: Mathematics, Fluid Mechanics and Hydraulic Machines														
Course Educational Objectives														
CEO1	To know the concept of fluid and its properties, manometer, hydrostatic forces acting on different surfaces and also problem solving techniques.													
CEO2	To relate the basic laws of fluids, flow patterns, viscous flow through ducts and their corresponding problems.													
CEO3	To analyze the hydrodynamic forces acting on vanes and their performance evaluation													
CEO4	To evaluate of the importance, function and performance characteristics of hydro machinery													
LIST OF EXPERIMENTS														
List of Experiment: (Minimum 8 Experiments)														
1. Determination of Metacentric Height and application to stability of floating bodies.														
2. Determination of Cv and Cd of Orifices.														
3. Experiments on impact of Jets														
4. Experiments on performance of Pelton Turbine														
5. Experiments on performance of Francis Turbine														
6. Experiments on performance of Kaplan Turbine														
7. Experiments on performance of centrifugal pump														
8. Experiments on performance of reciprocating pump														
9. Experiments on Reynold's Apparatus														
10. Experiments on Flow through pipes														
11. Verifications of Bernoulli's equation														
Course Outcomes: Upon successful completion of this course, students should be able to:														
CO1	Discuss the differences among measurement techniques, their relevance and applications.													
CO2	Explain the condition of floating and submerging of any object in water.													
CO3	Analyze the various parameters of flow through Orifice, Venturimeter.													
CO4	Calculate the performance analysis of turbines and pumps that can be used in power plants.													
CO5	Gaining knowledge to calculate and design engineering applications involving fluid.													
CO6	Analyze a variety of practical fluid-flow devices and utilize fluid mechanics principles in design.													
CO-PO & PSO Mapping														
PROGRAMME OUTCOMES											PSOs			
COs	1	2	3	4	5	6	7	8	9	10	11	1	2	
CO1	3			3						1				
CO2	2			3						2				
CO3	2			2						3				
CO4	2			3						3				
CO5	3		2	2						3				
CO6	3			2						3				
Avg.	2.5		2	2.5						2.5				

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SUBJECT CODE		COURSE TITLE										L	T	P	C
23BMEPC24102		MANUFACTURING SCIENCE LABORATORY										0	0	2	1
Pre -Requisite:															
Course Educational Objectives															
CEO1	Examine the principles associated with basic operations involving the casting, forming and welding of engineering materials														
CEO2	Interpret the advantages and limitations of each process and its influence on the properties of the material in the finished component														
CEO3	To know the basic processes used in performing forming and welding operations on engineering materials														
CEO4	Formulate practical design methods to materials working techniques														
LIST OF EXPERIMENTS															
List of Experiment: (Minimum 6 Experiments)															
1.Determination of grain size, clay content, permeability and green compressive strength of Molding sand. (2 to 3-experiments)															
2.Foundry Practices															
3. Preparation of a wood pattern.															
4.Determination of strength of brazed and solder joints															
5.Practice and preparation of job in TIG/MIG welding															
6. Practice and preparation of job in sheet metal using processes like forming and deep drawing.															
7.Demonstration of different rolling mills															
8.Demonstration of Extrusion processes															
Course Outcomes: Upon successful completion of this course, students should be able to:															
CO1	Utilize and determination of Sand properties testing for the molding sands.														
CO2	Understand the Pattern design and making, casting drawing														
CO3	Fabricate joints using GTAW and GMAW														
CO4	To plan and create jobs by using Brazing and soldering														
CO5	Understand and preparation of job using forming and deep drawing on sheet metal														
CO6	Demonstrate practical understanding of extrusion and rolling operation.														
CO-PO & PSO Mapping															
PROGRAMME OUTCOMES												PSOs			
COs	1	2	3	4	5	6	7	8	9	10	11	1	2		
CO1				3						1		1			
CO2				3						2			2		
CO3				2						2		2			
CO4				2						2		1			
CO5				2											
CO6				3											
Avg.				2.5						1.75		1	2		



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SUBJECT CODE	TITLE OF THE SUBJECT										L	T	P	C
23BMEPC24103	KINEMATICS OF MACHINERY LABORATORY										0	0	2	1
Pre Requisite: Physics , Mechanics, Theory of Machine														
Course Educational Objectives														
CEO1	To understand the concept of machines, mechanisms and elated terminologies													
CEO2	Discriminate mobility (number of degrees-of-freedom). Enumeration of rigid links and types of joints within mechanisms. To make the students become familiar and understanding of the most commonly used mechanisms (4-bar, 6-bar linkages, and cams).													
CEO3	To understand the Principles and working of various straight line motion mechanisms													
CEO4	To develop and analyze cam profiles for different mechanisms.													
LIST OF EXPERIMENTS														
List of Experiments: (Minimum 8 no. of Experiments)														
1. Design of any one working model related to Kinematics of Mechanisms i.e., unit I and unit II.														
2. Radius of Gyration of compound pendulum														
3. Radius of Gyration of Connecting Rod.														
3. Study of simple /compound/Reverted Gear trains														
4. Experiment on Cam Analysis Apparatus.														
5. Experiment on Coriolis component of acceleration.														
7.Experiment on Journal Bearing Apparatus														
8. Study of interference and undercutting for gear drives.														
9.Experiment on Epicyclic gear train														
Course Outcomes: Upon successful completion of this course, students should be able to:														
CO1	Develop the design concepts of different types of mechanism with lower pairs and higher pairs													
CO2	Analyze the velocity and acceleration of links of different mechanisms.													
CO3	Study and analyze the gear profiles and gear trains.													
CO4	Classify cams and followers & analyze the cam design.													
CO5	Evaluate radius of gyration of different components													
CO6	Analyze the variation of pressure distribution for design of journal bearing													
CO-PO & PSO Mapping														
PROGRAMME OUTCOMES											PSOs			
COs	1	2	3	4	5	6	7	8	9	10	11	1	2	
CO1	2		1	3					3				2	
CO2	2			3					2				2	
CO3	2			3					1					
CO4	2		2	3					2				2	
CO5	2			3					3				2	
CO6	2		2	3					3				2	
Avg.	2		2.5	3					2.3				2	



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Subject Code		Name of the Subject (4 th Sem)										L	T	P	C
23BBSHS24101		Advanced Communication Skills and Professional Ethics (Lab)										0	0	2	1
CEO1	To develop communication skills and soft skills of the students.														
CEO2	To enhance employability and entrepreneurial skills.														
CEO3	To inculcate professional ethics.														
Course Outcomes: The students will be able to:															
CO1	Develop ways to overcome barriers in professional communication														
CO2	Formulate advance speaking skills														
CO3	Organise professionals meetings and talks.														
CO4	Develop professional writing skills for career growth														
CO5	Understand the importance of ethics in professional life														
CO6	Use technological aids for self-learning														
CO-PO Mapping															
COs	PROGRAMMEOUTCOMES											PSOs			
	1	2	3	4	5	6	7	8	9	10	11	1	2		
CO1											3				
CO2										3	2				
CO3									3		2				
CO4										3	2				
CO5								3			2	2			
CO6										3	2				
Avg.								3	3	3	2.16				
SYLLABUS															
Listening Scientific Documentaries											(2 hours)				
Activity- Write down the important points in the documentaries															
Listening to a play/ short film											(2 hours)				
Activity- summarise it in your own words															
Spontaneous Speaking											(2 hours)				
Activity- Extempore															
Hosting a Meeting											(2 hours)				
Activity- Hosting a mock meeting in a given topic															
Teach a class											(2 hours)				
Activity-Giving lecture on any topic of choice to the class															
Give a Ted Talk											(2 hours)				
Activity- Prepare and Deliver a Ted Talk															
Article Writing											(2 hours)				
Activity- Analyze an article provided in class															
Social media post											(2 hours)				
Activity- reading social media post for a company															

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V Semester [Third Year]
B. Tech in Mechanical Engineering

Sl. No.	Course Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE
				L	T	P			
THEORY									
1	PC	23BMEPC35001	Dynamics of Machinery	3	0	0	3	40	60
2	PC	23BMEPC35002	Advanced Manufacturing Science	3	0	0	3	40	60
3	PC	23BMEPC35003	Internal Combustion Engines	3	0	0	3	40	60
4	PC	23BMEPC35004	Design of Machine Elements	3	0	0	3	40	60
5	PE	23BMEPE35011	Advanced Mechanics of Solid	3	0	0	3	40	60
		23BMEPE35012	Automobile Engineering						
		23BMEPE35013	Modern Manufacturing Processes						
		23BMEPE35014	Advanced Fluid Mechanics						
6	HS	23BMGMG30001	Organizational Behaviour	2	0	0	2	40	60
		23BMGMG30002	Engineering Economics and Costing						
PRACTICAL / SESSIONAL									
1	PC	23BMEPC35101	Dynamics of Machinery Laboratory	0	0	2	1	50	-
2	PC	23BMEPC35102	Advanced Manufacturing Science Laboratory	0	0	2	1	50	-
3	PC	23BMEPC35103	Internal Combustion Engines Laboratory	0	0	2	1	50	-
4	PST	23BMEPW35101	Mini Project-II	0	0	2	1	50	-
5	PST	23BMEPW35102	Summer Internship-II	-	-	-	1	50	-
TOTAL CREDITS							22		



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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPC35001	DYNAMICS OF MACHINERY	3	0	1	4
Pre-Requisite: Basic Mathematics, Engineering Physics, Engineering Mechanics					
Course Educational Objectives					
CEO1	To equip the student with fundamental knowledge of dynamics of machines so that student can appreciate problems of dynamic force balance, transmissibility of forces, isolation of systems, vibrations				
CEO2	Develop knowledge of analytical and graphical methods for calculating balancing of rotary and reciprocating masses				
CEO3	Develop understanding of vibrations and its significance on engineering design.				
CEO4	Develop understanding of dynamic balancing, flywheel analysis, gyroscopic forces and moments.				
SYLLABUS					
UNIT:1		[12 Hours]			
Dynamic force analysis of mechanisms: Dynamic Force Analysis: Introduction, D'Alembert's Principle, Equivalent Offset Inertia Force, Dynamic Analysis of Slider - Crank mechanism (Using Analytical method) Velocity and Acceleration of piston, Angular velocity and Angular Acceleration of Connecting Rod, Piston Effort (Effective Driving Force), Crank Effort, Turning moment diagram –fluctuation of energy.					
UNIT:2		[12 Hours]			
Gyroscope: Effect of precession, motion on the stability of moving vehicles such as motorcycle, motorcar, aeroplane and ships. Governors: Types of governors - Watt, Porter and Proell governors. Spring loaded governors – Hartnell and Hartung with auxiliary springs. Sensitiveness, isochronism and hunting – stability – effort and power of the governors.					
UNIT:3		[10 Hours]			
Friction: pivots and collars – uniform pressure, uniform wear – friction circle and friction axis. Clutches – Types – Single plate, multi-plate and cone clutches. Brakes and Dynamometers: Types of brakes: Simple block brake, band and block brake-internal expanding shoe brake-effect of braking of a vehicle. Dynamometers – absorption and transmission types. General description and methods of operation					
UNIT:4		[12 Hours]			
Balancing of Masses Balancing of Rotating Masses: Static and Dynamic Balancing, Balancing of single rotating mass by balancing masses in same plane and in different planes. Balancing of several rotating masses by balancing masses in same plane and in different planes. Balancing of Reciprocating Masses: Inertia Effect of crank and connecting rod, Single cylinder Engine, Balancing in multi cylinder-inline engine (primary and secondary forces), V-type engine, Radial engine – direct and reverse crank method.					

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UNIT:5

[12 Hours]

Vibration:

Free Vibrations: Free Vibration of mass attached to vertical spring – Transverse loads – vibrations of beams with concentrated and distributed loads. Dunkerly's method – Raleigh's method.

Whirling of shafts – critical speed–Damped vibration, Free vibrations with viscous damping, Logarithmic Decrement. – torsional vibrations, Natural frequency of free torsional vibration

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

CO1	Describe various dynamic forces involved in the working of machine elements
CO2	Analyze dynamic force analysis of slider crank mechanism, turning moments of flywheel
CO3	Apply and analyze gyroscopic effects on various dynamic for stabilization
CO4	Analyze and design centrifugal governors
CO5	Compute frictional losses, torque transmission of mechanical systems
CO6	Apply and analyze balancing and vibration in desire system

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert

Ref. Books:

1. Rao P.N., Manufacturing Technology, , Tata McGraw Hill publication.
2. Pandey P.C., Shan H.S., Modern Manufacturing Processes, Tata McGraw Hill
3. Ghosh and Mallik, Manufacturing Science, East West Press.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	2	3											
CO2	3	1											2
CO3	3	2											
CO4	3	1											
CO5	3	2											
CO6	3	1											2
Avg.	2.8	1.66											2

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPC35002	ADVANCED MANUFACTURING SCIENCE	3	0	0	3
Pre -Requisite: Engineering workshop, Mechanics					
Course Educational Objectives					
CEO1	To know the basics of metal machining and mechanics of metal machining				
CEO2	To study the different cutting tool materials and types & geometry of cutting tools				
CEO3	To acquire knowledge on various machining processes and its working principle				
CEO4	To select the best suitable non-conventional manufacturing process for processing of various hard, brittle and heat sensitive materials employed in modern manufacturing industries.				
SYLLABUS					
UNIT:1		[12 Hours]			
Classification of various tool and tool geometry, various tool angles of a single point cutting tool, ASA and ORS, Conversion of ASA to ORS and vice versa, Mechanics of chip formation, Effect of Geometrical parameters on cutting force and surface finish, Merchant's theory, Force relationship and velocity relationship, Cutting tool materials, Types of Tool Wear: Flank wear, Crater wear, Wear measurement, Cutting fluid and its effect; Machinability Criteria, Tool life and Taylor's equation, Effect of variables on tool life and surface finish.					
UNIT:2		[12 Hours]			
Conventional machining process and machine tools – Turning, Drilling, Shaping, Planning, Milling, Grinding. Machine tools used for these processes, their specifications and various techniques used.					
UNIT:3		[10 Hours]			
Production Machine tools – Capstan and turret lathes, single spindle and multi spindle semiautomatics, Gear shaper and Gear hobbing machines. Super finishing process- Honing, Lapping, Super Finishing, Polishing and Buffing.					
UNIT:4		[12 Hours]			
Principles of machine tools: Kinematics of machine tools, speed transmission from motor to spindle, speed reversal mechanism, mechanism for feed motion, Tool holding and job holding methods in different Machine tools, Indexing mechanism and thread cutting mechanism, Quick return mechanism. Calculation of Machining time for various machining process, Economics of machining.					
UNIT:5		[12 Hours]			
Non-traditional Machining processes: Need of non-conventional machining, Comparison of conventional and non-conventional machining, Working principle of Ultrasonic Machining, Laser Beam Machining, Plasma Arc Machining, Electro Chemical Machining, Electro Discharge Machining, Electron Beam Machining, Abrasive Jet Machining, Application, Advantage and limitation of various non-conventional machining processes.					

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Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Describe the concepts in tool geometry and develop relations for different physical quantities using appropriate technique during orthogonal cutting.
CO2	Discuss the working principle of conventional machines and the application of production machine tools
CO3	Acquire ability to use range of production machine tools and mastering super finishing techniques to ensure precision in manufacturing.
CO4	Explain the various mechanisms involved in conventional machines and interpret the concept of economics of metal cutting
CO5	Compare and contrast conventional and non-conventional machining processes..
CO6	Apply non-conventional machining techniques in practical applications, considering their advantages and limitations.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert

Reference Books:

1. Boothroyd G. and Knight W.A., Fundamentals of Machining and Machine Tools, CRC Press
2. Shaw M.C., Metal Cutting Principles, Oxford University Press
3. Sharma P.C., A Textbook of Production Engineering, S. Chand & Co
4. Rao P.N., Manufacturing Technology, Tata McGraw Hill publication.
5. Pandey P.C., Shan H.S., Modern Manufacturing Processes, Tata McGraw Hill
6. Ghosh and Mallik, Manufacturing Science, East West Press.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3												
CO2	3	1												2
CO3	3	2												
CO4	3	1												
CO5	3	2												
CO6	3	1												2
Avg.	2.8	1.66												2

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPC35003	INTERNAL COMBUSTION ENGINES	3	0	0	3
Pre -Requisite: Engineering Thermodynamics					
Course Educational Objectives					
CEO1	Understand the working principle of reciprocating internal combustion engine.				
CEO2	Understand the concept of atomization of fuel in carburetor and spray formation in injector.				
CEO3	Understand the mechanism of ignition, injection, combustion, supercharging, scavenging, knocking and detonation phenomena.				
CEO4	Understand the engine performance in terms of power, efficiency, exhaust emission and control.				
SYLLABUS					
UNIT:1		[08 Hours]			
Fundamentals of I.C. Engines Introduction, Classification of I.C. Engines. Fundamental difference between SI and CI engines, Comparison of two stroke and four stroke engines. Valve timing diagram, Properties and rating of IC engine, fuels, Additives and non-petroleum fuels.					
UNIT:2		[14 Hours]			
Carburetion and Fuel injection: Function of carburetors, Description and principle of simple carburetor and its drawback, petrol injections (Throttle and Port). Requirements of diesel injections system. Types of injection systems, Fuel pumps and nozzles, Types of fuel injections, Spray formation, penetration and direction. Combustion of Fuels: Stages of SI engine combustion, Effect of engine variables on ignition lag and flame propagation, fuel knock, control of knock. SI engine combustion chamber, Stage of diesel combustion, variables affecting delay period. Diesel knock and methods of control. CI engine combustion chambers					
UNIT:3		[08 Hours]			
Supercharging and scavenging: Thermodynamic cycle with supercharging and its effect. Efficiency of supercharging engines Methods of supercharging and scavenging of two stroke engines. Turbo-charging: Methods of turbo charging, effects of turbo charging on performance					
UNIT:4		[10 Hours]			
Engine Emission and Control: Engine Emissions and its harmful effects, Gasoline and Diesel emission: Methods of measuring pollutants controlling of engine emission. Catalytic Converters Cooling, Lubrication systems: Air cooling and water cooling systems, Effects of cooling on power output and efficiency. Properties of lubricants additives.					
UNIT:5		[10 Hours]			
Introduction to Alternative Fuels: LPG, LNG, CNG, Alcohol, Hydrogen, Vegetable oils and Biogas. Testing and Performance: Fuel air and power measurement methods. Performance of SI and CI engines Improvement in IC engines: Dual Fuel engine, Multi fuel engine, stratified engine and homogenous mixture compression engine.					



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Course Outcomes: Upon successful completion of this course, students will be able to:													
CO1	Identify and Explain the various components of IC engine and differentiate them												
CO2	Classify atomization, spray formation and combustion phenomena related to SI and CI engines and factors influencing combustion chamber design.												
CO3	Illustrate the working of IC Engines and various systems in them.												
CO4	Analyze exhaust gas emission formation in IC engines and its effects along with the legislation standards and selection of catalytic converter												
CO5	Design an IC engine and calculate the various performance parameters of it												
CO6	Understand the various improvements in IC engine and alternative fuels used it.												
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert													
Ref. Books:													
1. Ganeshan V., IC Engines, TMH, 4th edition													
2. Gupta H N., IC Engines, PHI Publication, 3 rd edition.													
3. Mathur and Sharma, IC Engines, Dhanpat Rai & Sons, 4 th edition.													
4. Gill and Smith, IC Engines, OXFORD & IBH, 4 th -edition.													
5. Heywood John B., IC Engines Fundamentals, TMH, 3 rd edition.													
CO-PO & PSO Mapping													
COs	PROGRAMME OUTCOMES											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	2	1											3
CO2	2	2											3
CO3	3	3	2										3
CO4	2	2	2			2	2						3
CO5	3	2	3			2	2						3
CO6	2					2	2						3
Avg.	2.3	2.0	2.33			2	2						3



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.SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPC35004	DESIGN OF MACHINE ELEMENTS	3	0	0	3
Pre Requisite: Mathematics, Mechanics of Solid					
Course Educational Objectives					
CEO1	To teach students how to apply the concepts of stress analysis, theories of failure and able to do tolerance analysis and specify appropriate tolerances for machine design applications by using data book.				
CEO2	To analyze and design structural joints.				
CEO3	To teach students how to apply mechanical engineering design theory to identify and quantify machine elements in the design of commonly used mechanical systems				
CEO4	To analyze and design mechanical springs.				
SYLLABUS					
UNIT:1		[8 Hours]			
Mechanical engineering design: Introduction to design procedure, General considerations in the design of Engineering Materials and their properties selection, Stages in design, Code and Standardization, Interchangeability, Preferred numbers, Fits and Tolerances, Use of Data books. Fundamentals of Machine Design: Types of load, Modes of failure, factor of safety concepts, Working stress, theories of failure – Design based on strength and stiffness					
UNIT:2		[8 Hours]			
Design for variable loading: Fatigue load stress cycle, Fluctuating load, reversed and repeated load, Endurance limit and factors affecting it, Endurance strength, S-N curves, Modifying factors: Size, surface finish, Stress concentration factors, Concept and mitigation of stress concentration, Notch sensitivity, Goodman, Gerber and Soderberg criteria., Stress due to combined loading.					
UNIT:3		[12 Hours]			
Machine Element Design: Design of Joints: Rivets, welds based on different types of loading, Boiler joints, cotter joints and knuckle joints					
UNIT:4		[12 Hours]			
Design of Keys, Shaft and Couplings: Classification of keys and pins, Design of keys and pins, Design of shafts: based on strength, torsional rigidity and fluctuating load. Design of couplings: Rigid coupling muff ,split muff and flange coupling , Flexible coupling					
UNIT:5		[10 Hours]			
Design of Lever: Classification, Design of levers, Cranked lever, Lever of safety valve, , Power screw ,design with square thread such as screw jack					
Course Outcomes: Upon successful completion of this course, students should be able to:					
CO1	Understand the design procedure and selection of material for a specific application				
CO2	Estimate allowable loads in machine elements using failure theories.				
CO3	Design a component when it is subjected to variable loads.				
CO4	Design the cotter , knuckle , riveted and welded joints.				
CO5	Develop the design of keys , shaft and couplings.				
CO6	Explain the design procedure of lever .				



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Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert

Ref. Books:

1. Bhandari V.B., Design of Machine Elements, Tata McGraw Hill, 3rd edition, 2010.
2. Shigley J.E., Budynas R.G. and Nisbett K.J., Mechanical Engineering Design, TMH, 10th edition, 2014

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	2											1
CO2	3	2	2										1
CO3	2	2	3										1
CO4	2	2	3										1
CO5	2	2	3										1
CO6	2	2	3										1
Avg.	2.33	2	2.8										1

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- Below it: "S.K." and "S.K." (initials).
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- Middle: "S.K." (initials).
- Middle right: "S.K." (initials).
- Right: "S.K." (initials).
- Far right: "S.K." (initials).



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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPE35011	ADVANCED MECHANICS OF SOLID	3	0	0	3
Pre -Requisite: Fundamentals in mathematics, Engg. Mechanics, and mechanics of solids					
Course Educational Objectives					
CEO1	Explain the students of different types of mechanical elements, structural bodies and their application				
CEO2	By Applng different types of theories of failure, strength of the machine elements structural bodies can be determined				
CEO3	Summarize the social need of the particular elements and their cost effective design satisfying for the need of society.				
CEO4	Make use of the concept of stress and strain in different types of beam, structure analysis, and design in machine elements.				
SYLLABUS					
UNIT:1		[8 Hours]			
Analysis of stress: Elementary concept of elasticity, stresses in three dimensions, Principal Stresses, Stress Invariants, Mohr's Circle for 3-D state of stress, Octahedral Stresses, State of pure shear, plane stress. Differential equations of equilibrium.					
UNIT:2		[8 Hours]			
Analysis of strain: State of strain at a point, Strain Invariant, Principal Strains, Plane state of strain, Strain measurements. Compatibility conditions. Energy Methods: Work done by forces and elastic strain energy stored. Reciprocal relations, Theorem of virtual work, Castigliano's theorems.					
UNIT:3		[8 Hours]			
Bending of beams: Asymmetrical bending, Shear centre, Bending of curved beams, Stress distribution in beam with rectangular, circular and trapezoidal cross section, stresses in crane hooks, ring and chain links., Deflection of thick curved bars. Axisymmetric problems: Thick walled cylinder subjected to internal and external pressures, Compound cylinders, Shrink fit					
UNIT:4		[8 Hours]			
Repeated stresses and fatigue in metals: Fatigue tests and fatigue design theory, Goodman, Gerber and Soderberg criteria, Concept of stress concentration, Notch sensitivity.					
UNIT:5		[8 Hours]			
Introduction to Mechanics of Composite Materials: Lamina and Laminates, Micromechanics of FRP Composites. Introduction to Fracture Mechanics: Basic modes of fracture, Fracture toughness evaluation.					
Course Outcomes: Upon successful completion of this course, students should be able to:					
CO1	Develop principles of elasticity theory to determine stresses and strains				
CO2	Apply theory of elasticity and formulate plane stress and plane strain problems				
CO3	Estimate stresses and deflection of beams under unsymmetrical bending and to locate shear Centre of thin wall beams.				
CO4	Analyze solid mechanics problem using classical methods and energy methods.				
CO5	Derive governing differential equations to solve engineering problem				
CO6	Understand the fatigue and fracture mechanics of failure mechanism and composites.				

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPE35012	AUTOMOBILE ENGINEERING	3	0	0	3

Pre -Requisite: Internal Combustion Engine, Kinematics and Dynamics of Machines

Course Educational Objectives

CEO1	To impart practical and theoretical knowledge in both practically by covering the various types of power-driven vehicles
CEO2	To familiarize the students with the fundamentals of Automotive Engine System, Chassis and suspension system, braking and transmission system, and cooling system
CEO3	To make the students acquainted with the operation, maintenance and repairs of all components of the various transportation vehicles
CEO4	To make the students aware of the various electrical vehicles and electrical system of automobiles

SYLLABUS

UNIT:1
[8 Hours]

Introduction:

Main units of automobile chassis and body, different systems of the automobile, description of the main parts of the engine, motor vehicle act.

Power for Propulsion: Resistance to motion, rolling resistance, air resistance, gradient resistance, power required for propulsion, tractive effort and traction, road performance curves.

UNIT:2 [8 Hours]

Braking systems:

Hydraulic braking system, braking of vehicles when applied to rear, front and all four wheels, theory of internal shoe brake, design of brake lining and brake drum, different arrangement of brake shoes, servo and power brakes.

UNIT:3
[12 Hours]

Transmission Systems:

Layout of the transmission system, main function of the different components of the transmission system, transmission system for two wheels and four wheels drives. Hotchkiss and torque tube drives.

Gear box:

Sliding mesh, constant mesh and synchromesh gearbox, design of 3 speed and 4 speed gear box, over drive, torque converter, semi and fully automatic transmission. Hooke's joint, propeller shaft, differential, rear axles, types of rear axles, semi floating, three quarter floating and full floating types.

UNIT:4	[10 Hours]
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Front wheel Geometry and steering systems:

Camber, castor, kingpin inclination, toe-in and toe-out, centre point steering condition for true rolling, components of steering mechanism, power steering (Hydraulic & Pneumatic).

Ignition System:

Requirements of an ignition system, conventional ignition system (Battery and Magneto), Modern ignition system (TCI, CDI), Spark advance mechanism.



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UNIT:5

[8 Hours]

Electrical system of an automobile:

Starting system, charging system, other electrical system. Electrical vehicles: History, electrical vehicles and the environment pollution, description of electric vehicle, Operational advantages, present EV performance and applications, battery for EV, Battery types and fuel cells, Solar powered vehicles, hybrid vehicles.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	List out the different components and systems of an automobile.
CO2	Illustrate the constructional designs and working principles involved in vehicle design.
CO3	Understand the various control systems of Automotive mechanics.
CO4	Utilize steering geometry, principle of gear box design and braking system for effective power transmission of vehicles
CO5	Explain different ignition system and battery as a source of energy.
CO6	Develop electrical vehicles considering environmental safety

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Models

Text Books:

1. Giri N.K., Automobile Mechanics, Khanna publishers, 3rd edition
2. Gupta K.M., Automobile Engineering, Vol I & II, Umesh Publication, 4th edition
3. Singh Kripal, Automobile engineering, Vol I & II Standard Publishers Distributors, 3rd edition
4. Crouse William H. and Anglin Donald L., Automotive mechanics: TMH, 5th edition
5. Heitner J., Automobile Mechanics, East West Press, 8th edition.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3												3
CO2	3	2	1										3
CO3	2	2											2
CO4	3	3	2										3
CO5	3												2
CO6	3		2				3						3
Avg.	2.83	2.33	1.67				3						2.67

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPE35013	MODERN MANUFACTURING PROCESSES	3	0	0	3
Pre -Requisite: Basic Manufacturing process, Machining science and technology					
Course Educational Objectives					
CEO1	To learn the concepts of material removal using various advanced machining operations				
CEO2	To develop competency in understanding of machine tools and mechanism involved in machining operations				
CEO3	To apply fundamentals principles of electro chemical, laser and plasma machining				
CEO4	To be able to control surface finish, material removal rate and accurate dimensions by applying different machining operations				
SYLLABUS					
UNIT:1		[14 Hours]			
ULTRASONIC MACHINING (USM): Introduction, equipment, tool materials & tool size, abrasive slurry, cutting tool system design :- Modelling for finding MRR, Effect of parameters on Material removal rate, tool wear, Accuracy, surface finish, applications, advantages & Disadvantages of USM. Numerical on MRR					
ABRASIVE JET MACHINING (AJM): Introduction, Equipment, Variables in AJM: Carrier Gas, Type of abrasive work material, standoff distance (SOD), nozzle design, shape of cut. Process characteristics - Material removal rate, Nozzle wear, Accuracy & surface finish. Modelling for finding MRR. Applications, advantages & Disadvantages of AJM. Numerical on MRR.					
Water Jet Machining: Principle, Equipment, Operation, Application, Advantages and limitations of Water Jet machining.					
UNIT:2		[12 Hours]			
ELECTROCHEMICAL MACHINING (ECM): Introduction, study of ECM machine, elements of ECM process: ECM Process characteristics – Material removal rate, Accuracy, surface finish, Applications, Electrochemical turning, Grinding, Honing, deburring, Advantages, Limitations. Numerical on MRR					
CHEMICAL MACHINING (CHM): Introduction, elements of process, chemical blanking process, process characteristics of CHM: material removal rate, accuracy, surface finish, Hydrogen embrittlement, advantages & application of CHM.					
ELECTRICAL DISCHARGE MACHINING (EDM): Introduction, mechanism of metal removal, dielectric fluid, spark generator, EDM tools (electrodes) Electrode feed control, EDM process characteristics: metal removal rate, accuracy, surface finish, Heat Affected Zone. Machine tool selection, Application, electrical discharge grinding, wire EDM					
UNIT:3		[12 Hours]			
PLASMA ARC MACHINING (PAM): Introduction, equipment, non-thermal generation of plasma, selection of gas, Mechanism of metal removal, PAM parameters, process characteristics. Applications, Advantages and limitations.					
LASER BEAM MACHINING (LBM): Introduction, equipment of LBM mechanism of metal removal, LBM parameters, Process characteristics, Applications, Advantages & limitations.					
ELECTRON BEAM MACHINING (EBM): Principles, equipment, operations, applications, advantages and limitation of EBM					



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UNIT:4

[10 Hours]

Surface engineering: Introduction, High speed machining and grinding: Application of advanced coatings in high performance modern cutting tools and high performance super-abrasive grinding wheels, Micro and nano machining of glasses and ceramics. Theory and application of chemical processing: Chemical Machining, Coating and Electro-less forming, PVD and CVD.

UNIT-5

[08 Hours]

Reverse Engineering: Introduction, Concurrent Engineering and Rapid prototyping: Solid based, liquid and powder based rapid prototyping methods.

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

CO1	Understand requirements to achieve maximum material removal rate and best quality of machined surface while machining various industrial engineering materials.
CO2	Analyze the machining process parameters, and mechanism involved in material removal process in various non-conventional machining.
CO3	Interpret contemporary issues in material removal process using advanced techniques, skills and modern engineering tools necessary for engineering practice.
CO4	Develop a thorough knowledge of surface engineering principles to effectively apply advanced coatings in modern cutting tools
CO5	Acquire knowledge in micro and nano machining, with a specific emphasis on glasses and ceramics, to achieve precise manufacturing
CO6	Apply the concept of concurrent, reversed engineering and rapid prototyping in various industrial applications.

Teaching Methods: Chalk& Board/ PPT/ Lecture by Industry Expert

Text Books:

1. Pandey and Shan, Modern machining process, Tata McGraw Hill 2000
2. Kalpakjian, Manufacturing Engg. & Technology, Pearson Education
3. R. Davis Joseph, Metals Handbook: Machining Volume 16, American Society of Metals.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	2											
CO2	3	1											
CO3	2	2			1								2
CO4	2	2											2
CO5	3	2											
CO6	3	1											
Avg.	2.6	1.6			1								2

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

CO1	Demonstrate the concept of fluid mechanics like statics, kinematics and dynamics, including concepts of mass, momentum and energy conservation equation.
CO2	Apply the principles of high and low Reynolds number flows to fluid flow systems.
CO3	Review the concepts of boundary layer and flow in transition.
CO4	Apply the fundamentals of one dimensional isentropic flow to variable area duct and principles of compressible flow to constant area duct subjected to friction or heat transfer
CO5	Apply the concepts of Computational Fluid Dynamics in the FVM and FEM to analyse and solve practical problems.
CO6	Apply dimensional analysis concepts to establish dimensional free equations for various fluid flow conditions

Teaching Methods: Chalk& Board

Text Books:

1. MohantyA K, Fluid Mechanics, TMH Publication
2. Som S K, Fluid Mechanics, TMH Publication
3. WhiteF M, Fluid Mechanics, TMH Publication
4. Schlitching, Fundamentals of Fluid Mechanics
5. Cengel and Cimbala, Fluid Mechanics, TMH Publication

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	2											
CO2	2	3											
CO3	2	2											
CO4	2	3											
CO5	3	2			2								
CO6	2	3											
Avg.	2.33	2.5			2								

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMGMG30001	ORGANIZATIONAL BEHAVIOUR	2	0	0	2
Pre -Requisite: Basic Management Principles					
Course Educational Objectives					
CEO1	Understand OB Fundamentals:				
CEO2	Apply Cognitive and Motivational Theories				
CEO3	Improve Communication and Decision-Making				
CEO4	Manage Stress and Performance				
SYLLABUS					
UNIT:1		[12 Hours]			
Introduction to OB - Definition, Nature and Scope – Environmental and organizational context – Impact of IT, globalization, Diversity, Ethics, culture, reward systems and organizational design on Organizational Behaviour. Cognitive Processes-I: Perception and Attribution: Nature and importance of Perception – Perceptual selectivity and organization – Social perception – Attribution Theories – Locus of control –Attribution Errors –Impression Management.					
UNIT:2		[10 Hours]			
Cognitive Processes-II: Personality and Attitudes – Personality as a continuum – Meaning of personality - Johari Window and Transactional Analysis - Nature and Dimension of Attitudes – Job satisfaction and organizational commitment-Motivational needs and processes- Work-Motivation Approaches Theories of Motivation- Motivation across cultures - Positive organizational behaviour: Optimism – Emotional intelligence – Self-Efficacy					
UNIT:3		[10 Hours]			
Dynamics of OB-I: Communication – types – interactive communication in organizations – barriers to communication and strategies to improve the follow of communication - Decision Making: Participative decision-making techniques – creativity and group decision making. Dynamics of OB –II Stress and Conflict: Meaning and types of stress –Meaning and types of conflict - Effect of stress and intraindividual conflict - strategies to cope with stress and conflict.					
UNIT:4		[10 Hours]			
Dynamics of OB –III Power and Politics: Meaning and types of power – empowerment - Groups Vs. Teams – Nature of groups – dynamics of informal groups – dysfunctions of groups and teams – teams in modern work place.					
UNIT:5		[8 Hours]			
Leading High performance: Job design and Goal setting for High performance- Quality of Work LifeSocio technical Design and High-performance work practices - Behavioural performance management: reinforcement and punishment as principles of Learning –Process of Behavioural modification - Leadership theories - Styles, Activities and skills of Great leaders.					

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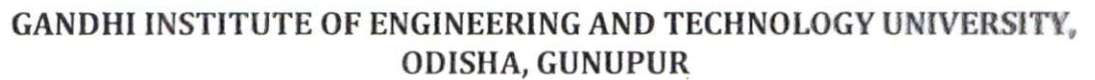
Course Outcomes: <i>Upon successful completion of this course, students should be able to:</i>													
CO1	Understand OB concepts and the impact of IT, globalization, and other factors.												
CO2	Use perception and attribution theories to understand behavior.												
CO3	Examine personality traits, attitudes, and motivational theories.												
CO4	Address communication barriers and enhance group decision-making.												
CO5	Identify and address stress and conflict in the workplace.												
CO6	Apply job design, quality of work life, and leadership theories for high performance.												
Teaching Methods: Chalk& Board													
Text Books:													
1. Luthans, Fred: Organizational Behaviour 10/e, McGraw-Hill,													
2. McShane: Organizational Behaviour, 3e, TMH,													
3. Nelson: Organizational Behaviour, 3/e, Thomson,													
4. Newstrom W. John & Davis Keith, Organisational Behaviour-- Human Behaviour at Work, 12/e,TMH, New Delhi,													
5. Pierce and Gardner: Management and Organisational Behaviour: An Integrated perspective,													
6. Thomson, Robbins, P. Stephen, Timothy A. Judge: Organisational Behaviour, 12/e, PHI/Pearson, NewDelhi,													
7. Pareek Udai: Behavioural Process at Work: Oxford & IBH, New Delhi,													
8. Schermerhorn: Organizational Behaviour 9/e, Wiley,													
9. Hitt: Organizational Behaviour, Wiley,													
CO-PO & PSO Mapping													
COs	PROGRAMME OUTCOMES											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	2											
CO2	3	2											
CO3	3	2											
CO4	2	2											
CO5	3	2											
CO6	2	2											
Avg.	2.66	2.0											











SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMGMG30002	ENGINEERING ECONOMICS AND COSTING	3	0	0	3
Pre -Requisite: Basic Economic Principles, Cost Accounting and Financial Analysis					
Course Educational Objectives					
CEO1	Develop a strong foundation in economic principles relevant to engineering, including supply and demand, cost analysis, and economic efficiency.				
CEO2	Equip students with the skills to perform financial analyses and apply engineering economics techniques to decision-making in product design and process planning.				
CEO3	Enable students to compare engineering alternatives using various financial evaluation methods, such as present worth and rate of return, to determine the most cost-effective solutions.				
CEO4	Prepare students to analyze asset management issues, including replacement, maintenance, depreciation, and inflation adjustments, to make informed and economically sound decisions.				
SYLLABUS					
UNIT:1		[12 Hours]			
Introduction to Economics, Flow in an economy, law of supply and demand, concept of engineering economics, engineering efficiency, economic efficiency, scope of engineering economics, element of costs, marginal cost, marginal revenue, sunk cost, opportunity cost, breakeven analysis, v ratio, elementary economic analysis, material selection for product design selection for a product, process planning.					
UNIT:2		[10 Hours]			
Make or buy decision, value engineering, function, aims, and value engineering procedure. interest formulae and their applications, time value of money, single payment compound amount factor, single payment present worth factor, equal payment series sinking fund factor, equal payment series payment present worth factor, equal payment series capital recovery factor, uniform gradient series annual equivalent factor, effective interest rate, examples in all the methods.					
UNIT:3		[10 Hours]			
Methods of comparison of alternatives, present worth method (revenue dominated cash flow diagram), future worth method (revenue dominated cash flow diagram, cost dominated cash flow diagram), annual equivalent method (revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, examples in all the methods.					
UNIT:4		[10 Hours]			
Replacement and maintenance analysis, types of maintenance, types of replacement problem, determination of economic life of an asset, replacement of an asset with a new asset – capital recovery with return and concept of challenger and defender, simple probabilistic model for items which fail completely.					

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UNIT:5

[8 Hours]

Depreciation, introduction, straight line method of depreciation, declining balance method of depreciation, sum of the years digits method of depreciation, sinking fund method of depreciation/annuity method of depreciation, service output method of depreciation, evaluation of public alternatives, introduction, examples, inflation adjusted decisions, procedure to adjust inflation, examples on comparison of alternatives and determination of economic life of asset.

Course Outcomes: *Upon successful completion of this course, students should be able to:*

CO1	Understand and apply key economic concepts in engineering.
CO2	Use engineering economics for material selection and process planning.
CO3	Apply financial formulas to evaluate engineering projects.
CO4	Compare alternatives using various financial methods.
CO5	Analyze replacement and maintenance strategies for asset management.
CO6	Compute and apply depreciation methods and adjust for inflation.

Teaching Methods: Chalk& Board

Text Books:

1. Panneer Selvam.R, Engineering Economics, Prentice Hall of India Ltd, New Delhi, 2001.
2. Suma Damodaran, Managerial economics, Oxford University press 2006.
3. Chan S.Park, Contemporary Engineering Economics, Prentice Hall of India, 2002.
4. Donald.G. Newman, Jerome.P.Lavelle, Engineering Economics and analysis, Engg. Press, Texas, 2002

CO-PO & PSO Mapping

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SUBJECT	COURSE TITLE	L	T	P	C
23BMEPC35101	DYNAMICS OF MACHINERY LABORATORY	0	0	2	1

Pre -Requisite: Kinematics of Machinery

Course Educational Objectives

CEO1	Understand the principles of dynamics applied in Theory of machinery
CEO2	To verify the gyroscopic principle under dynamic loadings.
CEO3	To conduct experimentation to find the damping co-efficient for natural and forced frequencies.
CEO4	To analyze the static and dynamic balancing of different components.

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

CO1	Evaluate and examined dynamic forces in various engineering components
CO2	Evaluate the effect of gyroscopic couple at different speeds.
CO3	Analyze performance characteristics of centrifugal governors.
CO4	Examine principle of clutch and brakes
CO5	Evaluate and analyze balancing and vibration in desire system
CO6	Determine the critical speed for shafts of various diameter

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	2		2					3				3
CO2	3	3		2					3				3
CO3	3	3		3					3				2
CO4	3	1							3				3
CO5	3	3		3					3				3
CO6	3	3		2					3				2
Avg	3	2.5		2.4					3				2.7

LIST OF EXPERIMENTS

List of Experiment: (Minimum 8 Experiments)

1. Study on clutches
2. Determination of gyroscopic couple using gyroscopic test rig.
3. Performance characteristics of a watt governor
4. Determination of critical speed of rotating shaft
5. Experiment on static and dynamic balancing apparatus
6. Experiment on brakes
7. Experiment on Dynamometers
8. Determination of natural frequencies of un-damped as well as damped vibrating systems.
9. Experiment on evaluation of damping in a vibrating system

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SUBJECT CODE	COURSE TITLE	L	T	P	C
23BMEPC35102	ADVANCED MANUFACTURING SCIENCE LABORATORY	0	0	2	1

Pre -Requisite: Basic Knowledge of Thermodynamic cycle and Mathematics

Course Educational Objectives

CEO1	To provide the student with personal, hands-on experience in the operation of standard machine tools
CEO2	To provide to the students an understanding and appreciation of the abrasive metal cutting processes.
CEO3	To provide a proper insight about the importance of lubrication and wear problems.
CEO4	To provide the students with a proper understanding of nontraditional machining processes.

LIST OF EXPERIMENTS

List of Experiment: (Minimum 8 Experiments)

1. Job on lathe with taper turning, thread cutting, knurling and groove cutting
2. Gear cutting (with index head) on milling machine
3. Working with shaper, Planner and slotting machine.
4. Working with surface and cylindrical grinding.
5. Determination of cutting force using Lathe tool dynamometer.
6. Determination of cutting force in drilling using drill tool dynamometer.
7. Study of Non-traditional machining processes. (USM, AJM, EDM, ECM)
8. Study of CNC Lathe and demonstration of making job in CNC lathe.
9. Study of CNC Milling machine and demonstration of making job in CNC Milling machine.

Course Outcomes: Upon successful completion of this course, students should be

CO1	Classify the basic principle and techniques of lathe, shaper and planner, drilling, milling and grinding machines.
CO2	Evaluate different cutting force acts during machining by lathe tool dynamometer
CO3	Develop proficiency in shaping, planning, and slotting operations.
CO4	Gain knowledge of USM, AJM, EDM, ECM processes and CNC machining.
CO5	Define the concept and applications of modern machining processes.
CO6	Develop the design of job with proper dimension using CNC Lathe and milling.

CO-PO & PSO Mapping

PROGRAMME OUTCOMES												PSOs	
COs	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	1			2						1			
CO2	1			2						2			
CO3	1			2						2			
CO4	1			3						2			
CO5	1			2						2			
CO6	1			2						2			
Avg.	1			2.16						1.83			



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SUBJECT CODE	COURSE TITLE										L	T	P	C
23BMEPC35103	INTERNAL COMBUSTION ENGINES LABORATORY										0	0	2	1
Pre -Requisite: Basic Knowledge of Thermodynamic cycle and Mathematics														
Course Educational Objectives														
CEO1	Understand thermodynamic cycle, valve timing diagram, function of different components and its working principle.													
CEO2	Understand the mechanism of carburetion, injection and know the working principle of carburetor, injector, fuel pump, air filter.													
CEO3	Understand different types of cooling system, lubrication, analysis of exhaust gas emission.													
CEO4	Understand load test analysis, performance analysis of single cylinder/ multi cylinder SI and CI engine.													
LIST OF EXPERIMENTS														
List of Experiment: (Minimum 8 Experiments)														
1. Valve timing diagram of an IC engine														
2. Study of a modern carburetor (e.g. Solex Carburtor)														
3. Study of fuel injection system of a diesel engine														
4. Analysis of exhaust gas of automobile (Orsatapparatos)														
5. Study of different cooling systems in automobiles (Air cooling and water cooling).														
6. Study of lubrication systems in automobiles.														
7. Load test on 4-stroke single cylinder C.I. engine.														
8. Load test on 4-stroke single cylinder S.I. engine.														
9. Morse Test on multi-cylinder S.I. or C.I. engine														
10. Load test on variable compression ratio S.I. engine														
Course Outcomes: Upon successful completion of this course, students should be														
CO1	Classify the concept of valve timing diagram of both SI and CI engine.													
CO2	Describe the concept of carburetion, atomization, spray formation and injection technique.													
CO3	Compare lubrication and cooling phenomena related to SI and CI engines and factor influencing them.													
CO4	Measure load test analysis on four stroke multi cylinder SI and CI engine.													
CO5	Evaluate the quantity of various gases in exhaust of a vehicle.													
CO6	Calculate the performance parameters of IC engines.													
CO-PO & PSO Mapping														
PROGRAMME OUTCOMES											PSOs			
COs	1	2	3	4	5	6	7	8	9	10	11	1	2	
CO1	2			2									2	
CO2	1			3									2	
CO3	1			2									2	
CO4	1	2		2									2	
CO5		2	2				2						2	
CO6	1	2	2										2	
Avg.	1.25	2	2	2.5			2						2	



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VI Semester [Third Year]
B. Tech in Mechanical Engineering

Sl. No.	Course Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE
				L	T	P			
THEORY									
1	PC	23BMEPC36001	Heat Transfer	3	0	0	3	40	60
2	PC	23BMEPC36002	Design of Machine Members	3	0	0	3	40	60
3	PC	23BMEPC36003	Mechanical Measurement and Metrology	3	0	0	3	40	60
4	PE	23BMEPE36011	CAD / CAM	3	0	0	3	40	60
		23BMEPE36012	Refrigeration and Air Conditioning						
		23BMEPE36013	Fatigue, Creep and Fracture						
		23BMEPE36014	Product Design and Product Tooling						
5	OE	23BMEOE36011	Optimization Engineering	3	0	0	3	40	60
		23BMEOE36012	Research Methodology						
		23BMEOE36013	Principles and Practices of Management						
		23BMEOE36014	Soft Computing						
6	HS	23BMGMG30001	Organizational Behaviour	2	0	0	2	40	60
		23BMGMG30002	Engineering Economics and Costing						
PRACTICAL / SESSIONAL									
1	PC	23BMEPC36101	Heat Transfer Laboratory	0	0	2	1	50	-
2	PC	23BMEPC36102	Machine Design Laboratory	0	0	2	1	50	-
3	PST	23BMEPW36101	Mini Project-III	0	0	2	1	50	-
TOTAL CREDITS							20		










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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPC36001	HEAT TRANSFER	3	0	0	3
Pre -Requisite: Basics of Thermodynamics, Fluid Mechanics.					
Course Educational Objectives					
CEO 1	To understand the basic concept of mode of heat transfer.				
CEO 2	To analyze the 1D and 2D heat conduction in form transient and with heat generation mode.				
CEO3	To study the thermal boundary layer, during convective heat transfer over a pipe or flat surface.				
CEO4	To understand the effect of radiative heat transfer.				
SYLLABUS					
UNIT:1		(10 Hours)			
Introduction to heat transfer: Modes of heat transfer: conduction, convection, and radiation, Mechanism & basic laws governing conduction, convection, and radiation heat transfer; Thermal conductivity, Thermal conductance & Thermal resistance, Contact resistance, convective heat transfer coefficient, radiation heat transfer coefficient, Electrical analogy, combined modes of heat transfer.					
Heat conduction: The General heat conduction in co-ordinate systems, Simplification of the general equation for one dimensional steady with constant thermal conductivity without heat generation. Solution of the one dimensional steady state heat conduction problem in case of plane walls, cylinders and spheres for simple and composite cases. Critical radius of insulation for cylinders and spheres.					
UNIT:2		(10 Hours)			
Simplification of the general equation for one dimensional steady with constant thermal conductivity with heat generation variable with / Heat transfer in extended surfaces (pin fins) without heat generation, Long fin, short fin with insulated tip and without insulated tip and fin connected between two heat sources. Fin efficiency and fin effectiveness. Conduction in solids with negligible internal temperature gradient (Lumped heat analysis)					
UNIT:3		(10 Hours)			
Fundamentals of convection: Mechanism of natural and forced convection, local and average heat transfer coefficient, concept of velocity & thermal boundary layers. Forced convection: Dimensionless numbers and their physical significance, empirical correlations for external & internal flow for both laminar and turbulent flows. Natural convection: Introduction, dimensionless numbers and their physical significance, empirical correlations for natural convection.					
UNIT:4		(10 Hours)			
Radiative heat exchange: Introduction, Radiation properties, definitions of various terms used in radiation heat transfer; Absorptivity, reflectivity & transmissivity. Emissive power & emissivity, Kirchhoff's identity, Planck's relation for monochromatic emissive power of a black body, Derivation of Stefan-Boltzmann law and Wien's displacement law from Planck's relation, Radiation shape factor, Relation for shape factor and shape factor algebra. Heat exchange between black bodies through non-absorbing medium. Gray bodies and real bodies, Heat exchange between gray bodies. Radiosity and Irradiation. Radiation shields.					



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UNIT:5

(10 Hours)

Heat Exchangers: Introduction, Types of heat exchanger, the overall heat transfer coefficient and fouling factors, LMTD and E- NTU analysis of heat exchangers.

Heat transfer for boiling liquids and condensing vapours: Types of condensation, use of correlations for condensation on vertical flat surfaces, horizontal tube and; regimes of pool boiling, pool boiling correlations. Critical heat flux, concept of forced boiling. Numericals.

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

CO1	Analyze the various modes of heat transfer and implement the basic heat conduction equations for steady one dimensional thermal system.
CO2	Implement the general heat conduction equation to thermal systems with and without internal heat generation and transient heat conduction.
CO3	Evaluate the heat transfer rate in natural and forced convection.
CO4	Interpret heat transfer by radiation between objects with simple geometries.
CO5	Analyze the heat transfer equipment and investigate the performance.
CO6	Analyze the heat transfer of liquids and vapours through boiling and condensation.

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Reference Books:

1. Rajput R.K., Heat Transfer, Laxmi Publications, 3RD EDITION.
- 2 Sachdeva . R.C., Fundamentals of Engineering Heat and Mass Transfer, New Age, International, 2ND Edition.
3. CengelYonusA ,Heat and Mass Transfer, TMH, 6TH Edition.
- 4.Ghosdastidar, P.S., Heat Transfer, Oxford University Press, 3RD EDITION
5. Nag P.K., Heat Transfer, TMH 3RD EDITION.
6. Sukhatme S.P., Heat Transfer by, TMH, 3RD EDITION.
7. Holman J.P., Heat Transfer Tenth Edition, 4TH EDITION.

CO-PO & PSO Mapping

PROGRAMME OUTCOMES												PSOs	
COs	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	2											2
CO2	3	3											2
CO3	3	3											2
CO4	2	3	2										3
CO5	2	3											2
CO6	3	2											
Avg.	2.66	2.66	2.0										2.20



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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPC36002	DESIGN OF MACHINE MEMBERS	3	0	0	3
Pre -Requisite: Fundamentals in mathematics, Engg. Mechanics, TOM, MOS and Drawing.					
Course Educational Objectives					
CEO1	To introduce the mechanical engineering students to the basic components of machinery, and how to select and size these components to achieve design goals in the construction of mechanical system				
CEO2	To familiarize the various steps involved in the Design Process and to understand the principles involved in evaluating the shape and dimensions of a component				
CEO3	To satisfy functional and strength requirements and learn to use standard practices and standard data of machine components.				
CEO4	To develop an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice and obtaining design solutions to open ended problems through a systematic design process				
SYLLABUS					
UNIT:1		(12 Hours)			
BEARINGS: Classification of bearings applications, types of journal bearings – lubrication – bearing modulus – full and partial bearings – clearance ratio – heat dissipation of bearings, bearing materials – journal bearing design – ball and roller bearings – static loading of ball & roller bearings, bearing life.					
UNIT:2		(8 Hours)			
Design of Pressure vessels: Thin pressure vessels: cylindrical and spherical vessels, Design of end Closures, Thick cylindrical shells.					
UNIT:3		(8 Hours)			
MECHANICAL SPRINGS: Stresses and deflections of helical springs – extension compression springs – springs for fatigue loading, energy storage capacity – helical torsion springs – co axial springs, leaf springs					
UNIT:4		(8 Hours)			
POWER TRANSMISSIONS SYSTEMS, PULLEYS: Transmission of power by Belt and Rope drives, Transmission efficiencies, Belts – Flat and V types – Ropes - pulleys for belt and rope drives, Materials, Chain drives. Gears: Design of Spur, Helical, bevel and worm gears.					
UNIT:5		(10 Hours)			
Flywheel: Design of Flywheel. Design of I.C. Engine components: Design of Cylinder, Piston, Connecting Rod, Crank Shaft.					
Course Outcomes: Upon successful completion of this course, students should be able to:					
CO1	Apply technical skills and imagination to construct a proper design configuration.				
CO2	Develop a link between fundamental concepts with realistic component design.				
CO3	Design journal bearings, ball and roller bearings subjected to static and dynamic loads.				
CO4	Analyze and synthesize different power transmission elements and springs.				
CO5	Analyze and evaluate forces and stresses within a spur gear system and design simple power transmission systems.				
CO6	Acquaint themselves with the design of IC engine components for the schematic evaluation of elements in an engine.				

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPC36003	MECHANICAL MEASUREMENT AND METEROLOGY	3	0	0	3

Pre -Requisite:.

Course Educational Objectives

CEO1	Understand the fundamental principles and recent advancements in metrology and measuring instruments.
CEO2	Apply the concepts of limits, fits, tolerances, and gauging.
CEO3	Develop and implement measurement systems and methods for precise force, torque, pressure, temperature, and strain measurements
CEO4	Apply and evaluate standards and calibration techniques for accurate measurements.

SYLLABUS

UNIT:1

(12 Hours)

Definition and methods of measurement, classification of measuring instruments, Measuring systems, performance characteristics of measuring devices, types of errors. Functional elements of measuring system. Static and Dynamic Characteristics of Instruments: Static Performance Parameters, Selection and Specifications of Instruments, Dynamic Response, Compensation.

UNIT:2

(8 Hours)

Transducer Elements: Analog Transducers, Digital Transducers, Basic detector transducer elements: Electrical transducer, Sliding Contact devices, Variable-inductance transducer elements, the differential transformer, Variable-reluctance transducers, Capacitive transducers. The piezoelectric effect, photo-electric transducer, electronic transducer element.

UNIT:3

(10 Hours)

Strain Measurement:

The electrical resistance strain gauge. The metallic resistance strain gauge, Selection and Installation factors for metallic strain gauge, Circuitry, metallic strain gauge. The strain gauge ballast circuit, the starting gauge bridge circuit, Temperature compensation.

Measurement of Pressure:

Pressure measurement systems, Pressure measurement transducers, Elastic diaphragms, strain gauge pressure cells, measurement of high pressure, Measurement of low pressures, dynamic characteristics of pressure measuring systems.

Temperature Measurement:

Use of bimetals pressure thermometers, Thermocouples, Pyrometry, Calibration of temperature measuring devices

Force, Power, Speed and Torque Measurement:

Load Cell, Dynamometers, Tachometer and Tacho-generator, Stroboscope, The seismic instrument.- Vibrometers and accelerometers.

UNIT:4

(8 Hours)

Definition, objectives and concept of metrology, Need of inspection, Principles, process, methods of measurement, Line and End & optical Standards, Calibration, accuracy and Precision, Random error and systemic error. Measurement of Surface Roughness, Screw Thread and Gears. Measurement of straightness, Flatness and circularity.

LoadCell, Dynamometers, Tachometer and Tacho-generator, Stroboscope, The seismic instrument.- Vibrometers and accelerometers

UNIT:5

(10 Hours)

System of Limits, Fits, Tolerance and Gauging: Definitions; Tolerance zone and grades, Hole and

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPE36011	CAD / CAM	3	0	0	3
Pre -Requisite:					
Course Educational Objectives					
CEO1	To understand the Design process, Creating the Manufacturing Database.				
CEO2	To develop the Configuration, Graphics Packages, Database structure and content, Wire frame and solid modeling.				
CEO3	Classify Manual and Computer Aided programming, studying Problems with conventional NC, NC technology: CNC, DNC, Combined DNC/ CNC system.				
CEO4	To learn the Data exchange formats, Finite element analysis, Rapid prototyping.				
SYLLABUS					
UNIT:1		(10 Hours)			
Fundamentals of CAD: Design process, Applications of computer for design, Creating the Manufacturing Database, The Design workstation, Graphical Terminal, Operator input Devices, Plotters and other devices, Central Processing Unit, Memory types					
UNIT:2		(10 Hours)			
Computer graphics Software and Database: Configuration, Graphics Packages, Constructing the Geometry, Transformations of geometry, Database structure and content, Wire frame versus solid modeling, Constraint– Based modeling, Geometric commands, Display control commands, Editing					
UNIT:3		(10 Hours)			
Need of NC technology, Fundamental concepts in numeric control: structure and functions of NC System, advantages of NC technology over conventional manufacturing. Numerical Control and NC Part Programming: Numerical Control, Numerical Control elements, NC Cordinate system, NC motion control system, Types and functions of computer numeric control (CNC), Types and functions of direct numeric control (DNC), Need of adaptive control types, functions and types of adaptive control, its uses & benefits, Advantages of combined CNC/DNC systems.					
UNIT:4		(10 Hours)			
The APT language and programme for different operation, G & M codes for NC part programming, Part-programming for turning and milling operations, Data Exchange Formats and Applications: Data exchange formats, Finite element analysis, Rapid prototyping.					
UNIT:5		(10 Hours)			
Introduction to group technology (GT), computer aided process planning (CAPP), material requirement planning MRP (MRP), Robotics: Anatomy & configuration of robot, Characteristics of robots, Grippers, Application of robots in Industry 4.0. Overview of material handling equipment, automated material handling equipment – AGVs, conveyor systems.					

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPE36012	REFRIGERATION AND AIR CONDITIONING	3	0	0	3
Pre -Requisite: Basic of thermodynamics, Heat transfer					
Course Educational Objectives					
CEO1	Explain how thermodynamic principles are applied within the refrigeration and air conditioning, methods of lowering the temperature in single compression system.				
CEO2	Summarize about various system components and accessories of air-craft refrigeration system, VCRS, VARS and different air-conditioning system.				
CEO3	Apply knowledge of principles of producing low temperatures by using multi-compressor, multi-evaporator systems and cascade systems.				
CEO4	Illustrate the different types and classification of refrigerant with its properties and to carry-out cooling load calculations for different applications.				
SYLLABUS					
UNIT:1		[08 Hours]			
Air Refrigeration System: Introduction, Unit of refrigeration, Coefficient of performance, Reversed Carnot Cycle, Temperature limitations, maximum COP, Bell Coleman air cycle, Simple Air Cycle System for Air-craft with problems.					
UNIT: 2		[10 Hours]			
Vapour Compression System: Analysis of theoretical vapour compression cycle, Representation of cycle on T-S and p-h diagram, Simple saturation cycle, sub-cooled cycle and super-heated cycle, Effect of suction and discharge pressure on performance, Actual vapour compression cycle. Problem illustration and solution					
UNIT:3		[08 Hours]			
System Components: Compressors, General classification, comparison, Advantages and Disadvantages. Condensers-classification, Working Principles. Evaporators – classification, Working Principles. Expansion devices – Types, Working Principles. Refrigerants – Desirable properties, Common refrigerants used, Nomenclature, Ozone Depletion and Global Warming.					
UNIT:4		[10 Hours]			
Vapour Absorption System: Simple Ammonia - absorption system, Improved absorption system, Electrolux/Three fluid system, Lithium-bromide-water vapour absorption system, comparison of absorption system with vapour compression system.					
UNIT:5		[12 Hours]			
Psychrometrics: Properties of air-vapour mixture, Law of water vapour-air mixture, Enthalpy of moisture, Psychrometric chart, simple heating and cooling, Humidification, De-humidification, Mixture of air streams. Review question and discussions.					
Course Outcomes: Upon successful completion of this course, students will be able to:					
CO1	Recall the basic principle of thermodynamics and understand various refrigeration systems.				
CO2	Explain the working of various components and its types used in refrigeration systems.				
CO3	Calculate the performance parameters like COP, cooling capacity of different refrigeration systems				
CO4	Summarize the properties, applications and environmental issues of different refrigerants				
CO5	Evaluate and explain various terminologies involved in psychometric process.				
CO6	Calculate the cooling load for air conditioning systems used for various purposes.				

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Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert

Reference. Books:

1. Khurmi R.S., Refrigeration and Air Conditioning, 3rd edition and Refrigeration Chart
2. Arora S.C. and Domkundwar S., Refrigeration and Air Conditioning, Dhanpat Rai & Sons, 4th edition.
3. Balloney P. L., Refrigeration and Air conditioning, Khanna Publishers, 3rd edition.
4. Arora C. P., Refrigeration and Air conditioning Tata McGraw Hill, 4th edition.

CO-PO & PSO Mapping

PROGRAMME OUTCOMES												PSOs	
COs	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	1										2	2
CO2	2	2											
CO3	3	3											
CO4	2					2							
CO5	3	1											
CO6	3	3	2										
Avg.	2.6	2.0	2.0			2.0						2.0	2.0

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPE36013	FATIGUE, CREEP & FRACTURE	3	0	0	3
Pre -Requisite: Mechanics,					
Course Educational Objectives					
CEO1	Be familiar with the fatigue development and Influence of stress concentration under fatigue strength.				
CEO2	Understand and able to analyze Mechanism of creep and it effects in design components.				
CEO3	Interface various modes of fracture under different Theories.				
CEO4	Ability to conduct an experimental analysis on different materials subjected to creep, fatigue and fracture mechanisms.				
SYLLABUS					
UNIT:1		(08 Hours)			
Fatigue:Types of fatigue loading and failure, Fatigue test, endurance limit; Fatigue under combine stresses; Influence of stress concentration on fatigue strength, Notch sensitivity, Factors influencing fatigue behaviour.					
UNIT:2		(08 Hours)			
Phase in fatigue life, Crack initiation, Crack growth, Final fracture, Dislocations, Fatigue fracture surfaces.					
UNIT:3		(08 Hours)			
Creep:Creep-stress-time temperature relations, Mechanics of creep in tension, bending, torsion, creep buckling. Members subjected to creep and combined stresses.					
UNIT:4		(08 Hours)			
Fracture:Basic modes of fracture, Griffith of brittle fracture, Irwin's theory of fracture inelastic-plastic materials. Theories of linear elastic fracture mechanics, stress intensity factors, fracture toughness testing.					
UNIT:5		(08 Hours)			
Mode I, II and III, fatigue crack growth Behaviour of metals, Linear ElasticFracture Mechanics (LEFM), Stress Intensity Factor(SIF), Stress field near the crack tip, CriticalSIF and Fracture Toughness, Experimental determination of fracture toughness K , COD gaugesand standard ASTM Tests.					
Course Outcomes: Upon successful completion of this course, students should be able to:					
CO1	Analyze fatigue under combined stresses and comprehend the influence of stress concentration on fatigue strength.				
CO2	Describe the phases in fatigue life, including crack initiation, crack growth, and analyze dislocations and interpret fatigue fracture surfaces.				
CO3	Apply mechanics of creep in tension, bending, torsion, and creep buckling also proficiency in analyzing members subjected to creep and combined stresses.				
CO4	Apply Griffith's theory of brittle fracture and Irwin's theory of fracture in inelastic-plastic materials also have a comprehensive understanding of basic modes of fracture.				
CO5	Analyze the stress field near the crack tip and determine critical SIF and fracture toughness and knowledge of experimental methods for determining fracture toughness, including the use of COD gauges and standard ASTM tests.				
CO6	Apply the knowledge gained to solve real-world engineering problems related to fatigue, creep, and fracture to make informed decisions regarding material selection and design considerations based on fatigue and fracture mechanics principles.				

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPE36014	PRODUCT DESIGN & PRODUCT TOOLING	3	0	0	3
Pre -Requisite: Basic Manufacturing, Manufacturing science Technology, Project Management					
Course Educational Objectives					
CEO1	To study the basic concepts of product design and development process.				
CEO2	To study the applicability of product design and development in industrial applications.				
CEO3	To design dies for different forging operation and sheet metal working.				
CEO4	To study various locating and clamping methods as well as design jigs and fixtures				
SYLLABUS					
UNIT:1		[12 Hours]			
Product design, product design considerations, product development, product life cycle, value analysis and value engineering, product specification. Role of computer in product design. Process Planning – selection of processes, Design of sequence of operations, Time & cost estimation					
UNIT:2		[8 Hours]			
Forging design: forging allowances, die design for drop forging, upset forging die design, design of flash and gutter.					
UNIT:3		[8 Hours]			
Sheet metal working: Design consideration for shearing, blanking piercing, deep drawing operation, progressive and compound die, strippers , stops, strip layout, design calculation.					
UNIT:4		[8 Hours]			
Design of jigs and fixtures, principle of location and clamping, clamping methods, locating methods, Drill Jig bushing, Indexing type drilling Jig.					
UNIT:5		[8 Hours]			
Design of single point cutting tool, broach and form tool design. Tooling design for turret lathe and automats.					
Course Outcomes: Upon successful completion of this course, students should be able to:					
CO1	Interpret the concept of product design and product development.				
CO2	Understand the various aspects of process planning and time & cost estimation				
CO3	Apply principles of locating and clamping systems for designing jigs and fixtures.				
CO4	Select and design forging dies as well as progressive, compound or combination dies for sheet metal workings.				
CO5	Design single point cutting tool, broach and form tools against failure.				
CO6	Get knowledge in manual, mechanical and automated systems of lathe.				
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert					
Reference Books:					
1. Rao P.N., Manufacturing Technology, Tata McGraw Hill					
2. Sharma P.C., A Textbook of Production Engineering, S. Chand & Co					
3.Chitale A K, Gupta R C, Product Design & Manufacturing, Eastern Economy Edition, PHI.					
4. Krar, Technology of Machine Tools, Gill, Smid, Tata Mc Graw Hill					
5. Hoffman Edwrd G,Jigs & Fixture Design, Cengage Learning					



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CO-PO & PSO Mapping														
PROGRAMME OUTCOMES													PSOs	
COs	1	2	3	4	5	6	7	8	9	10	11		1	2
CO1	2	1	2											
CO2	2	1	1											
CO3	2	2	2											
CO4	3	1	2											
CO5	2	2	3											
CO6	2	1	2											
Avg.	2.16	1.34	2.00											

Smruti *SK* *Datta* *SE* *Prasanna* *Choudhary* *Prakash* *Prakash* *Prakash*



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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEOE36011	OPTIMIZATION ENGINEERING	2	0	0	2
Pre -Requisite: Basics of Mathematics, matrix, partial differential equation addition of linear equations					
Course Educational Objectives					
CEO1	To introduce the students how to use variables for formulating complex mathematical models in management science, industrial engineering and transportation science				
CEO2	To provide students with opportunity using various software package for solving liner programming and integer programming models				
CEO3	To introduce the students to use of basic methodology for solution of linear programs and integer programs				
CEO4	To introduce the students to advance methods for large scale transportation and assignment problems				
SYLLABUS					
UNIT:1		[12 Hours]			
Introduction Historical overview of operations research, fundamentals of OR Modeling Approach. Linear Programming: Basic assumptions, formulation, graphical method, simplex method, Big-M method, two phase method, duality theory, Dual simplex.					
UNIT:2		[10 Hours]			
Sensitivity analysis: Change in objective function coefficient, Change in RHS, Deletion of variable Integer programming: Special features, branch-and-bound technique Dynamic Programming: Principle of optimality, recursive relations, solution of LPP					
UNIT:3		[10 Hours]			
Transportation Problems: Methods for obtaining basic feasible solutions (NWCR, LCM & VAM), Methods for obtaining optimum solution (Stepping stone & Modi method) Specific features of transportation problem. Assignment Problem: Hungarian method for solving assignment problems. Maximization in Assignment problem, Unbalanced assignment problem.					
UNIT:4		[8 Hours]			
Queueing: Basic elements of queuing model, role of Poison & exponential distribution, single server model. Game theory: Maxi-min and Mini-max principle, mixed strategy, dominance theory					
UNIT:5		[14 Hours]			
Introduction to non-linear programming. Unconstraint optimization: Fibonacci and Golden Section Search method. Constrained optimization with equality constraint: Lagrange multiplier, Projected gradient method Constrained optimization with inequality constraint: Kuhn-Tucker condition, Quadratic programming.					



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

CO1	Formulate and solve linear programming problems using appropriate techniques.
CO2	Conduct and interpret post-optimal analysis of linear programming problems
CO3	Explain the concept of optimum allocation for transportation & assignment problems
CO4	Apply dynamic programming principle to Linear programming problems.
CO5	Develop mathematical skills to analyze and solve integer programming problem Queueing and Game theory.
CO6	Communicate ideas, explain procedures and interpret solution for Non-linear programming problems

Teaching Methods: Chalk& Board/PPT

REFERENCE BOOK :

1. Taha H.A., Operations Research 9th Edition, Prentice Hall of India, New Delhi, 2010Book
2. KantiSwarup., Man Mohan., and Gupta, P.K., Introduction to Operations Research 7th Edition, Sultan chand& Sons, New Delhi, 2005
3. P.K.Gupta, D.S.Hira, "Operations Research", S.Chand and Company Ltd
4. Hillier, F.S., and Lieberman G.J., Introduction to Operations Research, 7thEdition, TMH, 2009.
5. Kalyanmoy Deb, "Optimization for Engineering Design", PHI Learning Pvt Ltd

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	3		2								1	
CO2	2	3		1								1	
CO3	3	3		1								1	
CO4	2	3		1								1	
CO5	2	2		1								1	
CO6	2	3		1								1	
Avg.	2.33	2.83		1.17								1.0	

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEOE36012	RESEARCH METHODOLOGY	3	0	0	3
Pre -Requisite: Mathematics					
Course Educational Objectives					
CEO1	To educate on identifying the latest research domain for young researchers				
CEO2	To identify the gaps in research on the basis of literature review.				
CEO3	To educate on use of modern statistical tools for solving problems				
CEO4	To impart the financial and social benefits of research on the young minds				
SYLLABUS					
UNIT:1		[10 Hours]			
Fundamentals of Research- Meaning, Objective and Motivation in Research: Types of Research, Research Approaches, Research Process. Defining and formulating the research problem, Selecting the problem, Necessity of defining the problem, Importance of literature review, in defining a problem, Literature review, Identifying gap areas from literature review.					
UNIT:2		[10 Hours]			
Research Design: Features of Good Design, Types of Research Design, Basic Principles of Experimental Design. Methods of Data Collection: Primary Data, Questionnaire and Interviews, Collection of Secondary Data, Cases and Schedules. Processing of Data: Editing, Classification and Coding, Transcription, Tabulation, Graphical Representation.					
UNIT:3		[8 Hours]			
Data Analysis: Statistics in research, Measures of Central Tendency, Measures of Dispersion, Measures of association / Relationship, simple regression, multiple correlation and regression, time series analysis, Hypothesis Testing, Test of Significance.					
UNIT:4		[10 Hours]			
Technical writing and reporting of research: Types of research report, Structure and organization of research reports, Research ethics, plagiarism and impact of research: Research ethics, responsibility and accountability of the researchers, Plagiarism and use of plagiarism detection software. Impact factor of Journals, Journals in mechanical engineering, When and where to publish? Use of tools I techniques for Research: methods to search required information effectively, Reference Management					
UNIT:5		[8 Hours]			
Impact of research on environment and society. Funding agencies and research grants: Introduction to various research funding agencies such as-DST, DBT, AICTE, UGC, CSIR, ICMR, AAYUSH, and DRDO along with their function in India. Writing a research project and procurement of research grant. Project cost analysis.					
Course Outcomes: Upon successful completion of this course, students should be able to:					
CO1	Recall and describe the fundamental concepts of research, including the meaning, objectives, types, and approaches.				
CO2	Apply their knowledge of research design principles and methods of data collection to analyze and select appropriate research designs based on given scenarios.				



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CO3	Analyze and evaluate different statistical measures and methods used in data analysis, such as measures of central tendency, dispersion, association, regression, and hypothesis testing.												
CO4	Demonstrate the ability to create structured and ethical research reports.												
CO5	Understand the impact of research on society and the environment, identifying various funding agencies and their roles in India..												
CO6	Understand different software tools applied in research.												
Teaching Methods: Chalk& Talk, PPT, Video Lectures, Case studies													
Text Books:													
1. Kothari C.R., Research Methodology: Methods and Techniques, 2nd Edition, New Age International Publishers.													
2. Gupta S.P, Statistical Method, S. Chand & Sons, New Delhi,2005.													
3. Montgomery, Douglas C. (2007) 5/e, Design and Analysis of Experiments (Wiley India)													
CO-PO & PSO Mapping													
COs	PROGRAMME OUTCOMES											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3												
CO2		3	2										
CO3		2											1
CO4				2			2						1
CO5								1					
CO6				1					1				
Avg.	3	2.5	2	1.5			2	1	1				1



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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEOE36013	PRINCIPLES AND PRACTICES OF MANAGEMENT	3	0	0	3
Pre -Requisite: Mathematics					
Course Educational Objectives					
CEO1	To understand theoretical aspects, processes and principles, the scope of Management and its application to modern management practice.				
CEO2	To analyze how the field of Management has evolved and its significant contributions				
CEO3	To analyze and apply the critical role of managers in modern organizational settings				
CEO4	To illustrate and evaluate the importance of planning, organizing, directing and controlling in decision making				
SYLLABUS					
UNIT:1		[09 Hours]			
Management Nature and Concept : Nature, Concept, Scope and Significance; Functions; Management: Art or Science or Profession; Organization vs Administration vs Management, Schools of Management: Contributions of F.W. Taylor, Henry Fayol, Elton Mayo; Roles of Managers; Social Responsibility and Business Ethics.					
UNIT:2		[09 Hours]			
Planning: Concept, Objectives, Types, Steps and Techniques; Making Planning Effective; Decision Making: Steps in Decision Making and Types; Management by Objectives (MBO). Various case studies.					
UNIT:3		[10 Hours]			
Organizing: Structure, Nature, Types of Organizations, Principles of Organizing; Departmentalization; Delegation; Decentralization of Authority; Span of Control - Line and Staff Functions; Staffing: Concept, Significance and Functions.					
UNIT:4		[09 Hours]			
Leading :Introduction, Characteristics of a Leader, Functions of a Leader; Leadership and Management; Principles of Leadership, Styles of Leaders.					
UNIT:5		[8 Hours]			
Controlling : Introduction, Concept of Controlling, Purpose of Controlling; Types of Control; Steps in Controlling; Techniques in controlling.					
Course Outcomes: Upon successful completion of this course, students should be able to:					
CO1	Understanding Management Fundamentals				
CO2	Applying Planning and Decision Making				
CO3	Analyzing Organizational Structure and Design				
CO4	Evaluating Leadership Principles and Styles				

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CO5	Creating Effective Control Mechanisms												
CO6	Integrating and Applying Management Principles												
Teaching Methods: Chalk& Talk, PPT, Video Lectures, Case studies													
Text Books:													
1. Dipak Kumar Bhattacharyya (2012), Principles of Management: Text and Cases, New Delhi: Pearson Publications.													
2. Balasubramanian. N. (2012), Management Perspectives, New Delhi: MacMillan India Ltd.													
3. Charles Hill, Steven Mc Shane (2012), Principles of Management, New Delhi: Tata Mac Graw Hill													
4. Ricky W. Griffin (2012), Management, New Delhi: Cengage Learning.													
5. Terry and Franklin (2011), Principles of Management. New Delhi: AITBS Publishers.													
6. Robert Kreitner (2012), Principles of Management. New Delhi: Cengage, South-Western 12 E.													
CO-PO & PSO Mapping													
COs	PROGRAMME OUTCOMES											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	3	1	1	1	1							
CO2	2	3	2		1	1							
CO3	2	2	1										
CO4	2	2		1	1				1	1	1	1	
CO5	2	2	1	1	1						1	1	
CO6	2	2	1			1		1	1	1	1	1	
Avg.	2.17	2.33	1.2	1	1	1		1	1	1	1	1	



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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEOE36014	SOFT COMPUTING	3	0	0	3
Pre -Requisite: Mathematics					
Course Educational Objectives					
CEO1	Develop a strong foundation in soft computing concepts				
CEO2	Analyze and design intelligent systems using fuzzy set theory and neural networks				
CEO3	Apply evolutionary computation techniques to solve complex problems				
CEO4	Design and develop innovative soft computing applications				
SYLLABUS					
UNIT:1		[09 Hours]			
Difference between Hard and Soft computing, Requirement of Soft computing, Major Areas of Soft Computing, Applications of Soft Computing, Fuzzy Set Theory: Fuzzy Versus Crisp, Crisp Sets, Fuzzy Sets, Crisp Relations, Fuzzy Relations					
UNIT:2		[09 Hours]			
Fuzzy Systems: Crisp Logic, Predicate Logic, Fuzzy Logic, Fuzzy Rule Based Systems, Defuzzification Methods, Applications					
UNIT:3		[10 Hours]			
Fundamentals of Neural Networks: Basic Concepts of Neural Networks, Human Brain, Model of an Artificial Neuron, Neural Network Architectures, Characteristics of Neural Networks, Learning Methods, Taxonomy of Neural Network Architectures. Back Propagation Networks: Architecture of a Back Propagation Network, Back Propagation Learning.					
UNIT:4		[09 Hours]			
Associative Memory: Autocorrelations, Heterocorrelators, Associative Memory for Real-Coded Pattern Pairs, Applications (Recognition of Characters only). Adaptive Resonance Theory: Introduction, ART1, ART2, Applications (Recognition of Characters only), Sensitives of Ordering of Data.					
UNIT:5		[08 Hours]			
Genetic algorithms, Evolutionary Algorithm, Simulated Annealing, Ant colony optimization - Applications to Electrical engineering problems.					
Course Outcomes: Upon successful completion of this course, students should be able to:					
CO1	Define soft computing, explain its requirement, and describe major areas and applications.				
CO2	Explain fuzzy set theory, design fuzzy rule-based systems, and apply defuzzification methods.				
CO3	Explain neural network fundamentals, develop back propagation networks, and classify neural network architectures and learning methods				

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CO4	Explain and analyze associative memory, adaptive resonance theory, and sensitivities of ordering of data.
CO5	Explain genetic algorithms, evolutionary algorithms, simulated annealing, and ant colony optimization, and apply them to electrical engineering problems.
CO6	Integrate knowledge to design and develop soft computing applications, analyze suitability of techniques, and evaluate performance.

Teaching Methods: Chalk& Talk, PPT, Video Lectures, Case studies

Text Books:

1. George J.Klir and Bo Yuan, Fuzzy sets and Fuzzy Logic, Second Edition, PHI .
2. J.M.Zurada, Introduction to artificial neural systems, Jaico Publishing House.
3. D.E. Goldberg, Genetic algorithms in search, optimization, and machine learning, Addison-Wesley.
4. S.N.Sivanandam, and S.N.Deepa, Principles of Soft computing, Second Edition, Wiley India Pvt. Ltd.
5. N.P.Padhy and S.P.Simon, Soft computing with MATLAB programming, Oxford publishers.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	3		2								1	
CO2	2	3		1								1	
CO3	3	3		1								1	
CO4	2	2		1								1	
CO5	3	2		1								1	
CO6	2	3		1								1	
Avg.	2.5	2.66		1.17								1.0	



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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMGMG30001	ORGANIZATIONAL BEHAVIOUR	2	0	0	2
Pre -Requisite: Basic Management Principles					
Course Educational Objectives					
CEO1	Understand OB Fundamentals:				
CEO2	Apply Cognitive and Motivational Theories				
CEO3	Improve Communication and Decision-Making				
CEO4	Manage Stress and Performance				
SYLLABUS					
UNIT:1		[12 Hours]			
Introduction to OB - Definition, Nature and Scope – Environmental and organizational context – Impact of IT, globalization, Diversity, Ethics, culture, reward systems and organizational design on Organizational behaviour. Cognitive Processes-I: Perception and Attribution: Nature and importance of Perception – Perceptual selectivity and organization – Social perception – Attribution Theories – Locus of control –Attribution Errors –Impression Management.					
UNIT:2		[10 Hours]			
Cognitive Processes-II: Personality and Attitudes – Personality as a continuum – Meaning of personality - Johari Window and Transactional Analysis - Nature and Dimension of Attitudes – Job satisfaction and organizational commitment-Motivational needs and processes- Work-Motivation Approaches Theories of Motivation- Motivation across cultures - Positive organizational behaviour: Optimism – Emotional intelligence – Self-Efficacy					
UNIT:3		[10 Hours]			
Dynamics of OB-I: Communication – types – interactive communication in organizations – barriers to communication and strategies to improve the follow of communication - Decision Making: Participative decision-making techniques – creativity and group decision making. Dynamics of OB – II Stress and Conflict: Meaning and types of stress –Meaning and types of conflict - Effect of stress and intra individual conflict - strategies to cope with stress and conflict.					
UNIT:4		[10 Hours]			
Dynamics of OB –III Power and Politics: Meaning and types of power – empowerment - Groups Vs. Teams – Nature of groups – dynamics of informal groups – dysfunctions of groups and teams – teams in modern work place.					
UNIT:5		[8 Hours]			
Leading High performance: Job design and Goal setting for High performance- Quality of Work Life Socio technical Design and High-performance work practices - Behavioural performance management: reinforcement and punishment as principles of Learning –Process of Behavioural modification - Leadership theories - Styles, Activities and skills of Great leaders.					

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMGMG30002	ENGINEERING ECONOMICS AND COSTING	3	0	0	3
Pre -Requisite: Basic Economic Principles, Cost Accounting and Financial Analysis					
Course Educational Objectives					
CEO1	Develop a strong foundation in economic principles relevant to engineering, including supply and demand, cost analysis, and economic efficiency.				
CEO2	Equip students with the skills to perform financial analyses and apply engineering economics techniques to decision-making in product design and process planning.				
CEO3	Enable students to compare engineering alternatives using various financial evaluation methods, such as present worth and rate of return, to determine the most cost-effective solutions.				
CEO4	Prepare students to analyze asset management issues, including replacement, maintenance, depreciation, and inflation adjustments, to make informed and economically sound decisions.				
SYLLABUS					
UNIT:1		[12 Hours]			
Introduction to Economics, Flow in an economy, law of supply and demand, concept of engineering economics, engineering efficiency, economic efficiency, scope of engineering economics, element of costs, marginal cost, marginal revenue, sunk cost, opportunity cost, breakeven analysis, v ratio, elementary economic analysis, material selection for product design selection for a product, process planning.					
UNIT:2		[10 Hours]			
Make or buy decision, value engineering, function, aims, and value engineering procedure. interest formulae and their applications, time value of money, single payment compound amount factor, single payment present worth factor, equal payment series sinking fund factor, equal payment series payment present worth factor, equal payment series capital recovery factor, uniform gradient series annual equivalent factor, effective interest rate, examples in all the methods.					
UNIT:3		[10 Hours]			
Methods of comparison of alternatives, present worth method (revenue dominated cash flow diagram), future worth method (revenue dominated cash flow diagram, cost dominated cash flow diagram), annual equivalent method (revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, examples in all the methods.					
UNIT:4		[10 Hours]			
Replacement and maintenance analysis, types of maintenance, types of replacement problem, determination of economic life of an asset, replacement of an asset with a new asset – capital recovery with return and concept of challenger and defender, simple probabilistic model for items which fail completely.					

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UNIT:5

[8 Hours]

Depreciation, introduction, straight line method of depreciation, declining balance method of depreciation, sum of the years digits method of depreciation, sinking fund method of depreciation/ annuity method of depreciation, service output method of depreciation, evaluation of public alternatives, introduction, examples, inflation adjusted decisions, procedure to adjust inflation, examples on comparison of alternatives and determination of economic life of asset.

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

CO1	Understand and apply key economic concepts in engineering.
CO2	Use engineering economics for material selection and process planning.
CO3	Apply financial formulas to evaluate engineering projects.
CO4	Compare alternatives using various financial methods.
CO5	Analyze replacement and maintenance strategies for asset management.
CO6	Compute and apply depreciation methods and adjust for inflation.

Teaching Methods: Chalk& Board

Text Books:

1. Panneer Selvam.R, Engineering Economics, Prentice Hall of India Ltd, New Delhi, 2001.
2. Suma Damodaran, Managerial economics, Oxford University press 2006.
3. Chan S.Park, Contemporary Engineering Economics, Prentice Hall of India, 2002.
4. Donald.G. Newman, Jerome.P.Lavelle, Engineering Economics and analysis, Engg. Press, Texas, 2002

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	2	1											
CO2	2	1											
CO3	3	2											
CO4	3	2											
CO5	2	2											
CO6	2	1											
Avg.	2.33	1.5											

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SUBJECT CODE		TITLE OF THE SUBJECT										L	T	P	C
23BMEPC36101		HEAT TRANSFER LABORATORY										0	0	2	1
Pre -Requisite: Basics of Thermodynamics, Heat transfer															
Course Educational Objectives															
CEO1	To study the thermal boundary layer, during convective heat transfer over a pipe or flat surface.														
CEO2	To experimentally measure the effectiveness of heat exchangers.														
CEO3	To experimentally determine thermal conductivity and heat transfer coefficient through various materials.														
CEO4	To study the thermal boundary layer, during convective heat transfer over a pipe or flat surface.														
SYLLABUS															
List of Experiment: (Minimum 6 Experiments)															
1. Determination of Thermal conductivity of composite slab															
2. Determination of heat transfer coefficient in natural or forced convection.															
3. Determination of surface emissivity															
4. Performance test on parallel flow and counter flow heat exchanger															
5. Determination the efficiency and effectiveness of fins by natural convection.															
6. Determination of Fin Efficiency and Effectiveness by forced convection.															
7. Determination of Critical heat flux during boiling heat transfer.															
8. Verification of Stefan Boltzman's law															
Course Outcomes: <i>Upon successful completion of this course, students should be able to:</i>															
CO1	Demonstrate and organize the thermal conductivity of composite slab by testing														
CO2	Define and find the heat transfer coefficient in natural/forced convection by a particular equipment														
CO3	Relate the performance of heat exchanger types of parallel flow and counter flow														
CO4	Explain and Interpret the effectiveness of natural and forced convection through fins, the advantage of fins in heat transfer														
CO5	Measure the emissivity of a surface and understand concept of radiation.														
CO6	Understand the concept of boiling heat regimes.														
CO-PO & PSO Mapping															
PROGRAMME OUTCOMES												PSOs			
COs	1	2	3	4	5	6	7	8	9	10	11	1	2		
CO1	3	2		3						2		2	2		
CO2	3	2		2						2		2	2		
CO3	3	2		2						2		2	2		
CO4	2	2		2						2		2	2		
CO5	2	2		2						2		2	2		
CO6	2	2		2						2			2		
Avg.	2.75	2		2.25						2		2	2		

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SUBJECT CODE		TITLE OF THE SUBJECT										L	T	P	C
23BMEPC36102		MACHINE DESIGN LAB										0	0	2	1
Pre -Requisite: Engineering Drawing, Engineering Mechanics, Mechanics of Solid															
Course Educational Objectives															
CEO1	To equip students with the fundamental principles of designing mechanical components, including stress analysis, material selection, and failure criteria.														
CEO2	To develop students' ability to design and analyze critical machine elements such as levers, belt drives, springs, I. C. components														
CEO3	To enhance students' problem-solving abilities by applying mathematical, analytical, and computational tools to design.														
CEO4	To prepare students for real-world engineering challenges by integrating design standards, safety considerations, and industry best practices.														
SYLLABUS															
List of Experiment: (Minimum 6 Experiments)															
1. Design of thin/ thick cylindrical shells under internal fluid pressure															
2. Design of lever															
3. Design of Belt drive															
4. Design of Helical Spring															
5. Design of Piston															
6. Design of Connecting rod															
7. Design of Crank shaft															
8. Design of Fly wheel															
Course Outcomes: Upon successful completion of this course, students should be able to:															
CO1	Utilize design standards, factor of safety considerations, and analytical tools to create reliable and efficient mechanical components.														
CO2	Demonstrate the ability to design thin and thick-walled cylindrical shells under internal fluid pressure														
CO3	Develop the ability to design fundamental machine elements such as levers.														
CO4	Apply engineering principles to design belt drives, ensuring efficient power transmission while considering belt tensions and slip.														
CO5	Evaluate and design helical springs by applying theories of elasticity and failure.														
CO6	Design critical engine components such as pistons, connecting rods, crankshafts, and flywheels by considering dynamic loads.														
CO-PO & PSO Mapping															
PROGRAMME OUTCOMES												PSOs			
COs	1	2	3	4	5	6	7	8	9	10	11	1	2		
CO1	1	1		1						1			2		
CO2	1	2	2							2			1		
CO3	1	2	3							2			1		
CO4	1	2	3							2			1		
CO5	1	2	3										1		
CO6	1	2	3										1		
Avg.	1.0	1.5	2.8	1.0						1.75			1.16		

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPE47011	FINITE ELEMENT METHOD	3	0	0	3
Pre -Requisite: Basic Mathematics, Mechanics of solid					
Course Educational Objectives					
CEO1	To teach the basic principles, design and modeling considerations in using finite element Method.				
CEO2	Make the students to develop stiffness matrices for spring, truss, beam, plane stress problems and three dimensional problems.				
CEO3	To teach the finite element method to solve structural, fluid flow and thermal problem.				
CEO4	To teach the basics of FEM to solve various engineering problems.				
SYLLABUS					
UNIT:1		(08 Hours)			
FEM fundamental concepts, Difference between classical method and FEM and FDM, Application of FEM, Advantages and limitation of FEM, Commercial software used for FEM. Preprocessing, processing and post processing.					
UNIT:2		(10 Hours)			
Variational principles, Rayleigh Ritz and Galerkin Methods, Elimination and penalty approaches, Finite Element Modeling of one dimensional geometry –Bars, Truss, Beam					
UNIT:3		(12 Hours)			
Interpolation Methods: Polynomial form for interpolation functions- Linear, quadratic and cubic, Pascal triangle, Linear interpolation polynomials in terms of global coordinates and local coordinates for 2D simplex element.					
Higher Order and Isoparametric Elements: Lagrangian interpolation, Higher order 1D elements – quadratic, cubic element and their shape function, properties of shape functions, Shape functions of 2D quadratic triangular element in natural coordinate, 2D quadratic element shape functions – linear, quadratic, rectangular element.					
UNIT:4		(08 Hours)			
FEM formulation of 2-D and 3-D stress analysis problems. Jacobian matrix, Axisymmetric solids subjected to axisymmetric loadings. Two-dimensional isoparametric elements.					
UNIT:5		(08 Hours)			
Finite element modeling of fluid flow and heat conduction problems. Exposure to commercial FE codes in ANSYS					
Course Outcomes: Upon successful completion of this course, students should be able to:					
CO1	Explain the application and characteristics of FEM for simple elements, such as bars, beams, plane, isoperimetric elements, and 3-D element.				
CO2	Apply the concepts behind variational methods and weighted residual methods in FEM				
CO3	Analyze the element characteristic equation procedure and generation of global stiffness matrices				
CO4	Write the interpolation functions to higher order isoparametric elements.				
CO5	Solve bars, truss, beam and heat transfer problems using FEM an also to apply boundary conditions in realistic problems.				
CO6	Select the finite element method to solve problems involving axisymmetric solids subjected to axisymmetric loadings, fluid flow and heat conduction.				
Teaching Methods: Chalk& Board/ PPT/Video Lectures					

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Reference Books:

1. Chandraputla T.R. and Belegundu A.D., Finite Elements in Engineering, PHI.
2. Logan D.L., A First Course in the Finite Element Method, Cengage Learning
3. Reddy J.N., Introduction to Finite Element Method, Tata McGraw Hill.
4. Rao S.S., The Finite Element Method in Engineering, Elsevier
5. Hutton David V., Fundamentals of Finite Element Analysis, Tata McGraw Hill

CO-PO & PSO Mapping

PROGRAMME OUTCOMES												PSOs	
COs	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	2		1				1		1			
CO2	2	2									1		
CO3	3	2	1						1	1	1		
CO4	2	2	1						1	1	1		
CO5	2	2		2	1					1	1		
CO6	2	2			1					1	1		
Avg.	2.33	2	1	1.5	1			1	1	1	1		
















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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPE47012	GAS DYNAMICS AND JET PROPULSION	3	0	0	3
Pre -Requisite:					
Course Educational Objectives					
CEO1	To teach gas turbine cycle (Brayton) and know the working principle of each component of gas turbine engine				
CEO2	To make the students about the application of shaft power in gas dynamics , compressibility effects, normal shock wave and oblique shock wave				
CEO3	To teach about the design of combustion chamber and performance characteristics curve				
CEO4	To aware the students about the application of axial flow turbine ,turbojet, turbo prop, turbo fan, ram jet, pulse jet engine				
SYLLABUS					
UNIT:1		(10 Hours)			
Brayton cycle, regeneration and reheating cycle analysis , Axial flow fans and compressors, Elementary theory, degree of reaction , three dimensional flow, simple design methods, blade design, calculation of stage performance, overall performance.					
UNIT:2		(08 Hours)			
Introduction of gas dynamics – Compressibility effect, steady state one dimensional compressible flow of a perfect gas in a duct, isentropic flow in a constant area duct with friction,					
UNIT:3		(08 Hours)			
One-dimensional Flow: Continuity, Momentum, and Energy Equations, Adiabatic Flow Isentropic Flow, Normal Shock Waves ,Oblique Shock Waves , supersonic expansion and compression.					
UNIT:4		(10 Hours)			
Combustion: Performance characteristics. Combustion system, Form of combustion, important factors affecting combustion chamber design, combustion processes, combustion chamber performance, practical problem					
UNIT:5		(10 Hours)			
Axial flow turbines, construction of centrifugal and axial flow turbine, Analysis of Turbo Jet, Turbo Prop, Turbo Fan, Ram Jet, Pulse Jet Engine. Centrifugal fans Blowers and Compressors, Principle of operations, work done and pressure rise, slip factor, surging, choking, Stalling					
Course Outcomes: Upon successful completion of this course, students should be able to:					
CO1	Understand the concept of Brayton cycle, compressors, one and three dimensional flow, combustion theory, turbo machines etc.				
CO2	Solve problems on Brayton cycle, one dimensional flow,				
CO3	Explain gas dynamics, combustion chamber, centrifugal and axial compressors/turbines.				
CO4	Design and evaluate the performance of turbine blades, combustion chamber, turbine stages				
CO5	Illustrate and solve the problems related to the jet and rocket propulsion				
CO6	Develop turbo machineries with high performance.				

Signature of Faculty Members: [Handwritten signatures]



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Teaching Methods: Chalk& Board/ PPT/Video Lectures

Reference Books:

1. Cercignani Carlo, Rarefied Gas Dynamics: From Basic Concepts to Actual Calculations Volume 21 of Cambridge Texts in Applied Mathematics Rarefied Gas Dynamics: From Basic Concepts to Actual Calculations, 4TH EDITION
2. Ganeshan V., Fundamentals of Gas Turbine, Tata McGraw Hill, 3RD EDITION
3. Rajput R.K., Internal Combustion Engine, Laxmi Publication, 3RD EDITION

CO-PO & PSO Mapping

PROGRAMME OUTCOMES												PSOs	
COs	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	2											2
CO2	3	3											2
CO3	3	3											2
CO4	3	2	3										2
CO5	2	3											
CO6	3	2	3										2
Avg.	2.83	2.5	3										2

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SUBJECT CODE	TITLE OF THE SUBJECT		L	T	P	C
23BMEPE47013	ADVANCED WELDING THECHNOLOGY		3	0	0	3
Pre -Requisite:						
Course Educational Objectives						
CEO1	To impart knowledge regarding various advanced welding practices in industries					
CEO2	To understand the various parameters and requirements for welding processes					
CEO3	To apply the right kind of welding technique suitable for different materials					
CEO4	To evaluate the characteristics and properties of various metals and the related chemical, physical and mechanical properties					
SYLLABUS						
UNIT:1 (10 Hours)						
Introduction: Welding as compared with other fabrication processes, Importance and application of welding, classification of welding processes, Health & safety measures in Welding. Welding Power Sources: Physics of welding Arc, Basic characteristics of power sources for various arc welding processes, Transformer, rectifier and generators. Physics of Welding Arc: Welding arc, arc initiation, voltage distribution along the arc, arc characteristics, arc efficiency, heat generation at cathode and anode.						
Effect of shielding gas on arc, isotherms of arcs and arc blow. Metal Transfer: Mechanism and types of metal transfer in various arc welding processes						
UNIT:2 (08 Hours)						
Welding Processes: Manual Metal Arc Welding (MMAW), TIG, MIG, Plasma Arc, Submerged Arc Welding, Electrogas and Electroslag, Flux Cored Arc Welding, Resistance welding, Friction welding, Brazing, Soldering and Braze welding processes, Laser beam welding, Electron beam welding, Ultrasonic welding, Explosive welding, Friction Stir Welding, Underwater welding & Microwave welding						
UNIT:3 (08 Hours)						
Heat Flow Welding: Calculation of peak temperature; Width of Heat Affected Zone (HAZ); cooling rate and solidification rates; weld thermal cycles; residual stresses and their measurement; weld distortion and its prevention.						
UNIT:4 (10 Hours)						
Repair & Maintenance Welding: Hardfacing, Cladding, Surfacing, Metallizing processes and Reclamation welding.						
Weldability : Effects of alloying elements on weld ability, welding of plain carbon steel, CastIron and aluminum. Micro & Macro structures in welding.						
UNIT:5 (10 Hours)						
Weld Design: Types of welds & joints, Joint Design, Welding Symbols, weld defects, Inspection/testing of welds, Introduction to Welding Procedure Specification & Proceedure Qualification Record.						
Course Outcomes: Upon successful completion of this course, students should be able to:						
CO1	Understand the theoretical aspects of welding technology in depth.					
CO2	Intelligently select the appropriate welding process for a particular application					
CO3	Describe the basic metallurgy of melted and HAZ of a metal or alloy.					
CO4	Adjust welding parameters and techniques to optimize the weldment properties					
CO5	Identify the cause of welding defects and avoid them					
CO6	Demonstrate their ability to check weldment quality by inspection and testing methods.					

Signatures of faculty members and the Head of Institution.



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Teaching Methods: Chalk& Board/ PPT/Video Lectures

Reference Books:

1. R.S.Parmar, "Welding processes & Technology", Khanna Publishers.
2. S.V. Nandkarni, "Modern Arc Welding Technology", Oxford & IDH publishing Co
3. L.M.Gourd, "Principles of Welding Technology", ELBS/ Edward Arnold.
4. Richard L. Little, "Welding & Welding Technology", Mc-Graw Hill.
5. Rossi, "Welding Technology", Mc-Graw Hill

CO-PO & PSO Mapping

PROGRAMME OUTCOMES												PSOs	
COs	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	2											
CO2	3	1										3	
CO3	2	2											2
CO4	2	1											3
CO5	2	1											
CO6	3	2											
Avg.	2.16	1.5										3	2.5

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPE47014	TRIBOLOGY	3	0	0	3
Pre -Requisite: Mechanics, Design OF Machine Elements					
Course Educational Objectives					
CEO1	To expose the student to different types of bearings, bearing materials,				
CEO2	To understand friction characteristics and power losses in journal bearings.				
CEO3	To learn theory and concepts about different types of lubrication.				
CEO4	To learn concept of loss of materials on surfaces and its effects				
SYLLABUS					
UNIT:1		(08 Hours)			
Introduction to tribology: Historical background, practical importance, and subsequent use in the field. Lubricants: Types and specific field of applications. Properties of lubricants, viscosity, its measurement, effect of temperature and pressure on viscosity, lubrication types, standard grades of lubricants, and selection of lubricants.					
UNIT:2		(08 Hours)			
Friction: Origin, friction theories, measurement methods, friction of metals and non-metals.					
Wear: Classification and mechanisms of wear, delamination theory, debris analysis, testing methods and standards. Related case studies					
UNIT:3		(08 Hours)			
Hydrodynamic journal bearings: Friction forces and power loss in a lightly loaded journal bearing, Petroff's equation, mechanism of pressure development in an oil film, and Reynold's equation in 2D.					
Introduction to idealized journal bearing, load carrying capacity, condition for equilibrium, Sommerfeld's number and its significance; partial bearings, end leakages in journal bearing, numerical examples on full journal bearings only.					
UNIT:4		(08 Hours)			
Plane slider bearings with fixed/pivoted shoe: Pressure distribution, Load carrying capacity, coefficient of friction, frictional resistance in a fixed/pivoted shoe bearing, center of pressure, numerical examples.					
Hydrostatic Lubrication: Introduction to hydrostatic lubrication, hydrostatic step bearings, load carrying capacity and oil flow through the hydrostatic step bearing, numerical examples.					
UNIT:5		(08 Hours)			
Bearing Materials: Commonly used bearings materials, and properties of typical bearing materials. Advantages and disadvantages of bearing materials.					
Introduction to Surface engineering: Concept and scope of surface engineering. Surface modification – transformation hardening, surface melting, thermochemical processes. Surface Coating – plating, fusion processes, vapor phase processes. Selection of coating for wear and corrosion resistance.					
Course Outcomes: Upon successful completion of this course, students should be able to:					
CO1	Understand the fundamentals of tribology and associated parameters.				
CO2	Apply concepts of tribology for the performance analysis and design of components experiencing relative motion.				
CO3	Analyze the requirements and design hydrodynamic journal and plane slider bearings for a given application.				
CO4	Select proper bearing materials and lubricants for a given tribological application.				



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CO5	Apply the principles of surface engineering for different applications of tribology.
CO6	Analyze the tribological issues in the design of machine components and braking systems.

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Reference Books:

1. Basu, Sen Gupta and Ahuja, Fundamentals of Tribology, PHI
2. Srivatsava Sushil Kumar, Tribology in Industry, S. Chand & Co
3. Majumdar B.C., Tribology, Tata McGraw Hill Co Ltd
4. Gunther Raymono O, Lubrication, Bailey, Bros & Swinfan Ltd.
5. Barwell P.T., Bearing Systems - Principles and Practice
6. Dowson D, History of Tribology, Longman London, 1979.
7. Stachowiak G N, Batchelor A W and Stachowick G B "Experimental methods in Tribology", Tribology Series 44, Editor D Dowson, 2004.

CO-PO & PSO Mapping

PROGRAMME OUTCOMES												PSOs	
COs	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	1											
CO2	2	2	3										
CO3	2	3	3										
CO4	3	2	3										
CO5	3	3											
CO6	2	2											
Avg.	2.83	2.16	3										



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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPE47021	DESIGN AND ANALYSIS OF HEAT EXCHANGER	3	0	0	3
Pre -Requisite: Thermodynamics, Heat Transfer, Design of machine elements					
Course Educational Objectives					
CEO1	To know common heat exchanger types, their advantages and limitations.				
CEO2	To learn how to handle rating and sizing problems in heat exchanger design				
CEO3	To analyze various types of heat exchangers providing heat transfer between two or more fluids and acquiring necessary information for the design of heat exchangers.				
CEO4	To examine how to consider fouling of surfaces, incorporate fouling in designs, and handle fouling during heat exchanger operation.				
SYLLABUS					
UNIT:1		(10 Hours)			
Heat exchanger types, constructional details, Nature of heat exchange, Parallel flow, Counter flow, Cross flow, Concentric tube, Shell and tube, Multiple shell and tube, Compact heat exchanger, Condenser, Evaporator, Regenerator, Recuperator . Overall heat transfer coefficient, Thermal resistance, Efficiency. Temperature Distribution and its implications					
UNIT:2		(10 Hours)			
LMTD, effectiveness, Overall Heat transfer coefficients, Fouling factor, Scaling factor, Correction factor, NTU method, Flow Distribution, Friction Factor, Pressure Loss, Pumping power, Orifice, Flow nozzle, Diffusers, Bends, Baffles, Effect of Channel Divergence, Manifolds.					
UNIT:3		(10 Hours)			
Heat exchanger fabrication, Tubular versus flat plate, Tube to header joint, Finned surface, Design of Liquid to Liquid heat exchanger, Plate and Frame heat exchanger, Design of Gas to Gas heat exchanger, Tubular regenerators for gas turbine, Regenerator for mobile gas turbine, Recuperators for heat pipe, Design of Liquid to gas heat exchanger, Comparison of fin geometric, Design of automotive radiators.					
UNIT:4		(08 Hours)			
Stress in tubes, Headers sets and Pressure vessels: Differential Thermal Expansion, Thermal stresses, Shear stresses, Thermal sleeves, Vibration, Noise, types of failures					
UNIT:5		(08 Hours)			
Design Aspects: Heat transfer and pressure loss flow configuration effect of baffles. Effect of deviations from ideality. Design of cooling towers. Types of cooling tower, Wind loads, Dry cooling tower.					
Course Outcomes: Upon successful completion of this course, students should be able to:					
CO1	Understand different types of flow, heat exchanger & mechanism of heat exchange.				
CO2	Analyze the effectiveness of LMTD approach over AMTD approach based on different factors				
CO3	Evaluate the effectiveness of different heat exchangers				
CO4	Analyze the performance of compact Heat Exchangers and develop the radiator of an automotive.				
CO5	Calculate stress in the STHE by analyzing the various thermal parameters.				
CO6	Design and develop Heat Exchangers with different applications along with allied equipment.				

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Teaching Methods: Chalk& Board/ PPT/Video Lectures

Reference Books:

1. Heat and Mass Transfer by P.K. Nag, TMH, 3rd Ed.,
2. A.P. Frass and M.N.Ozisik, Heat Exchanger Design', John Wiley & Sons Inc, 1965.
3. W.M. Kays and A.L. London. Compact Heat Exchangers', 3rd Ed., TMH, 1984
4. G.Walker, Industrial Heat Exchangers', A basic guide, TMH V Book Co. 3rd Ed., 1980.

CO-PO & PSO Mapping

PROGRAMME OUTCOMES												PSOs	
COs	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	2	1	2										1
CO2	2	3	2										
CO3	2	3	2										
CO4	2	2											2
CO5	2	3											
CO6	2	2	2										2
Avg.	2	2.33	2										1.67

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPE47022	PRODUCTION AND OPERATION MANAGEMENT	3	0	0	3
Pre -Requisite: Statistical Mathematics,					
Course Educational Objectives					
CEO1	To educate basics of various Productions, operation and management system in various industry.				
CEO2	To develop an idea of safe work system design and selection of appropriate method for a process.				
CEO3	To build up an entrepreneurial skill through the topics like layout design, forecasting and inventory control.				
CEO4	To impart current advanced trends of different industries.				
SYLLABUS					
UNIT:1		[10 Hours]			
Introduction: Operations Function in an Organization, Manufacturing VS Service Operations, System view of Operations; Designing Products and Processes: New Product Design- Product Life Cycle, Product Development Process, Process Technology: Project, Job shop, Batch, Assembly Line, Continuous Manufacturing; Concepts of productivity and concurrent engineering. Work Study: Methods Study- Techniques of Analysis, recording, improvement and standardization; Work Measurement: Work Measurement Principles using Stopwatch Time Study, Predetermined Motion Time Standards and Work Sampling, Standard Time Estimation.					
UNIT:2		[10 Hours]			
Location and Layout: Factor Influencing Plant, Facility Location Procedure and Models: Qualitative Models, Breakeven Analysis, location Model, centroid method. Layout Types: Process Layout, Product Layout, Fixed Position Layout; Concept of GT. Forecasting: Principles and Method, Moving Average, weighted Moving Average, Exponential Smoothing, Linear regression, Delphi method, Forecasting Error.					
UNIT:3		[8 Hours]			
Inventory Control: Relevant Costs, Basic EOQ Model, Model with Quantity discount, Economic Batch Quantity, Periodic and Continuous Review Systems, Safety Stock, Reorder Point and Order Quantity Calculations. ABC Analysis, VED analysis.					
UNIT:4		[10 Hours]			
Manufacturing Planning and Control: The Framework and Components: Aggregate Planning, Master Production Scheduling, Material Requirements Planning, Capacity Requirements Planning, Supply Chain Management. Sequencing and Scheduling: Single Machine Sequencing: Basics and Performance Evaluation Criteria, Methods for Minimizing Mean Flow Time, Flow shop sequencing: 2 and 3 machines cases: Johnson's Rule, CDS heuristic and Job shop Scheduling: Priority dispatching Rules.					
UNIT:5		[10 Hours]			
Project Management: Introduction, phases, guidelines for network construction; Critical Path Method (CPM), project evaluation and review technique (PERT), Crashing of project network. Modern Trends in Manufacturing: Just in Time (JIT) System, FMS, Total Quality Management, Total/Productive Maintenance. Lean Manufacturing and Industry 4.0.					

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Course Outcomes: Upon successful completion of this course, students should be able to:	
CO1	Understand the concept of operation function, product design and process technology and correlate the factors affecting productivity of industries.
CO2	Apply different techniques of work-study, selection of location and layout design.
CO3	Analyze the data for forecasting through different techniques.
CO4	Understand the concept of inventory control models and learn manufacturing planning tools.
CO5	Apply different techniques of sequencing and scheduling in the selection of jobs.
CO6	Analyze project related issues through project management and learn modern trends in manufacturing.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert

Reference Books:

1. Chary S.N., "Production and Operations Management", Tata McGraw Hill.
2. Paneerselvam R., "Production and Operations Management, Prentice Hall of India.
3. Aswathappa& Bhatt – Production & Operations Management, HPH.
4. Gaither & Frazier - Operations Management, Cengage Publication
5. Russell & Taylor - Operations Management, PHI Publication
6. Chase, Aquilanno, Jacob & Agarwal - Operations Management, TMH Publication.
7. Adam E.E. and Ebert R.J., "Production and Operations Management", Prentice Hall of India
8. Buffa ES, Sarin RK. Modern Production: Operations Management, John Wiley and Sons Ltd.

CO-PO & PSO Mapping

PROGRAMME OUTCOMES												PSOs	
COs	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	2	2											2
CO2	1	2	2										
CO3	2	3	2										
CO4	1	3	2										
CO5	2	3											2
CO6	3	2											3
Avg.	1.83	2.5	2										2.33



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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPE47023	NON DESTRUCTIVE EVALUATION AND TESTING	3	0	0	3
Pre -Requisite: Machining Science Technology					
Course Educational Objectives					
CEO1	To provide students with a strong knowledge of terms, concepts, principles etc. involved in non-destructive testing.				
CEO2	To provide practical training in handling and testing the non-destructive testing equipment.				
CEO3	To develop knowledge and skills for interpretation and evaluation of the results.				
CEO4	To offer environment to enhance team essential skills for effective careers in the inspection profession				
SYLLABUS					
UNIT:1		(09 Hours)			
Importance of NDT, Scope of NDT, difficulties of NDT, future progress in NDT, economics aspects of NDT.					
Various physical characteristics of materials and their applications in NDT,					
Visual inspection – tools, applications and limitations -Fundamentals of visual testing: vision, lighting, material attributes, environmental factors.					
UNIT:2		(08 Hours)			
Liquid Penetrant Testing – Principles, types and properties of liquid penetrants, Developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results.					
Magnetic Particle Testing- Theory of magnetism, inspection materials , Magnetization methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism					
UNIT:3		(09 Hours)			
Principles of MPI, basic physics of magnetism, permeability, flux density, cohesive force, Magnetizing force, retivity, residual magnetism, Methods of magnetization, magnetization techniques, Interpretation of MPI, indications, advantage and limitation of MPI.					
UNIT:4		(10 Hours)			
Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction. Acoustic Emission Technique –Principle, AE parameters, Applications					
UNIT:5		(12 Hours)			
Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films – graininess, density, speed, contrast, characteristic curves, Penetra meters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Computed Radiography, Computed Tomography					
Course Outcomes: Upon successful completion of this course, students should be able to:					
CO1	Understand the basic theory and principles of NDT methods.				
CO2	Use of appropriate measurement techniques and tools to collect data.				
CO3	Interpret the results and investigate the possible artifacts.				
CO4	Apply the various NDT techniques to identify the defects				
CO5	Select the suitable NDT techniques for various defects				
CO6	Show confidence to take responsibility for on the job training and guidance of trainees and NDT level I personnel.				

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Teaching Methods: Chalk& Board/ PPT/Video Lectures

Reference Books:

1. Baldev Raj, Jayakumar T., Thavasimuthu M, "Practical Non-Destructive Testing", Narosa Publishing House, 2009.
2. Ravi Prakash, "Non-Destructive Testing Techniques", 1st revised edition, New Age International Publishers, 2010
3. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
4. Paul E Mix, "Introduction to Non-destructive testing: a training guide", Wiley, 2nd Edition New Jersey, 2005
5. Charles, J. Hellier, "Handbook of Nondestructive evaluation", McGraw Hill, New York 2001

CO-PO & PSO Mapping

PROGRAMME OUTCOMES												PSOs	
COs	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	2												1
CO2	1	2			2								1
CO3	2	2											1
CO4	1	1			2								1
CO5	1	1			2								2
CO6	1				2								2
Avg.	1.1	1.5			2								1.33



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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPE47024	TOTAL PRODUCTIVE MAINTENANCE	3	0	0	3
Pre -Requisite: Machining Science Technology					
Course Educational Objectives					
CEO1	Analyze TPM principles and objectives through case studies, noting implementation best practices and challenges.				
CEO2	Evaluate TPM's impact on efficiency and employee engagement across different industries.				
CEO3	Adapt to emerging trends like predictive maintenance and digitalization to enhance asset management.				
CEO4	Develop effective TPM strategies, emphasizing leadership commitment and frontline worker involvement.				
SYLLABUS					
UNIT:1		(09 Hours)			
Introduction to Total Productive Maintenance (TPM), Definition and Essence of TPM, Understanding the core principles and objectives of TPM in enhancing equipment reliability and overall operational efficiency. Evolution of TPM: Tracing the historical development of TPM from its roots in Japanese manufacturing practices to its global adoption across diverse industries. Importance of TPM: Exploring the significance of TPM in optimizing asset utilization, minimizing downtime, and fostering a culture of continuous improvement within organizations.					
UNIT:2		(08 Hours)			
Pillars and Principles of TPM: Eight Pillars of TPM: Delving into the foundational pillars of TPM, including Autonomous Maintenance (AM), Planned Maintenance (PM), Quality Maintenance (QM). Principles of TPM: Examining the key principles underlying TPM implementation, such as employee involvement, proactive maintenance, and continuous improvement. Role of Each Pillar: Understanding the specific contributions of each TPM pillar in achieving overall equipment effectiveness (OEE) and operational excellence.					
UNIT:3		(09 Hours)			
TPM Implementation Framework: Stages of TPM Implementation: Outlining the step-by-step process for implementing TPM, from initial assessment and planning to execution and continuous improvement. Leadership and Organizational Culture: Emphasizing the importance of leadership commitment, employee empowerment, and fostering a supportive TPM culture. Employee Training and Engagement: Strategies for involving frontline workers in TPM activities, providing necessary training, and creating a sense of ownership and accountability.					
UNIT:4		(10 Hours)			
TPM Tools and Techniques: Overall Equipment Effectiveness (OEE): Introduction to OEE as a key performance metric for assessing equipment performance, availability, and quality. Root Cause Analysis (RCA): Exploring RCA methodologies for identifying and addressing the root causes of equipment failures and inefficiencies. Visual Management and 5S: Utilizing visual management tools and the 5S methodology to streamline processes, enhance workplace organization, and promote standardization.					



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UNIT:5 (12 Hours)
Advanced TPM Practices and Case Studies: Advanced TPM Strategies: Examining advanced TPM practices, such as Total Productive Manufacturing (TPM), Total Productive Engineering (TPE), and Total Quality Management (TQM).
Case Studies and Best Practices: Analyzing real-world case studies of organizations that have successfully implemented TPM, highlighting best practices, challenges, and outcomes.
Future Trends in TPM: Discussing emerging trends and technologies in TPM, such as predictive maintenance, digitalization, and the integration of Industry 4.0 principles.

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

CO1	Understand about TPM's principles for better equipment performance.
CO2	Trace TPM's evolution from Japan to global adoption.
CO3	Apply TPM stages for continuous improvement.
CO4	Evaluate leadership's pivotal role in TPM implementation.
CO5	Assess TPM's impact on productivity and culture.
CO6	Analyze TPM case studies and future trends like predictive maintenance and digitalization.

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Reference Books:

1. Mishra, R. C., Pathak, K., "Maintenance Engineering and Management", 2nd Edition, Prentice – Hall of India.
2. Steven Boris, "Total Productive Maintenance", McGraw-Hill.
3. Terry Wireman, "Total Productive Maintenance", 2nd Edition, Industrial Press, 2004.
4. Tina Kanti Agustiady, Elizabeth A. Cudney, "Total Productive Maintenance: Strategies and Implementation Guide", Productivity Press, 2015.
5. Kern Peng, "Equipment Management in the Post-Maintenance Era: A New Alternative to Total Productive Maintenance (TPM)", Productivity Press, 2012.
6. David J. Sumanth, "Total Productivity Management (TPMgt): A Systematic and Quantitative Approach to Compete in Quality, Price and Time", Productivity Press, 1997.
7. Fumio Gotoh, Masaji Tajiri, "Autonomous maintenance in Seven Steps: Implementing TP Mon the Shop Floor", Productivity Press, 1999.
8. Seiichi Nakajima, "Total Productive Maintenance", Productivity Press, 11th edition, 1988

CO-PO & PSO Mapping

PROGRAMME OUTCOMES												PSOs	
COs	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	2		1		1					1		
CO2	3	2		1	1	1					1		
CO3	3	2		1		1							
CO4	2	2				1							
CO5	3	2		1	1								
CO6	2	2		1									
Avg.	2.66	2	0	1	1	1					1		

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPE47031	COMPUTATIONAL FLUID DYNAMICS	3	0	0	3
Pre -Requisite: Fluid Mechanics, Heat transfer, Finite element methods					
Course Educational Objectives					
CEO1	To introduce the basics of CFD through FVM,FDM and FEM to students				
CEO2	To teach different discretization scheme to formulate the governing equations.				
CEO3	To make the students understand about fluid flow problem through numerical method (staggering and discretization method).				
CEO4	To make the students familiar with transient heat transfer problems through finite volume method				
SYLLABUS					
UNIT:1		[10 Hours]			
Introduction: Illustration of the CFD approach, CFD as an engineering analysis tool, Review of governing equations, Modeling in engineering, Partial differential equations- Parabolic, Hyperbolic and Elliptic equation, CFD application in Chemical Engineering, CFD software packages and tools.					
UNIT:2		[12 Hours]			
Principles of Solution of the Governing Equations: Finite difference and Finite volume Methods, Convergence, Consistency, Error and Stability, Accuracy, Boundary conditions, CFD model formulation.					
UNIT:3		[08 Hours]			
Mesh generation: Overview of mesh generation, Structured and Unstructured mesh, Guideline on mesh quality and design, Mesh refinement and adaptation.					
UNIT:4		[10 Hours]			
Solution Algorithms: Discretization schemes for pressure, momentum and energy equations - Explicit and implicit Schemes, First order upwind scheme, second order upwind scheme, QUICK scheme, SIMPLE, SIMPLER and MAC algorithm, pressure-velocity coupling algorithms, velocity-stream function approach, solution of Navier-Stokes equations.					
UNIT:5		[08 Hours]			
CFD Solution Procedure: Problem setup – creation of geometry, mesh generation, selection of physics and fluid properties, initialization, solution control and convergence monitoring, results reports and visualization.					
Course Outcomes: Upon successful completion of this course, students should be able to:					
CO1	Develop mathematical models for solving fluid flow problems, through one dimensional geometry.				
CO2	Analyze the behavior of fluid flow through discretization using, finite volume method.				
CO3	Illustrate and Solve the unsteady heat conduction examples using finite volume method.				
CO4	Evaluate the transient convection –diffusion problems using different discretization scheme.				
CO5	Program and simulate simple CFD problems				
CO6	Understand the CFD role in industrial design applications and its limitations				
Teaching Methods: Chalk& Board/Video Lectures					
Reference Books:					
1. P.S. Ghosdastidar, Computer Simulation of Flow and Heat Transfer, Tata McGraw-Hill					



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2. Jr. D. A. Anderson, Computational Fluid Mechanics and Heat Transfer by McGraw-Hill Education
3. Muralidhar, K. and Sundararajan, T., Computational Fluid Flow and Heat Transfer, Norosa Publishing House, N. Delhi

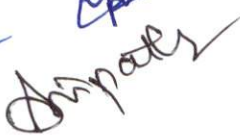
CO-PO & PSO Mapping													
PROGRAMME OUTCOMES												PSOs	
COs	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	3		2									
CO2	3	2		2									
CO3	2	3		2									
CO4	2	3		2									
CO5	2	2	2	3								2	1
CO6	3	2											
Avg.	2.5	2.5	2	2.2								2	1













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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPE47032	ADDITIVE MANUFACTURING	3	0	0	3
Pre -Requisite: Basic of Manufacturing processes					
Course Educational Objectives					
CEO1	To teach how to make objects from 3D model data, usually layer upon layer, as opposed to subtractive manufacturing methodologies, such as traditional machining				
CEO2	To make the students learn the manufacturing of highly complex parts can be an economically viable alternative to conventional manufacturing technologies				
CEO3	To teach type of material used, the deposition technique or by the way the material is fused or solidified				
CEO4	To expose the students to the mathematical models for AM to describe the transport phenomena such as heat/mass transfer and fluid flow				
SYLLABUS					
UNIT:1		(10 Hours)			
Overview – History - Need-Classification -Additive Manufacturing Technology in product development- Materials for Additive Manufacturing Technology – Tooling - Applications					
UNIT:2		(10 Hours)			
Basic Concept – Digitization techniques – Model Reconstruction – Data Processing for Additive Manufacturing Technology: CAD model preparation – Part Orientation and support generation – Model Slicing –Tool path Generation – Softwares for Additive Manufacturing Technology: MIMICS, MAGICS.					
UNIT:3		(6 Hours)			
Classification additive manufacturing systems – Liquid based system – Stereolithography Apparatus (SLA)- Stereolithography (SL), Principle, process, advantages and applications, SL resin curing process, SL scan patterns, Microstereolithography					
UNIT:4		(8 Hours)			
Solid based system –Fused Deposition Modeling - Principle, process, advantages and applications, Laminated Object Manufacturing- Principle, process, advantages and applications.					
UNIT:5		(10 Hours)			
POWDER BASED ADDITIVE MANUFACTURING SYSTEMS					
Selective Laser Sintering – Principles of SLS process - Process, advantages and applications, Three Dimensional Printing - Principle, process, advantages and applications- Laser Engineered Net Shaping (LENS), Electron Beam Melting					
Course Outcomes: Upon successful completion of this course, students should be able to:					
CO1	Explain the importance of AM in manufacturing				
CO2	Compare different method and discuss the effects of the Additive Manufacturing technologies				
CO3	Analyze the characteristics of the different AM models generated through computer based software.				
CO4	Elaborate the concept of liquid based AM method				
CO5	Enumerate the concept laser based and electron beam based 3D printing techniques				
CO6	Optimize FDM & LOM process parameters to improve the quality of the parts.				
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Guest Lectures					



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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPE47033	MECHANICAL VIBRATION	3	0	0	3
Pre -Requisite: Machining Science Technology					
Course Educational Objectives					
CEO1	Develop schematic models for physical systems and formulate governing equations of motion.				
CEO2	Analyze the vibration characteristics including critical speed of rotating and reciprocating systems				
CEO3	Design machine supporting structures, vibration isolators and absorbers.				
CEO4	Calculate free and forced vibration responses of multi degree freedom systems using modal analysis				
SYLLABUS					
UNIT:1		(09 Hours)			
Introduction to Mechanical Vibration, Types of Vibration, Simple Harmonic Motion (S.H.M.), Principle of superposition applied to S.H.M., Beats, Fourier analysis, Degree of freedom, Equations of motions, general solution of free vibration. Undamped free vibration of single degree freedom systems: Modeling of Vibrating Systems, Evaluation of natural frequency – differential equation, Equivalent systems..					
UNIT:2		(10 Hours)			
Damped free vibration of single degree freedom systems, Different types of damping, Equivalent viscous damping and Structural damping. Study of vibration response of viscous damped systems for cases of under damping, critical damping and over damping, Logarithmic decrement. Forced vibration of single degree freedom systems, Steady state solution with viscous damping due to harmonic force, reciprocating and rotating unbalance mass, vibration isolation and transmissibility due to harmonic force excitation and support motion.					
UNIT:3		(09 Hours)			
Vibration measuring instruments, Concept of critical speed and its effect on the rotating shaft. Undamped vibration of two degree freedom systems, Free vibration of spring coupled and mass coupled systems, Longitudinal, Torsional and transverse vibration of two degree freedom systems, influence coefficient technique.					
UNIT:4		(10 Hours)			
Transverse vibration of strings, longitudinal vibrations of bars, Lateral vibration of beams, Torsional vibration of circular shafts, whirling of shafts. Introduction, Method of Laplace transformation and response to an impulsive output, response to step-input, pulse-input, and phase plane method					
UNIT:5		(10 Hours)			
Two degree of freedom systems: Introduction, Formulation of equation of motion: Equilibrium method, Lagrangian method. Free vibration response, Eigen values and Eigen vectors, Normal modes and mode super position Forced vibration response, undamped vibration absorbers, Case studies on undamped vibration absorbers.					

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Course Outcomes: Upon successful completion of this course, students should be able to:													
CO1	Understand about the vibration and explain causes, effects, and classification of vibrating systems; identify variables, parameters, and degrees of freedom.												
CO2	Develop physical, schematic, and mathematical models; linearize nonlinear systems for analysis.												
CO3	Formulate SDF system equations of motion and analyze undamped and damped free vibrations.												
CO4	Evaluate forced vibration response to harmonic excitations and understand related applications.												
CO5	Formulate and solve equations of motion for 2-DOF systems; analyze free and forced vibrations.												
CO6	Analyze MDOF systems; apply modal analysis and experimental modal techniques.												
Teaching Methods: Chalk& Board/ PPT/Video Lectures													
Reference Books:													
1. G. K. Groover, Mechanical Vibrations, 8th Edition, Nem Chand & Bros, 2009. L. Meirovich, Elements of Vibrations Analysis, 1st Edition, Tata McGraw Hill, 1986													
2. S. Graham Kelly, Mechanical Vibrations, 1st Edition, Tata McGraw Hill, 1996													
3. Singiresu S. Rao, Mechanical Vibrations, 6th Edition, Pearson Education, 2018.													
CO-PO & PSO Mapping													
PROGRAMME OUTCOMES												PSOs	
COs	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	3	3	1	1						2		1
CO2	3	3	2	2	2						2		1
CO3	3	3	2	3	2						1		
CO4	3	3	2	2	3						1		1
CO5	3	3	3	1	1						2		
CO6	3	3	2	2	2						1		1
Avg.	3	3	2	2	2						1.5		1















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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPE47034	HYDRAULICS & PNEUMATICS	3	0	0	3
Pre -Requisite: DOF, SHM, Laplace Transformation					
Course Educational Objectives					
CEO1	To identify hydraulic and pneumatic components used in a real application				
CEO2	To summarize the features and functions of Hydraulic motors, actuators and Flow control valves				
CEO3	To explain the working of different pneumatic circuits and systems				
CEO4	To design hydraulic and pneumatic circuits.				
SYLLABUS					
Unit-1:		[9 hours]			
Hydraulic Systems: Introduction to fluid power - types, advantages and applications of fluid power systems. Properties of hydraulic fluids - general types of fluids. Construction of hydraulic reservoir. Gravity, spring loaded and gas loaded accumulators.					
Unit-2:		[12 hours]			
Hydraulic Pumps: Types of hydraulic pumps - construction and working principle - gear pumps, vane pumps and piston pumps - selection of hydraulic pumps.					
Hydraulic Control Valves: Types of hydraulic valves - construction and working principle – direction control valves, pressure control valves, flow control valves and servo valves.					
Unit-3:		[8 hours]			
Linear Actuators: Hydraulic cylinders - introduction, types of hydraulic actuators, hydraulic cylinder operation and cylinder mountings, hydraulic cylinder and cushions,					
Rotary Actuators: Types of hydraulic motors - construction and working principle - gear, vane and piston motors, hydraulic motor performance, hydrostatic transmissions.					
Unit-4		[11hours]			
Hydraulic Circuits: Introduction – control of a single-acting hydraulic cylinder – control of a double acting hydraulic cylinder – regenerative circuit, pump unloading circuit, hydraulic cylinder sequencing circuits, cylinder synchronizing circuits. Speed control of a hydraulic cylinder – speed control of a hydraulic motor.					
Pneumatic Circuits: Basic pneumatic circuits – operation of single acting cylinder – operation of double acting cylinder					
Unit-5		[8 hours]			
Maintenance: Introduction to types of maintenance - Oxidation and corrosion of hydraulic fluids - maintaining and deposing of fluids - wear of moving parts due to solid particle contamination of the fluid. Problems caused by gases in hydraulic fluids,					
Trouble-shooting: troubleshooting of hydraulic systems. Common problems in pneumatic systems - troubleshooting of pneumatic systems.					
Course Outcomes: <i>Upon successful completion of this course, students should be able to:</i>					
CO1	Understand the Fluid power and operation of different types of pumps, Hydraulic circuits and systems.				
CO2	Summarize the features and functions of Hydraulic motors, actuators and Flow control valves.				

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CO3	Elaborate the working of different pneumatic circuits and systems.
CO4	Design the various trouble shooting methods and applications of hydraulic and pneumatic systems.
CO5	Compare the operating characteristics of various types of hydraulic pumps
CO6	Select appropriate actuators for a particular application

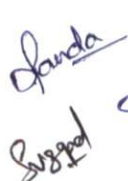
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Guest Lectures

Reference Books:

1. Anthony Esposito, "Fluid Power with Applications", Pearson Education 2005.
2. Majumdar S.R., "Oil Hydraulics Systems- Principles and Maintenance", Tata McGraw-Hill, 2001.
2. Shanmuga sundaram.K, "Hydraulic and Pneumatic controls", Chand & Co, 2006.
3. Majumdar S.R., "Oil Hydraulics Systems- Principles and Maintenance", Tata McGraw Hill, 2001
4. Majumdar, S.R., "Pneumatic Systems – Principles and Maintenance", Tata McGraw Hill, 2007.
5. Micheal J, Pinches and Ashby, J.G., "Power Hydraulics", Prentice Hall, 1989.
6. Dudelyt, A Pease and John J Pippenger, "Basic Fluid Power", Prentice Hall, 1987.
7. Srinivasan. R, "Hydraulic and Pneumatic Control", IInd Edition, Tata McGraw - Hill Education,

CO-PO & PSO Mapping													
PROGRAMME OUTCOMES												PSOs	
COs	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	3	2										
CO2	2	3	2	2									
CO3	2	3	2	2									
CO4	2	3	2										
CO5	2			2			2						
CO6	2	2	3	3			2						
Avg.	2.25	2.8	2.1	2.25			2						












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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEOE47011	RENEWABLE ENERGY SOURCES	3	0	0	3
Pre -Requisite:					
Course Educational Objectives					
CEO1	Comprehensive Understanding of Conventional and Non-Conventional Energy Sources:				
CEO2	Gain expertise in the principles, technologies, and applications of biomass energy.				
CEO3	Acquire the skills necessary to design, install, and operate solar power plants.				
CEO4	Understand and Explore the concept of captive power plants and their role in decentralized renewable energy generation.				
SYLLABUS					
UNIT:1		(10 Hours)			
Conventional and Non-conventional sources of energy: Conventional energy sources. Non-conventional energy sources. Need of non-conventional energy sources. Renewable Sources of Energy such as Hydro, Solar, Wind, Biomass, Tidal and Geothermal - their availability and limitations.					
UNIT:2		(10 Hours)			
Biomass Energy: Introduction to biomass and farm residue, management and briquetting. Bio-gas as a source of energy. Benefits of bio-gas. Technology of biogas. Principles, feedstock, types and design of biogas plants. Comparison of plant designs. Main parts of biogas plants, digester, gas holder, pressure gauge, gas controlling cocks and meter. Selection of biogas model and size. Site selection of biogas plants. Appliances of biogas plants - burner, heating plate, lamps. Operation, troubleshooting and maintenance of a biogas plant. Safety measures in biogas plants. Biomass Gasification, Different types of biomass gasifiers.					
UNIT:3		(10 Hours)			
Solar Power Plant : Solar constants, Measurement of solar radiations Solar Energy Conversion CSP generators, construction and working principle construction of a solar PV Systems: Solar cell, Module, Panel and array Types of solar PV system (i) Stand –Alone Solar PV system (ii) Grid-Interactive solar PV system (iii) Hybrid Solar PV system Grid connection issues of solar power plants					
UNIT:4		(10 Hours)			
Principle of wind energy conversion; Basic components of wind energy conversion systems; wind mill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of aerodynamic forces acting on wind mill blades and estimation of power output; wind data and site selection considerations.					
UNIT:5		(10 Hours)			
Captive power plant and other renewable energy sources, Ocean energy electrical conversion systems, Geothermal electrical energy conversion systems, Wave energy electrical conversion systems, Tidal energy electrical conversion systems					
Course Outcomes: Upon successful completion of this course, students should be able to:					
CO1	Develop a comprehensive understanding of the energy landscape by distinguishing between conventional and non-conventional sources				
CO2	Demonstrate the ability to evaluate the broader implications of biomass energy on the environment and society.				
CO3	Acquire expertise in designing and evaluating solar power plants, optimizing efficiency, assessing economic viability, and proposing integration into existing power grids using both photovoltaic and solar thermal technologies."				

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CO4	Analyze and optimize wind energy systems, including wind turbine principles, site selection, and environmental considerations, aiming for solutions that maximize efficiency while minimizing environmental impact.
CO5	Understand and Implement Decentralized Captive Power Plants
CO6	Blend insights from biomass, solar, wind, etc. to create complete solutions for sustainable energy

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Guest Lectures

Reference. Books

1. Renewable Energy Technologies, Solanki, Chetan S. PHI Learning, New Delhi,
2. A Text book of Power System Engineering, A Chakrabarti, M. L Soni, P. V. Gupta, U. S. Bhatnagar, Dhanpat Rai Publication
3. Wind Power Technology, Earnest, Joshua, PHI Learning, New Delhi, 2013
4. Wind Power in Power System, Thomas Ackermann, John Willey & Sons.
5. Renewable Energy Resources, J. Twidell and T. Weir, E & F N Spon Ltd, London,
6. Electric Power Generation: Transmission and Distribution, S. N. Singh, PHI Learning, New
7. Electrical Power, Dr. S.L. Uppal
8. Electrical Power System, Mehta, V.K. S. Chand and Company Bew Delhi.

CO-PO & PSO Mapping

PROGRAMME OUTCOMES												PSOs	
COs	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	2	1				1	2				1		
CO2	2	2	1	1		1	1	1	1	1	1		
CO3	2	2	1			1	1	1	1		1		
CO4	2	2	1	1	1	2	2	1	1		1		
CO5	1	1									1		
CO6	2	2	2	1		2	2	1	1	1	1		
Avg.	1.8	1.6	1.3	1	1	1.4	1.6	1	1	1	1		



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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEOE47012	CORROSION ENGINEERING	3	0	0	3
Pre -Requisite:					
Course Educational Objectives					
CEO1	Acquire comprehensive knowledge of electrochemical principles, corrosion mechanisms, testing methods, and prevention strategies.				
CEO2	Develop problem-solving skills to analyze and mitigate corrosion issues in various industries.				
CEO3	Apply theoretical knowledge to design and conduct corrosion testing, investigations, and prevention measures.				
CEO4	Demonstrate critical thinking to evaluate corrosion control measures, identify areas for improvement, and recommend innovative solutions.				
SYLLABUS					
UNIT:1		(10 Hours)			
Electrochemical and thermodynamic principles, Nernst equation and electrode potentials of metals, EMF and galvanic series, merits and demerits; origin of Roubaix diagram and its importance to iron, aluminum and magnesium metals.					
UNIT:2		(10 Hours)			
Exchange current density, polarization- concentration, activation and resistance, Tafel equation; passivity, electrochemical behavior of active/passive metals, theories of passivity					
UNIT:3		(10 Hours)			
Atmospheric, pitting, dealloying, stress corrosion cracking, inter granular corrosion, corrosion fatigue, erosion-corrosion, fretting corrosion and high temperature oxidation; hot corrosion; causes and remedial measures					
UNIT:4		(10 Hours)			
Purpose of testing, laboratory, semi-plant and field tests, susceptibility tests for IGC, stress corrosion cracking and pitting, immersion and salt spray testing, impedance analysis, sequential procedure for laboratory and onsite corrosion investigations, corrosion auditing and corrosion map of India					
UNIT:5		(10 Hours)			
Corrosion prevention by design improvements, anodic and cathodic protection, metallic, non-metallic and inorganic coatings, mechanical and chemical methods and various corrosion inhibitors.					
Course Outcomes: Upon successful completion of this course, students should be able to:					
CO1	Apply electrochemical principles to understand corrosion reactions and calculate electrode potentials.				
CO2	Analyze corrosion mechanisms to explain various corrosion types and identify causes/remedies.				
CO3	Conduct corrosion testing design and conduct tests to evaluate corrosion susceptibility.				
CO4	Develop corrosion prevention strategies to propose prevention methods by design, protection, coatings, and inhibitors.				
CO5	Investigate corrosion cases to apply procedures for laboratory and onsite corrosion investigations.				
CO6	Evaluate corrosion control measures to assess effectiveness of corrosion control measures and recommend improvements.				
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Guest Lectures					

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Reference. Books

1. Fontana M. G., Greene N.D., 8CorrosionEngineering9,2nd Edition, McGraw Hill.
2. Raj Narayan, An Introduction to Metallic Corrosion and itsPrevention9,1stEdition,
3. Oxford and IBH, An Introduction of Metallic Corrosion – R. Evans, Eward Arnold (Publishers) Ltd. London.
4. Introduction of High Temperature Corrosion – N. Birks and G. H. Meier
5. Mars G. Fontana, Corrosion Engineering, 3rd edition, McGraw-Hill Book Company, David Talbot and James Talbot, Corrosion Science and Technology, CRC Press, New York,
6. H. H. Uhlig and R. W. Revie, Corrosion and Corrosion Control, Wiley (NY)

CO-PO & PSO Mapping													
PROGRAMME OUTCOMES												PSOs	
COs	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	2	1											
CO2	3	2	1	1							1		
CO3	2	2	1								1		
CO4	3	2	1	1							1		
CO5	3	2											
CO6	2	2	1	1							1		
Avg.	2.5	1.83	1	1							1		

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEOE47013	INTERNET OF THINGS	3	0	0	3
Pre -Requisite:					
Course Educational Objectives					
CEO1	To understand the fundamentals of Industrial Revolutions, Industry 4.0, and IoT technologies				
CEO2	To design, develop, and implement IoT systems using various platforms and technologies				
CEO3	To analyze and apply the concepts of Smart Manufacturing, CPS, and IoT in real-world scenarios				
CEO4	To develop innovative IoT solutions for various industries and applications, demonstrating technical and problem-solving skills				
SYLLABUS					
UNIT:1		(10 Hours)			
The various Industrial Revolutions, Internet of Things (IoT) & Industrial Internet of Things, Overview on Technologies of Industry 4.0. Introduction to IoT, Sensing, Actuation, Basics of Networking, Communication Protocols Sensor Networks, Machine-to-Machine Communications, Interoperability in IoT.					
UNIT:2		(10 Hours)			
Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino, Introduction to Raspberry Pi and programming, Implementation of IoT with Raspberry Pi, Introduction to SDN, SDN for IoT.					
UNIT:3		(10 Hours)			
Smart Manufacturing; key characteristics, challenges, stages. Smart Machines; Characteristics, Technologies, interfaces, augmented reality. Cyber physical system (CPS). IoT; smart factory connectivity, key ingredients, Digital Twins, Predictive Maintenance					
UNIT:4		(10 Hours)			
IoT Physical Devices and Endpoints- Introduction to Arduino and Raspberry Pi- Installation, Interfaces (serial, SPI, I2C) Controlling Hardware- Connecting LED, Buzzer, Switching High Power devices with transistors, Controlling AC Power devices with Relays, Controlling servo motor, speed control of DC Motor, unipolar and bipolar Stepper motors.					
UNIT:5		(10 Hours)			
Light sensor, temperature sensor with thermistor, voltage sensor, ADC and DAC, Temperature and Humidity Sensor DHT11, Motion Detection Sensors, Wireless Bluetooth Sensors, Level Sensors, USB Sensors, Embedded Sensors, Distance Measurement with ultrasound sensor. Case Studies: Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Agriculture, Healthcare, Activity Monitoring					

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

CO1	Analyze Industrial Revolutions and Industry 4.0 technologies
CO2	Design and develop IoT systems using Arduino and Raspberry Pi
CO3	Explain Smart Manufacturing, CPS, and IIoT concepts
CO4	Interface and control physical devices using IoT endpoints
CO5	Apply sensor technologies and communication protocols in IoT
CO6	Design IoT applications for various industries and case studies

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Guest Lectures

Reference. Books

1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press.
2. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD).
3. Peter Friess, 'Internet of Things – From Research and Innovation to Market Deployment', River Publishers.
4. Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World 1st Edition, Kindle Edition by Michael R. Miller

CO-PO & PSO Mapping

PROGRAMME OUTCOMES												PSOs	
COs	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	1									1		
CO2	3	2		1							1		
CO3	3	3	1								1		
CO4	3	2	1								1		
CO5	3	2											
CO6	3	3	1	1							1		
Avg.	3	2.16	1	1							1		

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEOE47014	INDUSTRIAL INSTRUMENTATION	3	0	0	3
Pre -Requisite:					
Course Educational Objectives					
CEO1	Design instrumentation systems for process control.				
CEO2	Troubleshoot instrumentation faults efficiently.				
CEO3	Select optimal instrumentation devices for industry.				
CEO4	Ensure calibration and maintenance of instruments.				
SYLLABUS					
UNIT:1		(10 Hours)			
Introduction to industrial instrumentation, Definition and scope of industrial instrumentation, Types of instruments: measuring, controlling, and recording, Instrumentation systems: components and classification, Importance of instrumentation in process control					
UNIT:2		(10 Hours)			
Measurement of process variables, measurement of temperature: thermocouples, rtds, thermistors, measurement of pressure: bourdon tubes, diaphragms, strain gauges, measurement of flow: orifice plates, venturi meters, rotameters, measurement of level: hydrostatic, capacitive, ultrasonic					
UNIT:3		(10 Hours)			
Control systems and controllers, types of control systems: open-loop, closed-loop, feedforward, feedback, controllers: pid, on-off, bang-bang, cascade control, control valves: types, characteristics, and selection, actuators: pneumatic, hydraulic, electric					
UNIT:4		(10 Hours)			
Instrumentation Devices and Technologies, Sensors: types, characteristics, and applications, Transducers: types, principles, and applications, Signal conditioning and transmission: amplifiers, filters, converters, Microprocessors and microcontrollers in instrumentation.					
UNIT:5		(10 Hours)			
Process control systems: DCS, PLC, SCADA, Instrumentation for specific industries: oil and gas, power, chemical, Calibration, maintenance, and troubleshooting of instruments, Case studies of industrial instrumentation systems					
Course Outcomes: Upon successful completion of this course, students should be able to:					
CO1	Understand instrumentation fundamentals				
CO2	Analyze measurement systems for process variables				
CO3	Design and implement control systems				
CO4	Apply instrumentation devices and technologies				
CO5	Integrate instrumentation systems for process control				
CO6	Troubleshoot and maintain instrumentation systems				

Aspirant

Singh

San

S. Chandra

H. Datta

P. K. Saha

S. K.

Y. P. Singh

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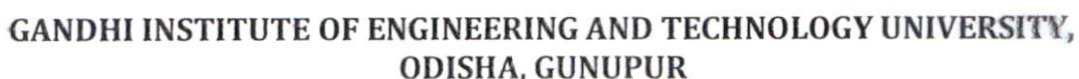
Reference. Books

1. Measurement and Instrumentation Principles by Alan S. Morris, Reza langar
2. Engineering Metrology and measurements by N.V.Raghavendra, L.Krishnamurthy
3. Industrial Instrumentation, by K Krishnaswamy, S. Vijyachitra, New AGE International Publication

CO-PO & PSO Mapping

PROGRAMME OUTCOMES												PSOs	
COs	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	2											
CO2	2	2											
CO3	2	2											
CO4	3	1											
CO5	2	2											
CO6	2	2											
Avg.	3	2.16											

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BHS47001	ENTREPRENEURSHIP DEVELOPMENT	3	0	0	3
Pre -Requisite:					
Course Educational Objectives					
CEO1	Understand entrepreneurship fundamentals				
CEO2	Develop project planning and appraisal skills				
CEO3	Understand financing options and capital management				
CEO4	Apply entrepreneurial skills and knowledge				
SYLLABUS					
UNIT:1		(10 Hours)			
Meaning, importance, benefits of entrepreneurship-characteristics, factors of Entrepreneurship- Barriers of entrepreneurship -Difference between entrepreneurship and management- Evolution of the concept of Entrepreneur-Differences between entrepreneurs. Motivational aspects of entrepreneur (McClelland' theory).					
UNIT:2		(10 Hours)			
Project identification and selection: meaning, classification of Projects-Factors involved in project identification, selection-significance, contents, formulation of a project report-specimen of a project report-planning commission's guidelines for formulating a Project-Basics of capital Budgeting- Payback period, Net present value, Internal Rate of Return.					
UNIT:3		(10 Hours)			
Sources of finance, Cost of capital-importance of a capital-Basic concepts, rational assumptions-cost of debt, reference, equity capital-source of finance-internal, external sources-institutional finance to entrepreneurs and institutional support to entrepreneurs.					
UNIT:4		(10 Hours)			
Concept project appraisal-Methods of project appraisal, Economic analysis, Financial analysis, Market analysis Technical feasibility and Managerial competence (Assessment of working and fixed capital Govt. Policies, qualitative methods of market analysis, Life cycle segmentation).					
UNIT:5		(10 Hours)			
Ownership structures-sole trader, partnership (Partnership deed) types of partnership -Joint stock companies -Difference between private and a public company -Advantage and disadvantages of the ownership Structures-Distinction between MDP and EDP-Training methods and Role playing					
Course Outcomes: Upon successful completion of this course, students should be able to:					
CO1	Understand the concept of entrepreneurship, its importance, benefits, characteristics, and barriers, as well as the difference between entrepreneurship and management.				
CO2	Learn how to identify and select projects, including classification, factors involved, and the significance of project reports, along with basics of capital budgeting.				
CO3	Identify sources of finance, understand the cost of capital, and learn about internal and external sources of finance, including institutional finance and support for entrepreneurs.				
CO4	Master project appraisal methods, including economic, financial, market, and technical analysis, as well as assessment of working and fixed capital.				
CO5	Understand ownership structures, including sole trader, partnership, joint stock companies, and the differences between private and public companies.				
CO6	Learn about training methods, role-playing, and the distinction between Management Development Programs (MDP) and Entrepreneurship Development Programs (EDP).				



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VIII Semester [Fourth Year]
B. Tech in Mechanical Engineering

Sl. No.	Course Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE
				L	T	P			
THEORY									
1	PE	23BMEPW48011	Power Plant Engineering	3	0	0	3	40	60
		23BMEPW48012	Composite Materials						
		23BMEPW48013	Mechatronics						
		23BMEPW48014	Cryogenics						
2	OE	23BMEOE48011	Integrated Solid Waste Management	3	0	0	3	40	60
		23BMEOE48012	Pollution and Its Control						
		23BMEOE48013	Modern Construction Materials						
		23BMEOE48014	Hybrid Electric Vehicles						
3	OE	23BMEOE48011	Industrial Robotics	3	0	0	3	40	60
		23BMEOE48012	Green Technology						
		23BMEOE48013	Intellectual Property Rights						
		23BMEOE48014	Industrial Automation and Control						
PRACTICAL / SESSIONAL									
1	PST		Project Work-II and Dissertation	0	0	12	6	300	-
TOTAL CREDITS							15		















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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPW48011	POWER PLANT ENGINEERING	3	0	0	3
Pre -Requisite: Mathematics, Thermodynamics, Physics					
Course Educational Objectives					
CEO1	To teach principles of thermodynamics, fluid mechanics, and heat transfer to the design and analysis of thermodynamical systems by considering the environmental issues				
CEO2	To make the student aware of the relevance of environmental different power plants				
CEO3	To teach about the power plant overall issues on practical field				
CEO4	To teach the concept of sources of energy and their optimum utilization				
SYLLABUS					
UNIT:1		[10 Hours]			
Introduction to power plants and boilers- Layout of Steam Power Plants Combined Power cycles – comparison and selection, Steam boilers and cycles – High pressure and Super Critical Boilers – Fluidised Bed Boilers Fuel and ash handling, Combustion Equipment for burning coal, Mechanical Stokers. Pulveriser, Electrostatic Precipitator, Draught-Different Types, Condenser types, cooling Towers					
UNIT:2		[14 Hours]			
Flow Through Nozzles- Types of nozzles and their area of application & related calculation, critical pressure & Choked flow, super saturated flow. Effect of friction and nozzle efficiency Steam turbines -Turbine types, Variation of Pressure and Velocity in different types of turbines, Simple impulse Turbines, Flow through turbine blades and velocity diagram, Pressure -compounded impulse turbines and Velocity compounded impulse turbines. Turbine power and related calculations.					
UNIT:3		[08 Hours]			
Nuclear power plants Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors: Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium-Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants					
UNIT: 4		[08 Hours]			
Power from Renewable Energy Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.					
UNIT: 5		[10 Hours]			
Energy, economic and environmental issues of power plants Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants					
Course Outcomes: Upon successful completion of this course, students should be able to:					
CO1	Understand and analyze the working principle of the components of nuclear, thermal and oil based power plant.				
CO2	Evaluate the performance of nozzle, turbines and economics of power plant.				
CO3	Apply safety measures and pollution control technologies to coal and nuclear power plant				
CO4	Compare and solve power tariffs and costs of electrical energy production.				
CO5	Explain the layout, construction and working of power obtained from renewable energy.				
CO6	Familiarize the working principles of various nuclear reactors.				

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Teaching Methods: Chalk& Board/ PPT/Video Lectures/Guest Lectures

Ref. Books:

1. Nag P.K., Power Plant Engineering, Tata McGraw- Hill ,2007, 3rd Edition
2. EI-Wakil M.M ,Power Plant Technology, Tata McGraw-Hill 1984,6thEdition
3. Rajput R K, Power plant Engineering, Laxmi Publication, 4th Edition
4. K.K. Ramalingam , “ Power Plant Engineering “, Scitech Publications, 2002
5. G.R, Nagpal, “Power Plant Engineering”, Khanna Publishers 1998, 3rd Edition

CO-PO & PSO Mapping

PROGRAMME OUTCOMES												PSOs	
COs	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	3											
CO2	3	3	2										
CO3	1					2							
CO4	2	2											
CO5	2	2											
CO6	2												
Avg.	2.1	2.5	2			2							

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SUBJECT CODE	TITLE OF THE SUBJECT		L	T	P	C
23BMEPW48012	COMPOSITE MATERIALS		3	0	0	3
Pre -Requisite: Introduction to Physical Metallurgy						
Course Educational Objectives						
CEO1	To teach basic concept of composites and their classification					
CEO2	To extend a knowledge of applications and selection of different composites in consideration of the properties and characteristics to students					
CEO3	To teach the manufacturing processes of reinforcement fibers and volume fraction effect on matrices of composites					
CEO4	To teach the concept of tailored design philosophy					
SYLLABUS						
UNIT:1			[08 Hours]			
Introduction: Definitions, Composites, Reinforcements and matrices, Types of reinforcements, Types of matrices, Types of composites, Carbon Fibre composites, Properties of composites in comparison with standard materials, Applications of metal, ceramic and polymer matrix composites.						
UNIT:2			[08 Hours]			
Manufacturing methods: Hand and spray lay - up, injection molding, resin injection, filament winding, pultrusion, centrifugal casting and prepregs. Fibre/Matrix Interface, mechanical. Measurement of interface strength. Characterization of systems; carbon fibre/epoxy, glass fibre/polyester, etc.						
UNIT:3			[08 Hours]			
Mechanical Properties -Stiffness and Strength: Geometrical aspects – volume and weight fraction. Unidirectional continuous fibre, discontinuous fibers, Short fiber systems, woven reinforcements – Mechanical Testing: Determination of stiffness and strengths of unidirectional composites; tension, compression, flexure and shear.						
UNIT: 4			[08 Hours]			
Laminates: Plate Stiffness and Compliance, Assumptions, Strains, Stress Resultants, Plate Stiffness and Compliance, Computation of Stresses, Types of Laminates -, Symmetric Laminates, Anti-symmetric Laminate, Balanced Laminate, Quasi-isotropic Laminates, Cross-ply Laminate, Angle-ply Laminate. Orthotropic Laminate, Laminate Moduli, Hygrothermal Stresses						
UNIT: 5			[08 Hours]			
Joining Methods and Failure Theories: Joining –Advantages and disadvantages of adhesive and mechanically fastened joints. Typical bond strengths and test procedures.						
Course Outcomes: Upon successful completion of this course, students should be able to:						
CO1	Compare the properties of composites with standard materials and analyze their applications in metal, ceramic, and polymer matrix composites.					
CO2	Acquire knowledge and skills in various manufacturing methods and understanding of the fiber/matrix interface, along with the ability to measure and characterize interface strength in composite systems.					
CO3	Analyze the mechanical properties of composites, with a focus on stiffness and strength as well as mechanical testing methods for unidirectional composites, including tension, compression, flexure, and shear.					

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPW48013	MECHATRONICS	3	0	0	3
Pre -Requisite: Basic electronics, physics					
Course Educational Objectives					
CEO1	Develop a comprehensive understanding of mechatronics design processes, including design parameters, ergonomics, and safety considerations.				
CEO2	Acquire skills to create, validate, and analyze models for mechanical, electrical, fluid, and thermal systems using simulation tools.				
CEO3	Gain expertise in designing and analyzing various mechatronic systems and their dynamic responses, including real-time interfacing and control.				
CEO4	Apply knowledge to design, integrate, and troubleshoot practical mechatronic systems and control solutions in real-world scenarios.				
SYLLABUS					
UNIT:1		[08 Hours]			
Key elements – Mechatronics design process – design parameters – mechatronics and traditional design – Advanced approaches in mechatronics design – Introduction to industrial design, modelling, simulation and analysis – Ergonomics and safety.					
UNIT:2		[10 Hours]			
Basic System Modelling , Introduction – model categories – model development – Simulation using software’s – verification and validation – Mathematical modelling: Basic system modelling – mechanical electrical, fluid and thermal.					
UNIT:3		[10 Hours]			
Mechatronic System Modelling, Engineering systems: Rotational – translational, electro-mechanical, pneumatic-mechanical, hydraulic-mechanical, micro electro mechanical system – Dynamic responses of system: first order, second order system – Performance measures					
UNIT: 4		[08 Hours]			
Real Time Interfacing, Introduction – Selection of interfacing standards- elements of data acquisition and control systems – Overview of I/O process – general purpose I/O cards and its installation – Data conversion process – Application software’s – Man machine interface					
UNIT: 5		[08 Hours]			
Motion control using DC Motor, AC Motor and Servomotor - Temperature control of hot/cold reservoir – Pick and place robot – Car parking barriers – Motion and temperature control of washing machine – Auto focus camera, exposure control					
Course Outcomes: Upon successful completion of this course, students should be able to:					
CO1	Understand and use mechatronics design principles, including ergonomics and safety.				
CO2	Develop and validate models for mechanical, electrical, fluid, and thermal systems using simulation .				
CO3	Model and analyze various mechatronic systems and their dynamic responses.				
CO4	Use interfacing standards and data acquisition systems for effective man-machine communication.				

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CO5	Design control systems for DC motors, AC motors, servomotors, and other applications.
CO6	Integrate and troubleshoot practical mechatronic applications like robots and temperature control systems.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Guest Lectures

Ref. Books:

1. Bodgan Wilamowski, J. David Irwin, Control and Mechatronics, 1st edition, CRC Press.
2. Devdasshetty S, Richard A. Kolk, "Mechatronics System Design", 2nd Edition, Cengage Learning.
3. Georg pelz, "Mechatronic Systems: Modeling and simulation" with HDL's, John wiley and sons Ltd.
4. Yigang He, Xue Qing, Automatic Control, Mechatronics and Industrial Engineering, CRC Press.
5. Bradley, D.Dawson, N.C. Burd and A.J. Loader, "Mechatronics: Electronics in Products and Processes", CRC Press 1991, First Indian print.
6. De Silva, "Mechatronics: A Foundation Course", Taylor & Francis, Indian Reprint.

CO-PO & PSO Mapping

PROGRAMME OUTCOMES												PSOs	
COs	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	2									1		
CO2	2	3									1		
CO3	3	2									1		
CO4	2	2									1		
CO5	3	2									1		
CO6	2	2									1		
Avg.	2.5	2.16									1		

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEPW48014	CRYOGENICS	3	0	0	3
Pre -Requisite: Fundamentals of Thermodynamics, and Refrigeration Engineering					
Course Educational Objectives					
CEO1	To familiar with the classification of physics properties of materials at cryogenics parameters.				
CEO2	To make the student understand how to apply cryogenic treatments and cryogenic insulations in the technical application.				
CEO3	To teach the design and analysis the Characterization of cryogenically processed materials.				
CEO4	To familiar with the evaluation& preparation of cryogenic processing of materials for different applications in the real world with a consideration for environmental hazards.				
SYLLABUS					
UNIT:1		[10 Hours]			
Properties of engineering materials at cryogenic temperatures, mechanical properties thermal properties, electric & magnetic properties, super conducting materials, thermo electric materials, composite materials, properties of cryogenic fluids, super fluidity of He3 &He4. Measurement systems for low temperatures:-Temperature measurements, pressure measurements, flow measurements, liquid level measurements, fluid quality measurements					
UNIT:2		[8 Hours]			
Gas Liquefaction Systems: -Liquefaction systems for Air Simple Linde –Hampson System, Claude System, Heylndt System, Dual pressure, Claude. Liquefaction cycle Kapitza System. Comparison of Liquefaction Cycles Liquefaction cycle for hydrogen, helium and Neon, Critical components of liquefaction systems.					
UNIT:3		[8 Hours]			
Gas Cycle Cryogenic Refrigeration Systems: -Classification of Cryo coolers Stirling cycle Cryo – refrigerators, Ideal cycle – working principle. Schmidt’s analysis of Stirling cycle Various configurations of Stirling cycle refrigerators Integral piston Stirlingcryo-cooler, Free displacer split type StirlingCryo coolers, Gifford McMahon Cryo- refrigerator, Pulse tube refrigerator, Solvay cycle refrigerator, Vuillimier refrigerator, Cryogenic regenerators.					
UNIT:4		[10 Hours]			
Cryogenic insulation & Vacuum Technology: -Fundamental principles. Production of high vacuum, Mechanical vacuum pumps, Diffusion pumps, Cryo-pumping, Measurement of high vacuum level. Cryogenic Insulation: Heat transfer due to conduction, Evacuated porous insulation Powder & Fibers Opacified powder insulation, Gas filled powders & Fibrous materials Multilayer super-insulation, Composite insulation. Desirable qualities for materials used in cryogenic applications, History and applications of metallic / non-metallic materials, Understanding properties and fabrication processes of superconducting Nb3Sn wires, High temperature superconductors. Characterization of cryogenically processed materials					

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEOE48011	INTEGRATED SOLID WASTE MANAGEMENT	3	0	0	3
Pre -Requisite: Environment and waste					
Course Educational Objectives					
CEO1	Grasp logistics principles, methods, and technologies for waste management.				
CEO2	Use GPS and GIS for optimizing waste management routes and tracking.				
CEO3	Create and manage effective waste collection systems and public-private roles.				
CEO4	Design and manage waste transfer stations and integrate recycling processes.				
SYLLABUS					
UNIT:1		[10 Hours]			
Introduction to waste management logistics, importance, methods of logistics, human components, technological components- waste handling equipment and technology, and managerial goals, steps in waste management logistics.					
UNIT:2		[8 Hours]			
Basics of GPS & GIS - introduction, importance; GPS aided vehicle; GPS in India, US, Russia. variable cycle (multi-day, weekly, bi-weekly, monthly, quarterly),variable route start location, route optimization, scheduling, GPS tracking, mobile communications.					
UNIT:3		[8 Hours].			
Waste collection system and organization: Environmental aspects of waste collection, role of public authority and private sector in waste collection, organizing collection of residential waste, fee schemes, public awareness programs.					
UNIT:4		[10 Hours]			
Source segregation and collection - source-segregated waste, Purpose of source segregation, segregation criteria and guidance, segregation potential and efficiencies, systems for collecting segregated fraction					
UNIT:5		[10 Hours]			
Waste transfer stations: waste delivery, waste transfer, transportation of the reloaded waste, siting and Design of waste transfer station, economical considerations, recycling solid wastes, materials recovery facilities.					
Course Outcomes: Upon successful completion of this course, students should be able to:					
CO1	Describe the importance, methods, and components of waste management logistics, including waste handling equipment, technology, and managerial goals.				
CO2	Utilize GPS and GIS technologies for waste management, including route optimization, scheduling, and tracking for efficient logistics.				
CO3	Develop and manage waste collection systems considering environmental aspects, roles of various sectors, fee schemes, and public awareness initiatives.				
CO4	Design and apply systems for source segregation of waste, understanding the purpose, criteria, and efficiencies of segregation.				
CO5	Plan and design waste transfer stations, addressing waste delivery, transfer, transportation, site design, and economic considerations.				
CO6	Integrate recycling processes and material recovery facilities into waste management systems to enhance sustainability and efficiency.				

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COs	PROGRAMME OUTCOMES											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	2	1									1		
CO2	2	2									2		
CO3	3	2									1		
CO4	3	3									1		
CO5	3	3									1		
CO6	2	2									2		
Avg.	2.5	2.16									1.33		

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEOE48012	POLLUTION AND ITS CONTROL	3	0	0	3
Pre -Requisite: Chemical and simple environment concept					
Course Educational Objectives					
CEO1	Understand Air Pollutants and Their Impacts				
CEO2	Apply Air Pollution Dispersion Models				
CEO3	Implement techniques for reducing particulate emissions using various control technologies.				
CEO4	Analyze and control noise pollution, including measurement, standards, and health impacts.				
SYLLABUS					
UNIT:1		[10 Hours]			
Air Pollutants: sources, classification, effect on animal health, vegetation, materials, and atmosphere. Chemical and photochemical reactions in the atmosphere and their effects: smoke, smog, acid rain and ozone layer depletion. Greenhouse gases, global warming and its implications. Global atmospheric and climate change, Heat island effects. Air pollution legislation and standards. Issues of indoor air quality.					
UNIT:2		[10 Hours]			
Air pollution dispersion and modeling, Meteorology and air pollution: atmospheric stability and inversions, behavior of air pollutant plumes as effected by nature of source, meteorology, obstacles and terrain; maximum mixing depth. Effluent dispersion theories: models for point and line sources based on Gaussian plume dispersion and their limitations: Box model for area sources.					
UNIT:3		[8 Hours]			
Particulate emission and its controls, Reduction in the generation of particulate matter by process modification, good housekeeping, and other means. Control of SPM: concepts and the design elements of gravitational settlers, centrifugal collectors, wet collectors, electrostatic precipitators, fabric filters, condensers					
UNIT:4		[10 Hours]			
Sources of air pollution from fossil fuels and industrial processes. Prevention and reduction of emissions, cleaner production. Carbon sequestration techniques, Air pollution control by absorption, adsorption, condensation, incineration, bioscrubbers, biofilters, etc. Design and performance equations, case studies.					
UNIT:5		[10 Hours]			
Generation and propagation of sound; sound power, sound intensity and sound pressure levels; plane, sources; outdoor and indoor noise propagation; psycho-acoustics and noise criteria. Noise problem analysis- OSHA regulations, Annoyance rating schemes; noise standards and limit values. Effects of noise on health. Noise pollution measuring instrumentation and monitoring procedure. Noise pollution prevention and control.					












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

CO1	Recognize sources and classifications of air pollutants and their impact on health, vegetation, and the atmosphere.
CO2	Understand dispersion models and meteorological factors affecting air pollutant behavior.
CO3	Apply methods and design elements for controlling particulate matter emissions, including various collection technologies.
CO4	Utilize strategies for emission reduction and control, including cleaner production and carbon sequestration.
CO5	Comprehend sound generation, propagation, and its effects on health, including noise standards and regulations.
CO6	Employ noise measurement instrumentation and control methods to manage and reduce noise pollution.

Teaching Methods: Chalk& Talk, PPT, Video Lectures

Text Books:

1. Introduction to Environmental Engineering and Science, G. M. Masters, Prentice-Hall of India, New Delhi.
2. Air Pollution Control Engineering, N. de Nevers, 2nd Edition. McGraw Hill, Singapore.
3. Environmental Noise Pollution, P. E. Cuniff, McGraw Hill, New York.
4. Air pollution control equipments, Louis Theodore, Wiley Publication. Year Fundamentals of Air pollution, R. W. Boubel, D. L. Fox, and A. C. Stern, Academic Press, NY.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	2	2									1		
CO2	2	2									1		
CO3	3	2									1		
CO4	3	2									1		
CO5	2	2									1		
CO6	3	2									1		
Avg.	2.5	2									1		















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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEOE48013	MODERN CONSTRUCTION MATERIALS	3	0	0	3
Pre -Requisite: Physical Metallurgy					
Course Educational Objectives					
CEO1	Develop a comprehensive understanding of the properties, applications, and advancements in modern and traditional building materials to enhance construction practices.				
CEO2	Critically evaluate and select appropriate materials, including polymers, composites, and specialized concretes, for diverse structural and environmental needs.				
CEO3	Apply knowledge of waterproofing and insulating materials to address practical challenges in building design and construction.				
CEO4	Integrate and innovate with various building materials to propose effective solutions for contemporary construction problems and sustainability goals.				
SYLLABUS					
UNIT:1		[10 Hours]			
Introduction, properties and uses of modern building materials: fly ash bricks, soil – cement blocks, calcium silicate bricks, red mud jute fibre polymer composite (RFPC), glass reinforced gypsum.					
UNIT:2		[10 Hours]			
Introduction, properties and use of: geosynthetics, bituminous material, fire resistant materials (chemicals, paints, tiles, bricks, glass), metals, light - weight concrete, mass concrete, waste material based concrete.					
UNIT:3		[8 Hours]			
Introduction, properties and use of: Ferro cement & fibre reinforced concrete, different types of fibres, high density concrete, Nuclear concrete, heat resisting & refractory concretes, prefabricated systems.					
UNIT:4		[10 Hours]			
Introduction, properties and use of: Polymers, fibre reinforced polymers, polymer concrete composites (PCCs), Sulphur concrete and Sulphur - infiltrated concrete.					
UNIT:5		[10 Hours]			
Introduction , properties and use of: Conventional and modern water proofing materials, Conventional and modern insulating materials(thermal, sound and electrical insulating materials).Concept of polymer floor finishes.					
Course Outcomes: Upon successful completion of this course, students should be able to:					
CO1	Compare the properties and uses of modern building materials like fly ash bricks and glass-reinforced gypsum.				
CO2	Evaluate the characteristics of geosynthetics, bituminous materials, and fire-resistant materials.				
CO3	Understand the properties and applications of Ferro cement, fibre-reinforced concrete, and prefabricated systems.				

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CO4	Identify the uses of advanced polymers, fibre-reinforced polymers, and sulphur-based concretes.
CO5	Explain the properties of conventional and modern waterproofing and insulating materials.
CO6	Apply knowledge of various materials to address construction challenges and meet functional requirements.

Teaching Methods: Chalk& Talk, PPT, Video Lectures

Text Books:

1. Santhakumar A.R., Concrete Technology, Oxford University Press, New Delhi. 2007.
2. Mamlouk, M.S. and Zaniewski, J.P., Materials for Civil and Construction Engineers, Prentice Hall Inc., 1999.
3. Ashby, M.F. and Jones.D.R.H.H. "Engineering Materials I: An Introduction to Properties, applications and designs", Elsevier Publications, 2005.
4. Shan Somayaji, Civil Engineering Materials, Prentice Hall Inc., 2001
5. Aitkens , High Performance Concrete, McGraw Hill, 1999
6. Deucher K.N, Korfiatis, G.P and Ezeldin, A.S, Materials for Civil and Highway Engineers, Prentice Hall Inc., 1998.
7. Shetty M.S, Concrete Technology: Theory and Practice, S. Chand & Company Ltd., 2005.

CO-PO & PSO Mapping													
COs	PROGRAMME OUTCOMES											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	2	2											
CO2	3	2											
CO3	2	2											
CO4	2	2											
CO5	2	2											
CO6	2	2											
Avg.	2.16	2											



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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEOE48014	HYBRID ELECTRIC VEHICLES	3	0	0	3
Pre -Requisite: Basic electrical and automotive engineering					
Course Educational Objectives					
CEO1	Analyze the fundamental principles and components of electric vehicles, including their vehicle mechanics, dynamics of vehicle motion, and propulsion system design.				
CEO2	Evaluate and design battery packs for electric vehicles by understanding battery types, parameters, technical characteristics, and properties.				
CEO3	Compare and apply knowledge of DC and AC electrical machines, including their ratings and requirements, to assess their suitability for use in electric vehicles.				
CEO4	Design and optimize the electric vehicle drive train and transmission configurations, including component sizing, regenerative braking, and overall drive train efficiency.				
SYLLABUS					
UNIT:1		[10 Hours]			
Electric vehicles , Introduction, Components, vehicle mechanics – Roadway fundamentals, vehicle kinetics, Dynamics of vehicle motion - Propulsion System Design.					
UNIT:2		[10 Hours]			
BATTERY Basics – Types, Parameters – Capacity, Discharge rate, State of charge, state of Discharge, Depth of Discharge, Technical characteristics, Battery pack Design, Properties of Batteries.					
UNIT:3		[8 Hours]			
DC & AC electrical machines, Motor and Engine rating, Requirements, DC machines, Three phase A/c machines, Induction machines, permanent magnet machines, switched reluctance machines.					
UNIT:4		[10 Hours]			
Electric vehicle drive train , Transmission configuration, Components – gears, differential, clutch, brakes regenerative braking, motor sizing.					
UNIT:5		[10 Hours]			
Types – series, parallel and series, parallel configuration – Design – Drive train, sizing of components.					
Course Outcomes: <i>Upon successful completion of this course, students should be able to:</i>					
CO1	Explain the fundamental concepts and mechanics of electric vehicles, including propulsion system design and vehicle dynamics.				
CO2	Analyze and evaluate different types of batteries, including their parameters, technical characteristics, and design considerations for electric vehicle applications.				
CO3	Understand and compare various DC and AC electrical machines, including their ratings, requirements, and functionalities in electric vehicles				
CO4	Describe the components and configuration of electric vehicle drive trains, including transmission systems and regenerative braking.				

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CO5	Design and size electric vehicle drive trains and components based on series, parallel, and series-parallel configurations.
CO6	Integrate knowledge of vehicle dynamics, propulsion systems, and battery characteristics to assess overall electric vehicle performance and design.

Teaching Methods: Chalk& Talk, PPT, Video Lectures

Text Books:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley.
3. Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press.
4. Mehrdad Ehsani, Yimin Gao, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals", CRC Press.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	2	2									1		
CO2	3	2									1		
CO3	3	3									1		
CO4	3	3									1		
CO5	2	2									1		
CO6	2	2									1		
Avg.	2.5	2.33									1		















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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEOE48011	INDUSTRIAL ROBOTICS	3	0	0	3
Pre -Requisite: EME					
Course Educational Objectives					
CEO1	Develop a comprehensive understanding of the basic principles and components of industrial robotic systems.				
CEO2	Demonstrate the ability to assess and implement safety protocols in industrial robotic environments				
CEO3	Understand the various control systems employed in industrial robotics and their applications.				
CEO4	Explore advanced applications of industrial robotics in diverse industries.				
SYLLABUS					
UNIT:1 Introduction to Robotics and Automation		[8 Hours]			
Historical Development, Definition and Basic Concepts, Definition of a robot and its characteristics, Classification of robots based on their configuration (articulated, SCARA, delta, etc.), Key features such as precision, speed, payload capacity, and flexibility. Overview of Automation: Understanding the concept of automation and its role in improving efficiency, Different levels of automation (from manual to fully automated systems), Comparison between traditional manufacturing and automated production. Types of Industrial Robots: Articulated robots, Cartesian robots, SCARA robots, delta robots, and more, End-effectors and grippers for different applications, Mobile robots and their use in logistics and material handling.					
UNIT:2 Robotics Components and Kinematics		[12 Hours]			
Essential Components: In-depth study of sensors, actuators, controllers, and end-effectors, Understanding the role of sensors in providing feedback for closed-loop control, Different types of actuators (electric, hydraulic, pneumatic) and their applications. Kinematics of Robotic Systems: Forward kinematics and the relationship between joint angles and end-effector position, Inverse kinematics and solving for joint angles given end-effector position, Geometric interpretation of kinematic solutions.					
UNIT:3 Sensors and Perception in Robotics		[8 Hours]			
Types of Sensors: Vision systems for object recognition and tracking, Proximity sensors for detecting the presence or absence of objects, Force/torque sensors for measuring interaction forces, Principles of Perception: Understanding how robots perceive their environment, Sensor fusion techniques for combining information from multiple sensors, Robot used for pick-and-place, assembly, and quality inspection.					
UNIT: 4 Robot Control Systems		[12 Hours]			
Control Architectures: Overview of centralized and decentralized control architectures, Hybrid control systems combining manual and automated control. Redundancy resolution in control architectures. Feedback Control Systems: Principles of closed-loop control and its importance in robotics, PID (Proportional-Integral-Derivative) controllers and their tuning, Stability analysis and ensuring robust control. Safety Considerations: Importance of safety in industrial robotics, designing safety systems and emergency stop mechanisms, Regulatory standards and compliance in robotic safety.					

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UNIT:5 Robotics in Manufacturing and Industry 4.0

[10 Hours]

Applications of robotics in various manufacturing processes (welding, painting, assembly), Design considerations for integrating robots into production lines. Flexible Manufacturing Systems, Robotic work cells and their advantages.

Overview of Industry 4.0 and the fourth industrial revolution, Role of robotics in smart factories and the Internet of Things (IoT), Interconnectivity and data exchange in the context of industrial robotics. Emerging technologies in industrial robotics (AI, machine learning), Environmental sustainability in robotic manufacturing, Predictions for the future development of industrial robotics.

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

CO1	Demonstrate a comprehensive knowledge of the fundamental principles and concepts governing industrial robotics, including robot kinematics, dynamics, and control systems.
CO2	Gain insights into the principles and applications of collaborative robotics.
CO3	Identify and apply various sensors, including vision systems, proximity sensors, and force/torque sensors, for object recognition, tracking, and interaction force measurement in robotic applications.
CO4	Designing and analyzing control systems for robotics applications
CO5	Proficient in designing and implementing comprehensive safety protocols for robotic systems
CO6	Analyze case studies and real-world examples of successful industrial robotic applications in manufacturing.

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Reference Books:

1. Mikell P Groover, Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, "Industrial Robotics, Technology programming and Applications", McGraw Hill.
2. S.R. Deb, "Robotics Technology and flexible automation", Tata McGraw-Hill Education.,
3. Richard D.Klafter, Thomas .A, ChriElewski, Michael Negin, "Robotics Engineering an Integrated Approach", PHI Learning.,
4. Francis N. Nagy, Andras Siegler, "Engineering foundation of Robotics", Prentice Hall Inc.
5. P.A. Janaki Raman, "Robotics and Image Processing an Introduction", Tata McGraw Hill Publishing company Ltd.,
6. Carl D. Crane and Joseph Duffy, "Kinematic Analysis of Robot manipulators", Cambridge University press.

CO-PO & PSO Mapping

PROGRAMME OUTCOMES												PSOs	
COs	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	2	3	2	2	1	1	2	2	1	1		
CO2	2	2	1	1	2	1	1	2	1	1	2		
CO3	2	2	1	1		1	1	1		1			
CO4	2	2	2	2						1	1		
CO5	2	1	1	1		1	1	1	1	1	1		
CO6	3	2	1	1	1	2	2	2	2	2	2		
Avg.	2.3	1.8	1.5	1.3	1.6	1.2	1.2	1.6	1.5	1.2	1.4		

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEOE48012	GREEN TECHNOLOGY	3	0	0	3
Pre-Requisite: Basic science and environmental engineering					
Course Educational Objectives					
CEO1	Develop a Comprehensive Understanding of Global Warming and its Impacts				
CEO2	Analyze and Evaluate Strategies for Reducing Carbon Emissions				
CEO3	Assess Opportunities and Technologies for Carbon Control				
CEO4	Implement Green Technologies and Adaptive Measures for Sustainable Development				
SYLLABUS					
UNIT:1		(8 Hours)			
Global Warming and its effect:- Introduction and physical definition of global warming, the New Carbon Problem: Accumulation, Long Half-Life, Heating Potential, Carbon Emission Factors, Carbon Absorption in Nature, The Global Emission Situation and its effect in India, The Kyoto and Other Protocols and its view in India, Effect of climate change and its impact. Planning for the Future to reduce global warming Steps taken to Control Carbon Emissions universally, Use of Promotional and Punitive Mechanisms for Reducing Carbon in Atmosphere, The General Approach in Planning for the Future, Developing Countrywide Adaptive Measures for Safety of Local People, Developing Mitigative Measures for Global Reduction of Carbon, India's National Action Plan on Climate Change (NAPCC) till date, National Mission for a Green India, The MRV Debate.					
UNIT:2		(9 Hours)			
Opportunities in Control of Carbon Emissions and Accumulation:- Essential Steps for Control of Carbon Emissions and Accumulation, Procedure to develop own Priorities and Business Opportunities in India for control of carbon emissions and accumulation, Needs a Mix of Green and Traditional Power Sources in India, A Logical Approach for Carbon Reduction, Need in India — More Forests, Less Deforestation and payment rates procedure for controlling carbon emissions and its Promotional Mechanisms at India. Green Technologies for Energy Production:- Various Technologies Available for Energy Production, Cost Comparison of a Few Typical Systems for Power Generation, Sources of Energy Production Already in Use, Alternative Methods Ready for Use, Green Technologies Needing some Prior R&D Work.					
UNIT:3		(8 Hours)			
Green Technologies for Personal and Citywide Application: - Measures to be taken for Green city, Carbon Emission Reduction at Personal Level, Carbon Emission Reduction at Local Authority and Citywide Level, Carbon Emissions from Imports.					
UNIT:4		(10 Hours)			
Green Technologies for Specific Applications:- Promotion of 'Green' Buildings, Guidelines, The Energy Conservation Building Code (ECBC), Green Hotels and Hospitals, Green Technologies for Transport, Green Roads, Ports and Harbors, Industries, Carbon, Carbon Emissions from a Few Selected Industries in India, The Changing Scenario in Cities, Need for Wider Application to Town Planning and Area Re-Development Projects, 'Green' Infrastructure for Municipal Services, Bringing up Indian Villages, Green Services for Crematoria, Spreading Message to all Stakeholders.					

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UNIT:5

(10 Hours)

Some High-tech Measures for Reducing Carbon Emissions: Use of Solar Power with Satellite-Based Systems, Use of Carbon Capture and Storage (Sequestration), Microorganisms, A Quick SWOT Analysis.

Recommended Plan of Action:- India's National Action Plan Take Us to a Low-Carbon Path, The Missions Help Develop Awareness, Few case studies on Projects undertaken by Various Countries, Adaptive Measures Essential for Indian People to Cope with Climate Change

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

CO1	Understand the concept of global warming and its effect as well as the methods to reduce it.
CO2	Identify different opportunities in control of carbon emission & understand the principles of Energy efficient technologies for energy production.
CO3	Estimate the carbon credits of various activities and apply green technologies at personal and wider level.
CO4	Creating innovative ideas for further enhancing green technologies in specific applications.
CO5	Implement green technologies for specific applications in villages to promote environmental sustainability.
CO6	Recognize of some hi-tech measures for reducing carbon emission and able to do some plan of action for future.

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Reference Books:

- Arceivala Soli J., Green Technologies, Mc Graw Hill Education
- Khan B.H, Non-conventional energy resources, Tata McGraw-Hill, New Delhi 2006.
- Rashmi Sanghi and M.M. Srivastava, Green Chemistry-Environment Friendly Alternatives, Narosa Publishing House, New Delhi
- Singh Ritu and Kumar Sanjeev, Green Technologies and Environmental Sustainability

CO-PO & PSO Mapping

PROGRAMME OUTCOMES												PSOs	
COs	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	1			1								
CO2	2	3	1	3	2								
CO3	2	3	3	3	2				1		1		
CO4	2				1				1				
CO5	2				2				1		1		
CO6	2	3	3	3	2				1		1		
Avg.	2.25	2.5	3.5	3	1.6				1		1		

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEOE48013	INTELLECTUAL PROPERTY RIGHTS	3	0	0	3
Pre -Requisite:					
Course Educational Objectives					
CEO1	Gain knowledge of intellectual property (IP) types, including copyrights, patents, trademarks, and others, along with their importance and international frameworks.				
CEO2	Learn the purpose, registration, and protection of trademarks, including handling infringement and recent legal developments.				
CEO3	Understand the fundamentals of copyright and patent laws, including rights, registration processes, and infringement issues.				
CEO4	Study design rights, trade secret laws, and unfair competition issues, including protection mechanisms and legal remedies.				
SYLLABUS					
UNIT 1:		[08 Hours]			
Introduction to Intellectual property: Meaning of Property, Origin, Nature, Meaning of Intellectual Property Rights, Kinds of Intellectual property rights- Copy Right, Patent, Trade Mark, Trade Secret and trade dress, Design, Layout Design, Geographical Indication, Plant Varieties and Traditional Knowledge, International Organizations, Agencies and Treaties, Importance of Intellectual Property Rights.					
UNIT 2:		[10 Hours]			
Trade Marks: Purpose and Function of Trademarks, Acquisition of Trade Mark Rights, Protectable Matter, Selecting and Evaluating Trade Mark, Trade Mark Registration Process, Infringement & Remedies, Offences Relating to Trade Marks, Passing Off, Penalties and New Developments in Trade Mark Law.					
UNIT 3:		[12 Hours]			
Law of copy rights: Fundamental of Copy Right Law, Originality of Material, Rights of Reproduction Rights to Perform the Work Publicly, Copy Right Ownership Issues, Copy Right Registration, Notice of Copy Right, International Copy Right Law.					
Law of patents: Origin, Meaning of Patent, Types, Inventions which are not Patentable, Registration Procedure, Rights and Duties of Patentee, Assignment and License, Restoration of Lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties.					
UNIT 4:		[06 Hours]			
Design: Meaning, Definition, Object, Registration of Design, Cancellation of Registration, International convention on design, functions of Design. Semiconductor Integrated circuits and layout design Act-2000					

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UNIT 5:

[08 Hours]

Trade Secrets: Trade secret law, determination of trade secrets status, liability for misappropriations of trade secrets, protection for submission, trade secret litigation.

Unfair competition: Misappropriation right of publicity, False advertising.

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

CO1	Understand the legal principles related to copyrights, patents, trade secrets, designs and trade marks
CO2	Identify and Apply the principles of patent and copyright in the project works.
CO3	Understand the current emerging issues related to IP protection.
CO4	Summarize the knowledge of different unfair competitions.
CO5	Make use of IP and avoid plagiarism in the project work.
CO6	List out the various penalties and remedies for different IPs.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert

Ref. Books:

1. Deborah, E. Bouchoux, Intellectual Property Right, Cengage learning
2. Wadehra Dr. B.L., Law relating to Intellectual Property, Universal Law Publishing Co., 5th edition.
3. Bansal K and Bansal P, Fundamentals of IP for Engineers
4. Intellectual Property Right- NPTEL Resource

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	2							3			2		
CO2	2							3		3			
CO3	2							3					
CO4	2							2			1		
CO5	2							2		3			
CO6	2							2					
Avg.	2							2.5		3	1.5		

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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C
23BMEOE48014	INDUSTRIAL AUTOMATION AND CONTROL	3	0	0	3
Pre -Requisite:					
Course Educational Objectives					
CEO1	Design and implement industrial automation systems, including sensor selection, signal conditioning, and control strategies, to achieve process control objectives.				
CEO2	Analyze and optimize process control systems using PID control, sequence control and advanced control structures to ensure efficient and safe process operation.				
CEO3	Develop and implement machine tool control systems, including CNC machines, hydraulic actuator systems, and pneumatic control systems, to achieve precise control and high productivity.				
CEO4	Integrate industrial automation and control systems with fieldbus communication protocols and networking technologies to achieve efficient, flexible, and scalable process control solutions.				
SYLLABUS					
UNIT 1:		[08 Hours]			
Introduction to Industrial Automation and Control: Architecture of Industrial Automation Systems. Introduction to sensors and measurement systems. Temperature measurement, Pressure and Force measurements, Displacement and speed measurement, Flow measurement techniques, Measurement of level, humidity, pH etc, Signal Conditioning and Processing, Estimation of errors and Calibration.					
UNIT 2:		[10 Hours]			
Process Control: Introduction to Process Control PID Control, Controller Tuning. Implementation of PID Controllers. Special Control Structures: Feed forward and Ratio Control. Predictive Control, Control of Systems with Inverse Response, Cascade Control, Overriding Control, Selective Control, Split Range Control.					
UNIT 3:		[12 Hours]			
Sequence Control: Introduction to Sequence Control PLCs and Relay Ladder Logic Sequence Control, Scan Cycle, RLL Syntax Sequence Control, Structured Design Approach Sequence Control, Advanced RLL Programming Sequence Control: The Hardware-environment					
UNIT 4:		[06 Hours]			
Control of Machine tools: Introduction to CNC Machines Control of Machine Tools, Analysis of a control loop, Introduction to Actuators, Flow Control Valves. Hydraulic Actuator Systems,: Principles, Components and Symbols, Hydraulic Actuator Systems: Pumps and Motors, Proportional and Servo Valves.					
UNIT 5:		[08 Hours]			
Pneumatic Control Systems: System Components Pneumatic Control Systems, Controllers and					



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Integrated Control Systems. Networking of Sensors, Actuators and Controllers: The Fieldbus, The Fieldbus Communication Protocol, Introduction to Production Control Systems.

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

CO1	Analyze the architecture of industrial automation systems and explain the role of sensors and measurement systems in process control.
CO2	Design and implement PID control systems, including controller tuning and special control structures, to achieve desired process outcomes.
CO3	Develop sequence control programs using PLCs and relay ladder logic, applying structured design approaches and advanced programming techniques.
CO4	Explain the control of machine tools, including CNC machines, actuators, and hydraulic actuator systems, and analyze control loops for optimal performance.
CO5	Design and implement pneumatic control systems, including system components, controllers, and fieldbus communication protocols, for efficient process control.
CO6	Integrate knowledge of industrial automation and control systems to troubleshoot and optimize complex processes, ensuring accuracy, precision, and safety.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert

Ref. Books:

1. "Industrial Automation and Control", S. R. Venkatesh and S. K. Singh, McGraw-Hill Education.
2. "Automation, Control and Industrial Engineering", Wen-Hsiang Hsieh, CRC Press
3. "Industrial Automation: Hands On", Frank D. Petruzella, McGraw-Hill Education
4. "Industrial Automation and Robotics", K. K. Singh and R. K. Singh, PHI Learning
5. Automation and Control Engineering", P. S. V. Nataraj, Pearson Education

CO-PO & PSO Mapping													
COs	PROGRAMME OUTCOMES											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	2											
CO2	2	3									1		
CO3	2	3									1		
CO4	3	2									1		
CO5	2	2									1		
CO6	2	2									1		
Avg.	2.33	2.33									1		

Date of BoS Approval

Chairman BoS