

DEPARTMENT OF MECHANICAL ENGINEERING
FACULTY OF TECHNOLOGY AND ENGINEERING
THE M S UNIVERSITY OF BARODA

UG TEACHING SCHEME

BE - CRS MECHANICAL ENGINEERING

BE-I CRS (MECHANICAL ENGINEERING)											
Semester	Sub Code Theory	Sub Code TW/Viva	Subject Name	Teaching Scheme				Examination Scheme			
				L	T	P	Credit	Theory		Practical	
								IA	UA	IA	UA
FS BE-I	AMT1114CS	---	Calculus	3	1	0	4		100		
	MME1111CS	---	Material Science and Metallurgy	3	0	0	3		100		
	APH1110CS	APH1110LCS	Applied Physics	3	1	2	5		100		50
	MEC1110CS	---	Engineering Thermodynamics	4	0	0	4		100		
	CVL1112CS	CVL1112LCS	Fundamentals of Civil and Environmental Engineering	3	1	2	5		100		50
	ELE1101CS	ELE1101LCS	Basic Electrical and Electronics Engineering	3	0	2	4		100		50
	FTE1101CS	---	Universal Human Values I	1	0	0	0		50		
Total (Semester 1)				20	3	6	25				800
SS BE-I	AMT1215CS	---	Linear Algebra and Vector Calculus	3	1	0	4		100		
	ENG1002CS	ENG1002LCS	Communication Skills	2	0	1	2.5		50		50
	APM1208CS	AMP1208LCS	Applied Mechanics	3	1	2	5		100		50
	---	MEC1214LCS	Workshop Practices	0	0	4	2				100
	MEC1210CS	MEC1210LCS	Engineering Drawing	3	0	4	5		100		50
	MEC1209CS	MEC1209LCS	Computational Techniques and Programming	3	0	2	4		100		50
Total (Semester 2)				14	2	13	22.5				750
TOTAL (YEAR 1)							47.5				1550

L = Lecture in Hrs per week
T = Tutorial in Hrs per week
P = Practical/Lab Hrs per week
UA = University Assessment
IA = Internal Assessment

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: B.E.-Mechanical

PSO1 Apply fundamentals of design, thermo-fluids and production engineering knowledge for innovative and critical thinking, problem-solving and Experimental skills with integrity and inclusivity in professional engineering practice or business.

PSO2 Achieve further career development through graduate education, professional development courses and/or on-the-job training and experience.

PSO3 Develop leadership and collaborative roles in their careers.

Programme Outcome (PO)

PO1 Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Problem Analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Design/development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 Modern Tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6 The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Mathematics		Academic Year				2022-23			
BE-I Mechanical Engineering										
Year	I	Core / Elective / Foundation CALCULUS (AMT1114CS)	Credits / Hours per week				03(L) + 01(T)= 04			
Semester	I	Year of Introduction: 2021-2022	Maximum Marks / Grade				100			
Mode of Transaction		Lecture and Tutorial								
Course Outcome (CO) (AMT1114CS)										
CO1 Evaluate successive differentiation of given function and solve identities involving higher order derivatives, evaluate radius of curvature, obtain Taylor & McLaurin series expansion of function of single variable. Evaluate limits of indeterminate forms.										
CO2 Test for convergence series using various tests like comparison test, ratio test. Also find the convergence, absolute and conditional convergence for alternating series.										
CO3 Apply the concept of surfaces and level curves in solid geometry which helps in solving various application of engineering.										
CO4 Understand and implement the methods of curve tracing in two – dimensional space.										
CO5 Understand and apply the concept of multivariable functions, its differentiability concept and applications of partial derivatives in various engineering problems.										
CO6 Understand the requirement of complex numbers their various representations, De’Moivre’s theorem and its applications. Logarithm of complex numbers. Evaluate and use circular functions, hyperbolic functions.										
CO7 Understand a given complex valued function and determine whether it is differentiable, analytical, harmonic, and harmonic conjugate.										
Unit No.	Topic		Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/	Relevance to Local (L)/ National (N)/ Regional	Relation to Gender (G), Environment and Sustainable

							Skill Develop ment (SD)	l(R)/Glo bal (G)	bility (ES), Human Values (HV)an d Professi onal Ethics (PE)
1	Functions of one variable Reorientation, Successive differentiation, Leibnitz rule for the nth order derivative of a function, Mean value theorems, Curvature, Indeterminate forms. Convergence and divergence of infinite series, Geometric series, P – Series, Necessary condition for convergence, Comparison test, ratio test, Absolute convergence and conditional convergence of alternating series, Taylor's expansion of functions.	14	29	1, 2, 3, 5	CO1 CO2	PO1 PO2	Emp, SD	G	PE
2	Analytical geometry: Reorientation of solid geometry, Surfaces and Conicoids, Curvilinear Coordinates (polar, cylindrical and spherical), Curve tracing: Cardioid, Cycloid, Lemniscates, Spirals and Four leaves rose. Level curves, Geometrical interpretation of function of two variables.	8	17	1, 2, 3, 4, 5	CO3 CO4	PO1 PO2			
3	Functions of Several Variables: Limit, Continuity and partial differentiation of function of two variables, Geometrical interpretation of partial derivatives, Higher order partial derivatives, Partial differentiations of composite functions, Euler's theorem on homogeneous functions. Applications of partial derivatives:	12	25	1, 2, 3, 4, 5	CO5	PO1 PO2			

	Tangent plane and normal line, Taylor's expansion, Error & approximation, Maxima and minima, Lagrange's multiplier method								
4	Function of complex variables: Reorientation of complex numbers, polar form of complex numbers, Curves and regions in complex plane, De'Moivre's theorem, Elementary functions. Limit, continuity and differentiability of functions of a complex variable, Cauchy-Riemann Equations, Necessary and sufficient conditions for differentiability, Analytic functions, Harmonic functions and applications to complex heat potential.	14	29	1,2,3,4,5	CO6 CO7	PO1 PO2			

Reference Books

1.	B. V. Ramana	Higher Engineering Mathematics, Tata Mc. Graw – Hill. (Core Engineering Series), 2006.
2.	C. R. Wylie	Advanced Engineering Mathematics, Mc. Graw – Hill Inc., 1986
3.	David V. Widder	Advanced Calculus, Prentice Hall of India Pvt. Ltd., 1986.
4.	Erwin Kreyszing:	Advanced Engineering Mathematics, (6th edition) Johnwiley&Sons.,1988
5.	G. B. Thomas, R. L. Finney	Calculus and Analytic Geometry, Addison-Wesley Publishing Co., 2010
6.	Gordon Fuller	Analytic Geometry, Addison-Wesley Pub.Com.Inc.1954
7.	J. W. Brown, R.V. Churchill	Complex variables and Applications, McGraw-Hill Higher Education, 2013.
8.	P. V. O'Neil	Advanced Engineering Mathematics, Cengage Learning (India edition), 1991.
9.	Shantinayakan	Differential Calculus, S. Chand & Co. New Delhi.

Bloom's Taxonomy Levels:

1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: BE (Metallurgical & Materials) Regular Programme**Programme Specific Outcome (PSO)** Graduate will be able to,

- PSO1 Apply knowledge of material sciences, metallurgical engineering and material technology in identifying and providing appropriate solution for metallurgical and materials industries.
- PSO2 Design, optimize various metallurgical and materials engineering processes to develop quality and cost effective products
- PSO3 Build successful career in design, development, manufacturing and process control of metallurgical and materials engineering industries.
- PSO4 Acquire their knowledge in the domain of different metal and materials working and testing to undertake the challenges of the related industries
- PSO5 Manage proficiency and necessary skills to take up entrepreneurial Venture.
- PSO6 Serve to the needs of metallurgical and materials engineering Industry and the Nation.
- PSO7 Get platform to design and create prototypes with changing demands of the metallurgical and materials engineering fields through various research and development.
- PSO8 Develop the right attitude in the metallurgical and materials engineering field so that they become an employable or to pursue higher studies

Programme Outcome (PO) : Engineering Graduates will be able to:

- PO1.** Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO2.** Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- PO3.** Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO4.** Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- PO5.** Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- PO6.** The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- PO7.** Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- PO8.** Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- PO9.** Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- PO10.** Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- PO11.** Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- PO12.** Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

		The Maharaja Sayajirao University of Baroda Faculty of Technology and Engineering Department of Metallurgical and Materials Engineering			Academic Year			2022-2023		
SS of BE-I Mechanical Engineering										
Year		I	Core / Elective / Foundation : Code: MME1111CS Subject Name : Materials Science and Metallurgy			Credits / Hours per Week			03 (Theory)	
Semester		I	Year of Introduction :			Maximum Marks / Grade			100 (Theory)	
Mode of Transactions				Lectures and Tutorials						
Course Outcome (CO) / MME1111CS CO-1: Understanding of materials, its Structure and their classification CO-2: Learning Mechanical, Electrical And Magnetic properties and behavior of these properties on engineering materials. CO-3: Study of phase, phase diagram and defects in materials. CO-4: Learning about various types of materials & advanced materials. CO-5: Understanding briefly about corrosion & its protection methods.										
Unit No.	Topic/Unit		Contact Hours	Weightage (%)	^[1] BT Level	CO	PSO	^[2] Elements of EMP/ENT/SD	^[3] Relevance to L/R/N/G	^[4] Relation to GN/ES/HV/PE
1	Introduction of Engineering Materials Metalica Materials, Ceramic Material, Polymers, Composite and Nano-materials.		02	10%	1/2/3/4	CO1	PSO8	SD	G	ES
2	Crystal Structure		06	20%	1/2/3/5	CO2	PSO2	SD	G	ES

[illegible]

Text Books or Reference Books:	
1.	Askeland D.R., & P. P. Fullay (2007), The Science and Engineering of Materials –4th Cengage Learning Publishers
2.	William D. Callister, Jr (2008), Callister’s Materials Science and Engineering, (Adopted by R. Balasubramaniam) Wiley-Eastern
3.	A.S. Edelstein and R.C. Cammarata Ed.(1998), Nano Materials: Synthesis, Properties and Applications, Inst. Of Physics Publishing, UK

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: B.E.-Mechanical

PSO1 Apply fundamentals of design, thermo-fluids and production engineering knowledge for innovative and critical thinking, problem-solving and Experimental skills with integrity and inclusivity in professional engineering practice or business.

PSO2 Achieve further career development through graduate education, professional development courses and/or on-the-job training and experience.

PSO3 Develop leadership and collaborative roles in their careers.

Programme Outcome (PO)

PO1 Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Physics			Academic Year			2022-23		
B.E. (Civil, Mechanical, Civil -Irrigation and Water Management): Regular Programme										
Year	I	Core / Elective / Foundation APH1110CS: Applied Physics			Credits / Hours per week			(credits 03 –Lecture, 01-Tutorial, 02 - Practical)		
Semester	I	Year of Introduction: 2022 Year of Syllabus Revision: 2022			Maximum Marks / Grade			100 (Theory) + 50 (Practical)		
Mode of Transaction		Lectures/ Tutorials/Practical:: 03:01:02								
Course Outcome (CO) APH1110CS										
CO1 Understand the basics of laws governing physical world CO2 Understanding the basics of solar photo voltaic system CO3 Understanding the basics of sound and electromagnetic waves CO4 Application of physical laws in various engineering applications										
Unit No.	Topic/Unit	Contat Hours	Weighta ge (%)	BT Level	CO	PSO	Elemen ts of Employ ability (Emp)/ Entrepre neurship (Ent)/ Skill Develop ment (SD)	Relevan ce to Local (L)/ National (N)/ Regiona l(R)/Glo bal (G) develop mental needs	Relation to Gende r(G), Environ ment and Sustaina bility (ES), Human Values (HV)an d Professi onal Ethics (PE)	

No.	Experiment							
1	Microscope: - To determine the average separation between consecutive wires of a given grid using travelling Microscope	02	1,2	CO1, CO2	PSO1, PSO2	SD	G	PE
2	Telescope: - To determine the resolving power of given Telescope using Raleigh Criteria of Resolution	02	2	CO1 CO2	PSO1, PSO2			
3	Frequency of AC Mains: To determine the frequency of A. C. Mains	02	2,3	CO3 CO4	PSO1, PSO2			
4	Sound Waves: To determine the velocity of sound wave in air using resonance tube	02	3,4	CO4	PSO1, PSO3			
5	Ultrasonic Waves: To determine the frequency of Ultrasonic waves and find out the velocity of Ultrasonic wave in air by using the interference theory of longitudinal wave.	02	2,3	CO1 CO2	PSO1, PSO4			
6	Solar Cell: Study of I-V characteristics and determine the various parameters of given solar cell	02	2,3	CO4	PSO1, PSO3			
7	Laser Parameters: To determine the full angular divergence of the given gas laser	02	3,4	CO4	PSO1, PSO3			
8	Wavelength of Laser: To determine the wavelength of the given laser source using diffraction	02	3,4	CO4	PSO1, PSO3			
9.	Temperature Sensor: To study the nature of different temperature (NTC/PTC/Pt-100)	02	4,5	CO1	PSO1, PSO3			
10.	Young's Modulus: To determine the Young's Modulus of a given object	02	4,6	CO1	PSO1, PSO3			
	References							
1.	Engineering Physics, R.K.Gaur and S.L.Gupta Dhanpatrai Publication Ltd. 8th Edition							
2.	Fundamentals of Physics, D.Haliday, R.Resnik and J.Walker Asisan Books Pvt Ltd, 8th Edition							
3.	Practical Physics, C.L.Arora S.Chand Publications							

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: B.E.-Mechanical

PSO1 Apply fundamentals of design, thermo-fluids and production engineering knowledge for innovative and critical thinking, problem-solving and Experimental skills with integrity and inclusivity in professional engineering practice or business.

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Programme Outcome (PO)

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Syllabus of Courses

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering.		Academic Year	2022-2023						
B. E. (Mechanical Engineering): Regular Programme										
Year	I	Core / Elective / Foundation MEC1110CS : Engineering Thermodynamics	Credits / Hours per week				Lectures: 04 Practical/Lab: NIL			
Semester	I	Year of Introduction: Year of Syllabus Revision: 2021	Maximum Marks / Grade				Theory: 100 PR/TW/VIVA: NIL			
Mode of Transaction: Lectures										
Course Outcome (CO) MEC1110CS CO1 Understand basic terms used in thermodynamics. CO2 Relate the laws of thermodynamics to engineering systems and its applications. CO3 Concepts of improving the performance of a system by reducing the irreversibility. CO4 Understand the relation between different thermodynamic properties and mathematical equations CO5 Comparison of real cycles with ideal cycle										
Unit No.	Topic		Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/	Relevance to Local (L)/ National (N)/ Regional	Relation to Gender (G), Environment and Sustainable

							Skill Develop ment (SD)	l(R)/Glo bal (G)	bility (ES), Human Values (HV)an d Professi onal Ethics (PE)
1	Basic Concepts and definitions Systems and surroundings, control mass and control volume, thermal equilibrium, energy, various forms of energy, work and heat, Process and cycles, point function and path function, thermodynamic properties, Pure substance, P-V-T surfaces for pure substances, Ideal gas and real gas behavior and equations of state, ideal gas mixtures	04	8	1, 2	CO1	PO1			
2	Thermodynamic Laws Zeroth law of thermodynamics and measurement of temperature First law analysis of closed systems, first law applied to flow processes, steady flow energy equation (SFEE)., application of steady flow energy equation, Heat engine and efficiency, Heat pump and COP, Kelvin-Plank and Clausius statement of second law of thermodynamics, equivalence of the two statements	10	21	1,3,4	CO2	PO2			
3	Irreversibility, Entropy and Availability: Reversibility and Irreversibility, Carnot cycle and theorem, Clausius Inequality, Entropy, law of increase of entropy of the universe, entropy change for closed and open systems, Exergy and exergetic (second law) efficiency	10	21	2, 3, 5	CO3	PO3			
4	Thermodynamic Relations Equations of state, Maxwell relations, thermodynamic relations involving internal energy, enthalpy and entropy, Clausius-Claapeyron equation, Joule-Thompson coefficient.	10	21	1, 2, 6	CO4	PO3, PO4			
5	Steam Generators Basics of fire tube and water tube boilers, properties of steam, use of steam tables	04	8	2, 3	CO1	PO5			

6	Gas and Vapor power cycle Basics of Rankine cycle, otto cycle, diesel cycle, Brayton Cycle, Vapour compression refrigeration cycle, Absorption refrigeration cycle.	10	21	2, 3, 4	CO1, CO5	PO6			
Reference Books									
1.	Moran and Shapiro, Fundamentals of Engineering Thermodynamics, 5th Ed., Jhon Wiley & Sons, 2006								
2.	Sonntag, Borgnakke and Van Wylen, Fundamentals of Thermodynamics, 6th Ed, Jhon Wiley & Sons, 2003								
3.	P.K Nag, Engineering Thermodynamics, McGraw Hill Education Private Limited, 2013.								
4.	Y. A, Cengel and M. A Boles, Engineering Thermodynamics, TATA McGraw Hill, 2004.								
5.	C, P, Kothandaraman, P. R. Khajuria and S. Domkundwar, A Course in Thermal Engineering, Dhanpat rai & Sons, 2004.								

Bloom's Taxonomy Levels:

1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Program Name: Bachelor of Civil Engineering

Programme Specific Outcome (PSO)

PSO1 Demonstrate knowledge and understanding of principles of Civil Engineering by using tools and methodologies to provide application-oriented solutions.

PSO2 Analyze and design civil engineering structures and systems which are cost effective, socially acceptable, and sustainable.

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Civil Engineering		Academic Year		2022-23					
B. E. ((Civil, Mech., Elec., Chem., Met. & Mat Sci., Electronics, IWM, Comp. Sc. & Engg., Text.Engg., Text.Tech, Text. Processing..)) : Regular Program										
Year	I	Core / Elective / Foundation CVL1112CS : FUNDAMENTALS OF CIVIL and ENVIRONMENTAL ENGINEERING (REVISED)	Credits / Hours per week				3-1-2			
Semester	I	Year of Introduction: 2018 Year of Syllabus Revision: 2019	Maximum Marks / Grade				100			
Mode of Transaction		Lectures: 3 Tutorial :1								
Course Outcome (CO) CVL1112CS CO1 To impart brief fundamental concept related to various materials and their use in building construction CO2 To study environmental pollution comprehensively and CO3 Students will know concept of linear and angular measurements CO4 Students will be aware of various constructional practices										
Unit No.	Topic		Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Emp, Ent, SD	Relevance to L,N,R,G	Relation to G, ES,HV

									(PE)
1	Building Material Stone - Introduction to stone – Uses of stone – Characteristics of good building stone – Availability, suitability and properties of different stone. Bricks - Comparison between stone work and brick work – Advantages of bricks – Characteristics of good brick – Standard test for brick along with field test for brick. Lime - Classification of Lime, Precautions in handling Lime. Cement - Basic ingredient of ordinary cement – Physical properties of cement – Field examinations of cement – Storing of cement and its uses. Timber - Introduction to timber – Importance of seasoning – Wood base product. Steel - Introduction – Use of different form of steel – Marketable forms of steel. Aggregates. Bitumen. FRP. Optical fiber. Plastic - Properties of plastics – Types and uses of plastic.	12 hrs	25	2,3	CO1	PSO2			
2	Environmental Science and Sustainable Development Introductory Environmental Engineering Terminology— Introduction to various types of pollution- Water and land pollution and remedial measures for control, water and wastewater quality criteria – Disposal of wastes – Air pollution and remedial for control – Ecology, Environmental Protection and legislation. Hydrologic cycle, Rain water harvesting, Green building, Solid waste management, Environment Impact Assessment, Basic environmental chemistry, Sustainable development – clean development mechanism, Global warming, Ozone layer depletion, Acid rain, and Climate change.	12 hrs	25	2,3	CO2	PSO2	(Emp), (Ent) , (SD)	(L), (N), (R), (G)	(ES) , (PE)
3	Surveying and Leveling Surveying - Introduction – Principle – Object of survey – Classification – Basic instruments of linear and angular measurements – chain, tape, Offsetting, Types of offsets, Ranging methods. Prismatic compass, Types of meridians, Types of bearings. Traverse survey: open and closed Examples based on compass. Leveling – Definitions – Computation of reduced levels– Introduction to contour, Methods of leveling and Examples on Level. Modern tools: Introduction to Theodolite, Total station – Introduction to GPS, GIS, Remote sensing.	14 hrs	30	2, 3, 4, 5	CO3	PSO 1 PSO 2			

4	Building Construction Building Construction & Infrastructures: Types of constructions – roads, pipelines, transmission lines – Typical details of load bearing and framed structures – Brief discussion and illustrational sketches of typical important building components – Foundation – Functions, Types of foundations such as Spread footing, Stepped footing, Isolated and Combined column footing, Raft, and Grillage foundation. Lintels – Function, Types of lintel. Flooring, Roofing. Mortar and concrete specifications – Ingredients for mortar and concrete – classification of mortar and concrete – selection of mortar and its uses – precaution in using mortar – Pre-stressed concrete – grades of concrete, Internet of things for buildings, Hydropower plants.	10 hrs	20	1, 2, 3	CO4	PSO 1 PSO 2			
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		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Civil Engineering			Academic Year		2022-23		
B. E. (Civil, Mech., Elec., Chem., Met. & Mat Sci., Electronics, IWM, Comp. Sc. & Engg., Text.Engg., Text.Tech, Text. Processing.)									
: Regular Program									
Year	I	Core / Elective / Foundation CVL1112LCS : FUNDAMENTALS OF CIVIL and ENVIRONMENTAL ENGINEERING (REVISED) : Field Practical			Credits / Hours per week		02		
Semester	I	Year of Introduction: 2018 Year of Syllabus Revision: 2019			Maximum Marks / Grade		50		
Course Outcome (CO) CVL1112LCS									
CO1 To impart brief fundamental concept related to various materials and their use in building construction									
CO2 To study environmental pollution comprehensively and									
CO3 Students will know concept of linear and angular measurements									
CO4 Students will be aware of various constructional practices									
Mode of Transaction		Practical's, discussion and viva			PSO1 is common for all experiments				
No.	Experiment				Contact Hours	Course Code	BT Level	CO	PSO
1	Conventional signs and symbols, scale, topographic-sheet				2		1,2,3	CO3	PSO1
2	Linear measurements: tape, ranging, offsets				4		2,3	CO3	PSO1
3	Compass: Introduction, Bearings				2		2,3,4	CO3	PSO1
4	Auto level: Introduction, HI, Rise and fall				6		2,3,4,5	CO3	PSO1
5	GPS : Introduction, and demonstration				2		2,3,4	CO3	PSO1

6	Theodolite and Total Station demonstration	6		2,3,4,5	CO3	PSO1
7	Any other term-work based on syllabus	2		1,2	CO1 CO4	PSO1, PSO2

Reference Books

1	Arora S.P. and Bindra S.P. (2012), A text book of Building Construction, Dhanpatai and Sons, Publishers.
2	Rangwala S.C. (2012), A text book of Building Construction, Charotar Publishing House, India.
3	Gilbert M Masters, (2006), Introduction to Environmental Engineering & Science, Prentice Hall of India Pvt. Ltd. New Delhi
4	Deshpande P.D., (2009) Basic Civil Engineering, Nirali Prakashan Pune.
5	G.S.Birdie, Water supply & Sanitary Engg., Dhanpatrai & Sons.
6	S.C.Rangwala, Engg. Materials, Charotar Books Staff, Anand.
7	Janardan Jha Building Material
8	Surendra Singh, Building Material, Vikas Pub. Pvt. New Delhi.
9	D.N.Ghose, Material of Construction, Tata McGraw Hill Pub. Co. Ltd. New Delhi
10	Surveying & Levelling – Kanetkar & Kulkarni Vol-I A.V.G. Prakashan, Puna.
11	Elementary Survey – B.C.Punmia Vol-I. Laxmi Pub. Dariya Gunj, New Delhi.
12	Surveying & Levelling – S.C.Rangwala, Charotar Pub. House, Anand.

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: B.E.-Mechanical

PSO1 Apply fundamentals of design, thermo-fluids and production engineering knowledge for innovative and critical thinking, problem-solving and Experimental skills with integrity and inclusivity in professional engineering practice or business.

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PSO3 Develop leadership and collaborative roles in their careers.

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PO1 Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Problem Analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Design/development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 Modern Tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6 The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

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PO10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering		Academic Year		2022-23					
B E (Electrical Engineering): Regular Programme										
Year	I	Core / Elective / Foundation ELE1101CS: Basic Electrical and Electronics Engineering	Credits / Hours per week				03 + 02			
Semester	I	Year of Introduction: 2022 Year of Syllabus Revision: NIL	Maximum Marks / Grade				100 + 50			
Mode of Transaction		Lectures and Laboratory								
Course Outcome (CO) (ELE1101CS) CO1 Evaluate the Electric AC and DC Circuits CO2 Explain Magnetic Circuit fundamentals CO3 Analyze various electrical machines CO4 Analyze dc circuits and ac circuits of semiconductor devices with their physical Operation CO5 Apply the knowledge of electronics devices , biasing and circuits CO6 Explain various forms of numerical representations in digital logic and carry out arithmetic operations										
Unit No.	Topic		Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Profession

[illegible]

3.	Problems in Electrical Engineering By Parkersmith
4.	Electrical and Electronics Technology by Edward Hughes
5.	Integrated Electronics: Millman & Halkias
6.	Electronic Devices and Circuits: Applied Electronics: G. K. Mittal
7.	“Op-Amps and Linear Integrated Circuits” by Ramakant A Gayakwad
8.	Electronic Devices and Circuit Theory: by Robert Boylestad and Louis Nashelsky
9.	“Digital Logic and Computer Design” by M Morris Mano

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: B.E.-Mechanical

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BE-I Mechanical										
Year	I	Core / Elective / Foundation AMT1215CS: Linear Algebra & Vector Calculus	Credits / Hours per week				03(L)+01(T)= 04			
Semester	II	Year of Introduction: 2022-23	Maximum Marks / Grade				100			
Mode of Transaction		Lecture and Tutorial								
Course Outcome (CO) (AMT1215CS) CO1 Implement various concepts of matrices in engineering problems and able to solve system of linear equations using matrices. CO2 Understands the Double, Triple integrations and can apply it appropriately, to evaluate Volume, Mass, Area, C.G. and M.I. CO3 Understand and know the properties of the improper integrals viz. Gamma, Beta, Error. Be aware and use them in problem evaluation. CO4 Able to focus on understanding and applications of gradient, curl and divergence in engineering problems. CO5 Understands the concept of different types of line integrals with evaluation techniques. CO6 Through various integral theorems, understands the relationships between various kinds of multiple integrals, line integral and apply These concepts in solving engineering problems related to area, mass volume, flow problems, work done etc. CO7 Able to understand and apply the concepts of Laplace transform to find out transform and inverse transforms for various functions.										
Uni t No.	Topic		Contact Hours	Weightage (%)	BT Level	CO	PSO	Elemen ts of Employ ability (Emp)/ Entrepre neurship (Ent)/ Skill Develop	Relevan ce to Local (L)/ National (N)/ Regiona l(R)/Glo bal (G)	Relatio n to Gender (G), Environ ment and Sustaina bility (ES), Human

							ment (SD)		Values (HV) and Professional Ethics (PE)
1	Matrices: Reorientation of Matrices, Rank of a matrix (by row echelon form and normal form), solution of homogeneous and non – homogeneous systems of linear equations, Eigen values and Eigen vectors of a matrix, Cayley – Hamilton theorem. Special matrices: Hermitian, skew Hermitian, orthogonal and unitary matrices.	12	25	1, 2, 3, 5	CO1	PO1 PO2	Emp, SD	G	PE
2	Improper Integrals & Multiple Integrals: Improper integrals, Gamma and Beta functions and their properties, Error functions and its properties. Reorientation of concept of integrals, double and triple integrals, Evaluation techniques, change of order of integration, Integrals in polar and cylindrical coordinates, transformation of multiple integrals, Application of double and triple integrals for evaluation of area, volume and mass.	14	29	1, 2, 3, 4, 5	CO2 CO3 CO6	PO1 PO2			
3	Vector Calculus: Scalar and vector fields, gradient of a scalar field, directional derivatives, divergence and curl of a vector field and their applications. Line integrals, Green's theorem, Surface integrals, Stoke's theorem, Volume integrals, Gauss divergence theorem.	12	25	1, 2, 3, 4, 5	CO4 CO5 CO6	PO1 PO2			
4	Laplace Transform: Existence of Laplace transform, Laplace transforms of elementary functions, inverse Laplace transforms, linearity property, first and second shifting theorem, Laplace transforms of derivatives and integrals, Laplace transform of Dirac delta function, unit step function, and convolution theorem.	10	21	1, 2, 5	CO7	PO1 PO2			

Reference Books		
1.	B. V. Ramana	Higher Engineering Mathematics, Tata Mc. Graw – Hill. (Core Engineering Series), 2006.
2.	C. R. Wylie	Advanced Engineering Mathematics, Mc. Graw – Hill Inc., 1986
3.	David V. Widder	Advanced Calculus, Prentice Hall of India Pvt. Ltd., 1986.
4.	Erwin Kreyszing	Advanced Engineering Mathematics, (6th edition) John Wiley & Sons.,1988
5.	G. B. Thomas, R. L. Finney	Calculus and Analytic Geometry, Addison-Wesley Publishing Co., 2010
6.	H. Schneider, G. Phillip Barker	Matrices and Linear Algebra, Dover Publications Inc, New York, 1973.
7.	P. V. O’Neil	Advanced Engineering Mathematics, Cengage Learning (India edition), 1991.

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Civil Engineering					Academic Year		2022-23	
S.S. B E – I All branches of Engineering									
Year	I	Core / Elective / Foundation ENG1002CS: COMMUNICATION SKILLS				Credits / Hours per week		2+0+2	
Semester	II					Maximum Marks / Grade		50+50=100	
Mode of Transaction		Lectures, and Practicals							
Course Outcome (CO) ENG1002CS COMMUNICATION SKILLS CO1 To know the process of communication and its components. CO2 To improve the language skills i.e. Listening Skills, Speaking Skills, Reading Skills and Writing Skills (LSRW). CO3 To effectively Conduct meetings and conferences CO4 To enhance phonetic competence, comprehension skills, presentation skills, group discussion skills etc. CO5 To build confidence for communicating in English and create interest for the life-long learning of English language.									
Unit No.	Topic	Contact Hours	Weight age (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R) /Global (G)	Relation to Gender(G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	Communication skills: Process of communication, Flows of Communication in organization, Barriers to communication (Formal Flow – Upward, Downward, lateral and diagonal, Strategies to improve Organizational Communication, Effectiveness in Managerial Communication, and importance of technical communication, Non verbal communication.	04	15%	1,2,	1	1	SD	G	ES
2	Listening Ability, Hearing and Listening, Types of Listening, Barriers to Effective Listening,	04	15%	1,2,3	2	1	SD	G	ES

	Traits of a Good Listener.								
3	Presentation Skills and Writing skills: Effective Presentation strategies: Purpose, analyzing the audience and locale, organizing the content, Oral presentation, Graphic presentation, Presentation aids, Personality Development. Newsletters, technical article and business letters. Technical Reports, characteristics, Importance, objectives, categories of report, format structure of reports, types of reports, importance of plagiarism check.	10	40%	1,2,3	3,4	1	SD	G	ES
4	Group Discussion and work place communication: Qualities needed for effective group discussion. Email etiquettes, Telephone Etiquettes, Role and responsibility of engineer, Work culture in jobs. Work place, rights and responsibilities	04	15%	1,2,4	4	1	SD	G	ES
5	Interviews and meetings: Types of interview, General preparation for interview, Gathering information about the company, knowing about the role/job position, Types of interviewing questions, Non-verbal communication to win the interview. Meeting and Conferences: Planning a meeting (Agenda and notice), Conducting a meeting, Post meeting actions (Minutes), Planning & Conducting a Conference (anchoring and Report writing), and Video/web conferences	04	15%	1,2,3	3,4	1	SD	G	ES

T.W./ Pr.	Termwork / Practicals shall be based on above syllabus.
REFERENCES	
1.	G,S,B,K Babu Rao, “Business Communication and Soft Skill”, Himalaya Publishing house (1stEdition)
2.	Raman Sharma, “Technical Communications”, Oxford Publication, London, 2004
3.	Sharma, R. and Mohan, K. “Business Correspondence and Report Writing”, TMH New Delhi2002.
4.	Kumar S and Lata P Communication Skills 2011: New Delhi Oxford University Press

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Syllabus of Courses

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Mechanics		Academic Year	2022-23
B.E. (Mechanical): Regular Program				
Year	I	Core / Elective / Foundation APM1208CS: APPLIED MECHANICS	Credits / Hours per week	3+1+2
Semester	II	Year of Introduction: Year of Syllabus Revision: 2010,2022	Maximum Marks / Grade	100+50=150
Mode of Transaction		Lectures		
Course Outcome (CO) APM1208CS Students will be able to... CO 1: Apply concept static equilibrium in evaluation of unknown quantities, friction application and support reactions. CO 2: Analyze plane and space truss and apply for design of truss. CO 3: Evaluate center of gravity and moment of inertia which enables to find deflection in beams. CO 4: Illustrate theory of lifting machines and tooth gearing, power transmission in belts. CO 5: Determine kinetics and kinematics force acting on a body, work, power and energy, impulse and momentum. CO 6: Evaluate elastic properties and stresses in the materials.				

Unit No.	Topic/Unit	Contact Hours	Weightage (%)	BT Level	CO	PS O	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/ Global (G) developmental needs	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)
1	Statics: Introduction, forces and force systems Introduction to the subject of applied mechanics and its various branches. SI units, coplanar, concurrent and non-concurrent force systems, resultant and resolutions, forces in space, moment of force, varignon's theorem, couple and its properties. Concentrated and uniform loads, equilibrium of a particle. External & internal forces, equilibrium of rigid body, types of supports. Structural members and beams, reactions of beams, determinateness. connected bodies, two force and three force members. Trusses, method of joint, method of section, space frames.	13	25	1,2,3,4,5	CO1, CO2	PS O1 2	SD,EMP	G	ES

2	Center of gravity, moment of inertia and static friction: Centre of gravity, centroids of composite areas, built-up sections, product of inertia, mass moment of inertia. Types of friction, equilibrium on rough inclined plane, wedge and screw friction.	13	25	1,2,5	CO1, CO3	PS O 1 2			
3	Statics: Transmission of power: Theory of lifting machine, basic machines, linear law, belt drive, velocity ratio, compound belt drive, length of belt. Transmission of power, gearings, train of wheels, epicyclic gearing, speed reduction gear, differential types of gear.	13	25	2,3,4,5	CO4	PS O1			
4	Dynamics and elastic properties of materials: Review of kinematics of a particle, force, mass and acceleration, rectilinear and curvilinear motion, D'Alembert's principle. Work, power and energy, impulse and momentum, equations of motion, translation and fixed axis rotation, problems involving friction. Simple stresses and strains, hook's law, elastic limit, ultimate stress, factor of safety, lateral strain, poisson's ratio, stress concentration, temperature stress, simple shear, elastic moduli relations.	13	25	1,2,3,4,5	CO1, CO5, CO6	PS O1			

Reference Books

1.	Applied Mechanics by S. B. Junnarkar and H. J. Shah, Charotar Pub.
2.	Engineering Mechanics by Merum and Kraige, John Wiley & Sons.
3.	Vector Mechanics by Beer and E. R. Johnstons, McGraw-Hill Book Co.
4.	Engineering Mechanics by Huges and Martin, E.L.B.S. and Macmillan.
5.	Engineering Mechanics by R. S. Kumar.

		The Maharaja Sayajirao University of Baroda			Academic Year		2022-23		
		Faculty Technology and Engineering							
		Department of Applied Mechanics							
B.E. (MECHANICAL): Regular Programme									
Year	I	Core / Elective / Foundation APM1208LCS: Laboratory Practical & Graphics			Credits / Hours per week		01/02		
Semester	II	Year of Introduction: Year of Syllabus Revision: 2010,2022			Maximum Marks / Grade		50		
Mode of Transaction		Laboratory Experiments, Graphics, discussion and viva			is common for all experiments				
No.	<u>EXPERIMENT</u>				Contact hours	%weightage	BT Level	CO	PSO
1	LAW OF PARALLELOGRAM OF FORCES				2	5	2,3	CO1	PSO1,2
2	LAW OF POLYGON				2	5	2,3	CO1	PSO1,2
3	SIMPLE BEAM				2	5	2,3	CO1	PSO1,2
4	JIB CRANE				2	5	2,3	CO2	PSO1,2
5	THEORY OF LIFTING MACHINE				2	5	2	CO4	PSO1,2
6	ROPE AND PULLEY BLOCK				2	5	2,3	CO4	PSO1,2
7	SCREW JACK				2	5	2,3	CO4	PSO1,2
8	DIFFERINTIAL AXLE				2	5	2,3	CO4	PSO1,2

9	WORM AND WORM WHEEL	2	5	2,3	CO4	PSO1,2
10	MOMENT OF INERTIA OF FLY WHEEL	2	5	2,3	CO3,5	PSO1,2
11	RADIUS OF GYRATION OF COMPOUND PENDULUM	2	5	2,3	CO5	PSO1,2

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Syllabus of Courses

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering		Academic Year				2022-23		
B. E. (Mechanical Engineering): Regular Programme Workshop Practice										
Year	I MECH	Core: MEC1214CS Workshop Practice		Credits / Hours per week				Lectures: 00 Practical:- 04		
Semester	II	Year of Introduction: 1960 Year of Syllabus Revision:2021		Maximum Marks / Grade				Theory: NILL PR/TW/VIVA: 100		
Mode of Transaction: Lectures and Practical										
Course Outcome (CO) MEC1214CS CO 01 Understand importance of workshop practices along with safety precautions in different shops. CO 02 Understand the basic operations of carpentry, fitting, smithy and molding shop by using various marking, measuring, cutting and inspection tools. CO 03 Hands on practice and job making in carpentry, fitting, smithy and molding shop CO 04 Understand various manufacturing operations in machine shop CO 05 Understand different types of metal joining processes and perform basic operations of welding shop CO 06 Perform basic operations on lathe and shaping machine in machine shop. CO 07 Understand the basic operations of press working										
Unit No.	Topic		Cont act Hou rs	Weigh tage (%)	BT Level	CO	PO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and PE

1	Introduction to workshop facility: Introduction to different shops of the workshop, general safety guidelines, familiarization with workshop facility	04	7	1,2,3,4,5,6	Co1	Po 2,3,4	Emp, Ent, SD	L,N,R,G	G, ES, HV, PE
2	Carpentry Shop: Introduction to different tools of carpentry shop, understanding drawing of the job to be made, making of finished job as per drawing out of the given raw material of wood.	08	14	1,2,3,4,5,6	Co2,3	Po 2,3,4,5			
3	Fitting Shop: Introduction to different tools of fitting shop, understanding drawing of the job to be made, making of finished job as per drawing out of the given raw material.	08	13	1,2,3,4,5,6	Co2,3	Po 2,3,4,5			
4	Smithy Shop: Introduction to different tools of smithy shop, understanding drawing of the job to be made, making of finished job as per drawing out of the given raw material.	08	13	1,2,3,4,5,6	Co2,3	Po 2,3,4,5			
5	Introduction to Machine Tools: Demonstration on different machine tools eg. Lathe machine, Shaping machine, Drilling machine, Grinding machine. Preparation of job by turning on lathe involving step turning and thread cutting.	12	20	1,2,3,4,5,6	Co2,4	Po 2,3,4,5,9			
6	Metal Joining Processes: Introduction to different tools of welding shop, Demonstration of welding process, Preparation of	08	13	1,2,3,4,5,6	Co5	Po 2,3,4,5			

	welding job as per drawing, Introduction to other metal joining processes such as soldering, brazing and riveting								
7	Moulding Practice: Introduction to different tools of moulding shop, Demonstration of moulding process, Preparation of mould assembly as per pattern.	08	13	1,2,3,4,5,6	Co2,3	Po 2,3,4,5			
8	Press Working: Demonstration of press working operations like blanking, punching, piercing etc.	04	7	1,2,3,4,5,6	Co7	Po 2,3,4,5			
		60	100						
Reference Books									
1.	Workshop Technology-I. W.A. J. Chapman Taylor & Francis								
2.	Comprehensive Workshop Technology (Manufacturing Processes). S.K. Garg Laxmi publications								
3.	Workshop practice manual. K.Venkata Reddy B.S.Publications.								
4.	Workshop Technology-I. Hazra and Chaudhary Media promoters & Publisher private limited								

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PO5 Modern Tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6 The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering.					Academic Year				2022-2023		
		B. E. (Mechanical Engineering): Regular Programme											
Year	I	Core / Elective / Foundation MEC1210CS: Engineering Drawing I				Credits / Hours per week				Lectures: 03 Practical/Lab: 04			
Semester	I (in All branched of engineering) /II in Mechanical Engineering	Year of Introduction: Year of Syllabus Revision: 2021-2022				Maximum Marks / Grade				Theory: 100 PR/TW/VIVA: 50			
Mode of Transaction: Lectures and Practical/Laboratory teaching													
	Course Outcome (CO) MEC1210CS CO1 Use the drawing instruments effectively and how to use the dimensioning methods. CO2 Observe, analyze and correlate two-dimensional (Orthographic view) and three dimensional (Isometric view) CO3 Construct and application of various engineering curves in engineering practice. CO4 Apply the knowledge of Projection of points, Lines and Planes in engineering. CO5 Understanding of solids and its sections with its true shape												
Unit No.	Topic				Contact Hours	Weightage (%)	BT Level	CO	PO	PSO	Elements of Emo, Ent, SD	Relevance to L,N, R, G	Relation to G, ES, HV PE
1	Introduction to Engineering Drawing: Introduction to ISI & ISO standards in drawing practice, Drawing instruments and their uses, Types of lines, lettering and dimensioning, construction of scales				02	04	1, 2, 6	CO3	PO1				
2	Engineering Curves:				06	12	1,2,6	CO5	PO2				

	Reference Books	
1.		Bhatt, N.D., 'Engineering Drawing',
2.		Shah, P. J., 'Engineering Drawing',

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering		Academic Year				2022-23	
B. E. (Mechanical Engineering): Regular Programme									
Year	I MECH	Core MEC1209CS :Computational Techniques and Programming		Credits / Hours per week				Lectures: 03 Practical:- 02	
Semester	II	Year of Introduction: 1960 Year of Syllabus Revision:2006 Shifted from SSBE III to SSBE I		Maximum Marks / Grade				Theory: 100 PR/TW/VIVA: 50	
Mode of Transaction: Lectures and Practical									
Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	Programming Languages: Digital computers Architecture, Types of Input & Output devices, operating systems - Single & Multi-user. Flow charts and Pseudo code are in programming. Concepts in	4	10	1,2,3	Co1Co2	Po1 Po2	Emp, Ent, SD	L,N,R,G	G, ES, HV, PE

	machine code and higher-level languages.								
2	Syntax C and Python for constants, variable, Arithmetic operations, Functions, Inputs, outputs, Dimensions and Arrays/Lists	4	10	3,4,5	Co1,co2	Po2 po3			
3	Repetitive computation procedures in C and Python. Transfer of control - conditional and unconditional loops and subroutines.	4	10	1,2	Co1,co2,co3,co5	Po3			
4	File input – output – sequential and random accesses files in C and Python	4	10	2,3,4,5	Co1	Po1			
5	Computational Techniques: Algorithm – Definition, classification and features, static and dynamic complexities, stability of algorithms.	4	5	2,3,56	Co4,co5	Po3,po4			
6	Errors – sources of errors in computation, sources of errors in Machine computations- Effect of rounding and number systems used in computing machines.	2	5	1,2,3	Co2,co3	Po1			
7	Linear simultaneous Algebraic Equations – Exact solution Algorithm –Gaussian Elimination, Choleskey Method, Croute Procedure, Matrix inversion, Gauss Jordon method, Approximate solution Algorithms – Jacobi Method, Gauss Siedel method. Eigen values problems, classification, algorithm for largest	4	10	2,3,45,6	Co4,co,co6	Po3,po4			

	and smallest Eigen value and corresponding vector, Jacobi method.								
8	Non linear equations – Roots of equation – Bracketing Methods – Methods of halving, Method of chord or linear interpolation open methods – Method of Tangent or Newton Raphson Method, Modified Newton Raphson Method.	4	10	2,1,3	Co4,co5,co6	Po5			
9	Lagranges interpolation, Richardson's extrapolation, Finite difference methods – ordinary differential equations – Forward, Backward and Central differences format for first, second and fourth order ordinary differential equations. Partial differential equations - finite differences for Laplace biharmonic equations.	4	10	3,4,6	Co5	Po4, po5			
10	Numerical Differentiation and Integration – Newton cotes formula, Waddle's rule for simple and double integration, Euler Method – Runge - Kutta Methods.	4	5	4,6	Co7	Po6			
11	Introduction to Finite Element Method – 1D & 2D analysis for Field problems.	4	10	3,4,6	C03	Po3			
12	Optimization – Constrained and unconstrained	2	5	1,2,6	Co7,co3	Po3, po6			
		44	100						

CO 05 Understand linear and nonlinear equation solving methods, Numerical Integration and Numerical differentiation with optimising techniques using programming languages.

Experiments

1.	Introduction to computer systems	2	10		Co1,co2,co3,co5	Po3	Emp, Ent, SD	L,N,R,G	G, ES, HV, PE
2.	Operating systems	2	10		Co1,co2,co3	Po3			
3.	Number systems	2	10		Co2,co3	Po1			
4.	Translator programs	2	10		Co4	Po3,po4			
5.	Program logic representation	2	10		Co4,co5	Po5			
6.	Programming in c	6	15		Co4,co5,co6	Po5			
8.	Computational Techniques	6	20		C03	Po3			
9.	Programming in Python	6	15		Co7,co3	Po3,po6			
		28	100						

CO 05 Understand linear and nonlinear equation solving methods, Numerical Integration and Numerical differentiation with optimising techniques using programming languages.

Reference Books	
1.	Programming in ANSI C, by Balagurusamy, Publisher - Tata mcgraw Hill
2.	C: The Complete Reference, by Herbert Schildt, Publisher – Tata mcgraw Hill.
3.	Chapra S.C, Canale, R P, Numerical Methods for Engineers , Tata mcgraw Hill, 2003
4.	E. Kreyszig, advanced engineering mathematics(8th edition), john wiley (1999)

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Textile Engineering				Academic Year		2025-26	
B.E. Mechanical Engineering									
Year	I	Core / Elective / Foundation FTE XXXX: Universal Human Values – I				Hours per week (L-T-P) & Credit 01-00-00, No Credit			
Semester	I	Year of Introduction: 2025-26 Year of Syllabus Revision: --				Maximum Marks / Grade 00			
Mode of Transaction		Lectures (Online)							
Course Outcome (CO) CO1: Understand and analyse the essentials of human values and skills, self-exploration, happiness and prosperity. CO2: Evaluate coexistence of the “I” with the body. CO3: Identify and evaluate the role of harmony in family, society and universal order. CO4: Understand and associate the holistic perception of harmony at all levels of existence. CO5: Develop appropriate technologies and management patterns to create harmony in professional and personal lives.									
Unit No.	Topic/Unit	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G) developmental needs	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)

1	Introduction to UHV, Aspirations and Concerns, Self-management, Health	6	40%		CO1 , CO2	-----	Emp, Ent, SD	L, N, R, G	G, ES, HV, PE
2	Relationships	4	27%		CO2 , CO3				
3	Society, Natural Environment, Self-evaluation	5	33%		CO4 , CO5				
Reference Books:									
1.	A foundation course in Human Values and Professional Ethics by R R Gaur, R. Ashthana and G P Bagaria, 2 nd Edition (2019).								
2.	Universal Human Values and Professional Ethics by Dr. Saroj Kumar, Prof. Sheenu Nayyar, Thakur Publication Pvt Ltd, (2020)								
3.	Online Universal Human Values material of AICTE.								

DEPARTMENT OF MECHANICAL ENGINEERING
FACULTY OF TECHNOLOGY AND ENGINEERING
THE M S UNIVERSITY OF BARODA

UG TEACHING SCHEME

BE - CRS MECHANICAL ENGINEERING

BE-II CRS (MECHANICAL ENGINEERING)											
Semester	Sub Code Theory	Sub Code TW/Viva	Subject Name	Teaching Scheme				Examination Scheme			
				L	T	P	Credit	Theory		Practical	
								IA	UA	IA	UA
FS BE-II	AMT1318CS	---	Differential Equations	3	1	0	4	30	70		
	APM1311CS	APM1311LCS	Mechanics of Materials	3	1	2	5	30	70		50
	MEC1311CS	MEC1311LCS	Production Technology-I	4	0	2	5	30	70		50
	MEC1312CS	MEC1312LCS	Theory of Machines-I	4	0	2	5	30	70		50
	MEC1313CS	MEC1313LCS	Thermal Engineering-I	4	0	2	5	30	70		50
	Total (Semester 3)			18	2	8	24	150	350		200
SS BE-II	ELE1424CS	ELE1424LCS	Elements of Mechatronics	4	0	2	5	30	70		50
	MEC1409CS	MEC1409LCS	Machine Drawing	2	0	2	3	15	35		50
	MEC1410CS	MEC1410LCS	Production Technology-II	4	0	2	5	30	70		50
	MEC1411CS	MEC1411LCS	Theory of Machines-II	4	0	2	5	30	70		50
	MEC1412CS	MEC1412LCS	Fluid Mechanics	4	0	2	5	30	70		50
	FTE1401CS	---	Universal Human Values II	3	0	0	3	30	70		
	Total (Semester 4)			21	0	10	26	165	385		250
	TOTAL (YEAR 2)						50				1500

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: B.E.-Mechanical

PSO1 Apply fundamentals of design, thermo-fluids and production engineering knowledge for innovative and critical thinking, problem-solving and Experimental skills with integrity and inclusivity in professional engineering practice or business.

PSO2 Achieve further career development through graduate education, professional development courses and/or on-the-job training and experience.

PSO3 Develop leadership and collaborative roles in their careers.

Programme Outcome (PO)

PO1 Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Problem Analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Design/development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 Modern Tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6 The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Mathematics					Academic Year			2023-2024	
		BE-II Mechanical									
Year		II	Core / Elective / Foundation AMT1318CS: Differential Equations			Credits / Hours per week				03(L) +01(T)= 04	
Semester		I	Year of Introduction: 2022-2023			Maximum Marks / Grade				100	
Mode of Transaction			Lecture and Tutorial								
		Course Outcome (CO) (AMT1318CS) CO1 Classify the differential equations with respect to their order and linearity; explain the meaning of different types of solutions of a differential equation. CO2 Apply the method of undetermined coefficients and variations of parameters to solve higher order linear differential equations. CO 3 Analyze Mathematical Modeling of real-world problems in field of Mechanical Engineering. CO 4 Find series solutions of Bessel differential equation and Legendre’s differential equations. CO 5 Apply the idea of Laplace transforms to solve Initial and Boundary Value Problems which occur in almost every problem of engineering. CO6 Make use of Fourier series to analyze wave forms of periodic functions and use it for solving/modeling systems in MECHANICAL engineering. CO7 Classify partial differential equations and apply various methods to solve them. CO8 Able to solve Initial Boundary Value problems and Boundary Value problems governed by Vibrating string and Heat conduction.									
Unit No.	Topic		Contact Hours	Weightage (%)	BT Level	CO	PSO	PO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/ Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and

										Professional Ethics (PE)
1	Ordinary Differential Equations: Reorientation, Exact differential equations, Reducible to exact differential equations, Linear differential equations, Reducible to linear differential equations, initial value problems (IVP) and boundary value problems (BVP), Existence and Uniqueness theorem. Higher order Linear differential equations, Principle of superposition, Solution of Homogeneous and Non-homogeneous linear equations with constant and variable coefficients using Method of variation of parameter and undetermined coefficients.	12	25	1, 2, 3, 5	CO1 CO2		PO1 PO2	Emp, SD	G	PE
2	Applications of ODE: Mathematical modeling pertaining to mechanical systems using first order and higher order differential equations. Solution of IVP and BVP using Laplace transform. Method of series solution, Bessel and Legendre's differential equations and their solutions as special functions.	12	25	1, 2, 3, 4, 5	CO3 CO4 CO5		PO1 PO2			
3	Fourier Series: Periodic functions, Fourier expansion of periodic functions, Conditions for convergence of Fourier series, Fourier series of even and odd functions, Half range series.	8	17	1, 2, 3, 5	CO6		PO1 PO2			
4	Partial differential equations: Formation of first order partial differential equations, Solution of first order partial differential equations: Lagrange's Linear equation, Second order partial differential equations, Classifications of second order partial differential equations, Mathematical modeling of one dimensional wave and heat equation, Solution of one dimensional wave and heat equation using method of separation of variables, Two dimensional heat equation with steady state conditions, Solution of Laplace equation using method of separable variables. Solution of Laplace equation in polar coordinates.	16	33	1, 2, 3, 4, 5	CO7 CO8		PO1 PO2			

Reference Books		
1.	B. V. Ramana	Higher Engineering Mathematics, Tata Mc. Graw – Hill. (Core Engineering Series), 2006.
2.	C. R. Wylie	Advanced Engineering Mathematics, Mc. Graw – Hill Inc., 1986
3.	Donald Greenspan	Introduction to Partial Differential Equations, Mc. Graw – Hill Inc., 2012
4.	Erwin Kreyszing:	Advanced Engineering Mathematics, (6th edition) John Wiley & Sons., 1988
5.	Michael D. Greenberg	Advanced Engineering Mathematics, Prentice Hall, 1988
6.	P. V. O’Neil	Advanced Engineering Mathematics, Cengage Learning (India edition), 1991.
7.	S. L. Ross	Differential Equations, Wiley, 2007
8.	Wilfrad Kaplan	Elements of Differential Equations, Addison-Wesley Educational Publishers Inc, 1964

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: B.E. (Mechanical)

Programme Specific Outcome (PSO)

- PSO1 Apply fundamentals of design, thermo-fluids and production engineering knowledge for innovative and critical thinking, problem-solving and experimental skills with integrity and inclusivity in professional engineering practice or business.
- PSO2 Achieve further career development through graduate education, professional development courses and/or on-the-job training and experience.
- PSO3 Develop leadership and collaborative roles in their careers

Programme Outcome (PO)

- PO1** Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO2** Problem Analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- PO3** Design/development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO4** Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- PO5** Modern Tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- PO6** The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- PO7** Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- PO8** Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- PO9** Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- PO10** Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- PO11** Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- PO12** Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Proposed Syllabus of Courses

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Mechanics				Academic Year				2023-24			
	B.E. (Mechanical) : Regular Programme											
Year	II	Core / Elective / Foundation APM1311CS : Mechanics of Materials			Credits / Hours per week				04			
Semester	I	Year of Introduction: 2023 Year of Syllabus Revision:			Maximum Marks / Grade				100			
Mode of Transaction		Lectures and Tutorial										
	Course Outcome (CO) APM1311CS CO1: Determine the material properties, shear force, bending moment, slope and deflection in beam and apply for further analysis and design of structures. CO2: Calculate the shear stress and bending stress in different cross section of beams. CO3: Determine the Principal stresses and strains analytically and graphically and analyze and design thin shells and bolted connections. CO4: Apply strain energy concept to determine stress due to gradual, sudden and Impact loading. CO5: Analyze column under axial and eccentric load and determine direct and bending stresses in chimney, dam and retaining wall. CO6: Analyze the circular shaft under pure torsion as well as combined bending and torsion along with its application for the analysis and design of helical spring.											
Unit No.	Topic/Unit			Contact Hours	Weightage (%)	BT Level	CO	PSO	PO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/ Global (G) development needs	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)

1	Shear force, Bending moment diagrams for Beams and beam stresses: Diagram of bending moment and shearing force in cantilever and simply supported beams under static loads-analytically with varying, distributed loads and couples <i>and verifying solutions to problems in mobile application</i> . Theory of simple bending: Distribution of normal stress due to bending, moment of resistance, Beam of uniform strength, Flitched beam, Built up section under bending, <i>verifying solutions to problems in FEM software and design of safe and economic beam section for residential and public buildings</i> . Distribution of shear stress across various cross sections. Curvature, slope and deflection of cantilever and simply supported beams including overhang beams, <i>Macaulay's Method, its maxima as per codal conditions</i> , Carriage springs	18	30	1,2,3,4,5	CO1, CO2,	PSO1		SD	G	ES

2	Principal stresses and strains and thin shells Ellipse and circle of stresses, Principal planes, Principal stresses and strains, Mohr's stress and strain circle for various applications of compound stress <i>and verifying solutions to problems in FEM software</i> Resilience of sudden, impact and shock loading, Stresses in thin cylinders subjected to internal pressure, Cylindrical shell with hemispherical ends, Spherical shell, <i>design of safe and economic blast resistant vessel in the industry</i> . Bolted joints, types of failure and load transfer in bolted joint, Design of bolted connections <i>as per codal conditions</i>	18	30	2,3,4,5	CO3, CO4	PSO1			
3	Columns subjected to axial and eccentric loading Eccentric loading on column, Tension or compression combined with bending, <i>design of solid, hollow and engineered material column, economic aspect of column and verifying solutions to problems in FEM software</i> , Middle third rule, Wind pressure on walls and chimney, Water pressure on dam. Simple strut theory - Euler's and Rankine's Formula.	12	20	2,3,4,5	CO5	PSO1			
4	Torsion of Circular shaft Torsion of circular shafts of uniform sections. Torsional resilience. Distribution of torsional stress- Angle of twist, Power transmissions from shafts, Combined Bending and Torsion including theories of failure, <i>economic aspect of shaft, verifying solutions to problems in FEM software</i> , Helical spring under axial force.	12	20	2,3,4,5	CO6	PSO1			
Reference Books									
1.	Mechanics of Structures Vol. I by S.B. Junnarkar and H. J. Shah.								
2.	Introduction to Mechanics of Solids by I.P. Kapila and S.N. Agnihotri.								
3.	Elementary Strength of Materials by S. Timonshenko.								
4.	Strength of Materials by Ramamrutham.								
5.	Strength of Materials by R.C. Patel , T.D. Bhagia, & B.M. Patel.								
		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Mechanics				Academic Year		2023-24	

		B.E. (Mechanical): Regular Programme									
Year		II	Core / Elective / Foundation APM1311LCS: Mechanics of Materials				Credits / Hours per week		02		
Semester		I	Year of Introduction: 2023 Year of Syllabus Revision:				Maximum Marks / Grade		50		
Mode of Transaction			Laboratory Experiments, Discussion and Viva				is common for all experiments				
No.	EXPERIMENT					Contact Hours	% weightage	PO	BT Level	CO	PSO
1	COPMLETE TENSILE TEST ON MILD STEEL (MS)					3	10		2,3	CO1, CO2	PSO1
2	MODULUS OF ELASTICITY FOR MS					3	10		2,3	CO1, CO2	PSO1
3	DIRECT SHEAR TEST ON MS					3	10		2,3	CO1, CO3	PSO1
4	COPMRESSION TEST ON MS AND CAST IRON (CI)					3	10		2,3	CO1, CO5	PSO1
5	COMPRESSION TEST ON TIMBER					3	10		2,3	CO1, CO5	PSO1
6	IZOD IMPACT TEST ON CI, MS AND BRASS					3	10		2,3	CO1, CO4	PSO1
7	HARDNESS TEST ON MS, CI AND BRASS					3	10		2,3	CO1	PSO1
8	TORSION TEST ON MS AND CI					3	10		2,3	CO1, CO6	PSO1
9	MODULUS OF RUPTURE OF TIMBER					3	10		2,3	CO1, CO2	PSO1
10	MODULUS OF ELSTICITY OF TIMBER					3	10		2,3	CO1, CO2	PSO1

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: B.E.-Mechanical

PSO1 Apply fundamentals of design, thermo-fluids and production engineering knowledge for innovative and critical thinking, problem-solving and Experimental skills with integrity and inclusivity in professional engineering practice or business.

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PSO3 Develop leadership and collaborative roles in their careers.

Programme Outcome (PO)

PO1 Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering			Academic Year			2023-24				
B. E. (Mechanical Engineering): Regular Programme												
Year	II	Core / Elective / Foundation MEC1311CS: Production Technology - I			Credits / Hours per week			Lectures: 04 Practicals: 02				
Semester	I	Year of Introduction: 2023			Maximum Marks / Grade			Theory: 100 PR/TW/VIVA: 50				
Mode of Transaction: Lectures and Lab exercises												
Course Outcome (CO) MEC1311CS												
CO-01 To understand Iron-carbon phase diagram and heat treatment of plain carbon steels, resulting microstructures.												
CO-02 To study foundry technology and fundamentals of casting process.												
CO-03 To understand welding and allied processes, their applications and practices.												
CO-04 To know principles of common Non-destructive Testing techniques, understand working and applications.												
CO-05 To study commonly used coatings and their applications.												
Unit No.	Topic				Contact Hours	Weightage (%)	BT Level	CO	PSO	Employability (Emp)/ Entrepreneurs hip (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/ Global (G)	Relation to Gender (G), Environ ment and Sustainab ility (ES), Human Values (HV)and Professio nal Ethics (PE)
1	Metallic materials: ferrous and non-ferrous, Plain carbon steels and alloy steels. Iron-Iron carbide equilibrium diagram:				14	23	1, 2, 3	CO1	PSO1	Emp Ent	L N	ES PE

	Allotropy of iron, Phases and reactions in Iron-Carbon diagram and resulting microstructures. Plain carbon steels, types. Cast iron, types, microstructures and properties. Heat treatment of plain carbon steels T-T-T and C-C-T diagrams, Transformations, Thermal cycles and resulting structures. Annealing, types, Normalizing, Hardening, Tempering, martempering and austempering.						SD	R G	
2	Foundry technology and Casting processes Furnaces used in foundry. Sand casting, steps, patterns and its, sand mould, cores, coreprints and chaplets. Gating systems and risering, Metal fluidity, Directional solidifications and metallurgical considerations, Casting defects. Investment casting, centrifugal and continuous casting, Die casting and squeeze casting.	18	30	2,3,4	CO2	PSO1			
3	Welding, Soldering and Brazing Metallurgical joining processes and classification. Fusion welding processes: Gas welding and cutting, principles, equipment and accessories, Types of flames, welding and cutting torches. Principle of arc welding, SMAW, equipment, electrodes, designations and selection, FCAW, TIG and MIG welding processes. Submerged arc welding. Welded joints and joint preparations. PAW, LBW, EBW and Thermit welding processes and their applications. Resistance welding processes, principles, types, applications. Friction welding, Stud welding, Ultrasonic and explosive welding, Friction stir welding processes. Weldability, basic welding metallurgy, welding defects, Welding symbols, Inspection and testing of welded joints. Introduction to welding codes, standards. Welding procedure.	20	33	1,2,3,4	CO3	PSO1			
4	Non Destructive Testing Liquid dye penetrant, Magnetic particle testing, Radiography, Eddy current and ultrasonic testing, principles and applications.	04	7	2,3,5	CO4	PSO1			
5	Coating processes Requirement, classifications, applications. Electroplating and electro less plating, Galvanizing and Anodizing. Thin film coating. PVD and CVD processes, Thick coating, Thermal spray process.	04	7	2,3,4	CO5	PSO1			
	Total	60	100						

Lab exercises list (Study exercises/Performance experiments)									
1.	Study of Iron-Carbon diagram - Phases, reactions and resulting microstructures.	02					Emp Ent SD	L N R G	ES PE
2.	Study of various Heat treatment processes for plain carbon steel and their applications.	02							
3.	Study of types of patterns and applications, molding sand properties, sand testing.	02							
4.	Sand casting mold preparation, elements of sand mold.	02							
5.	Study of Casting process, Risers, gating, Metal fluidity, fluidity test.	02							
6.	Study/practice of Gas welding, types of flames and gas cutting process.	02							
7.	Study and practice of Arc welding process.	02							
8.	SMAW Electrodes, understanding designation and selection	02							
9.	Study of Welded joints, Welding symbols	02							
10.	Study of resistance welding processes.	02							
11.	Welding defects, Welding inspection and testing of welded joints	02							
12.	Introduction to Welding codes and standards, Welder qualification, Welding procedure specification.	02							
13.	Study of coating processes overview, their characteristics and specific applications	02							
	Total	26	100						
Reference Books									
1	William D. Callister, Jr., David G. Rethwisch., “Materials Science and Engineering An Introduction”, John Wiley & Sons								
2	Donald R. Askeland, Donald R, Phule, Pradeep P, “The Science and Engineering of Materials”, Cengage Learning								
3	Kalpakjian S. And Steven S. Schmid, “Manufacturing processes for Engineering Materials”, Pearson Education India Edition.								
4	HajraChoudhury S.K., HajraChoudhury A.K. and Nirjhar Roy S.K., “Elements of Workshop Technology”, Vol. I, Media promoters and publishers private limited, Mumbai.								
5.	Rao P.N., “Manufacturing Technology”, Vol. I (Foundry, Forming and Welding), TataMcGrawHill.								
6.	RW Heine, CR Loper and PC Rosenthal Principles of Metal Casting, Tata-McGraw Hill.								
7.	A. Ghosh and A.K. Mallik Manufacturing Science, East West Press.								
8.	Parmar, R. S., “ <i>Welding Processes and Technology</i> ”, 3rd edition, Khanna Publishers								
9.	Houldcroft, Peter, “Welding Process Technology”, Cambridge University Press.								
10.	Cary, Howard B., Helzer, Scott, “Modern Welding Technology”, Pearson.								

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: B.E.-Mechanical

PSO1 Apply fundamentals of design, thermo-fluids and production engineering knowledge for innovative and critical thinking, problem-solving and Experimental skills with integrity and inclusivity in professional engineering practice or business.

PSO2 Achieve further career development through graduate education, professional development courses and/or on-the-job training and experience.

PSO3 Develop leadership and collaborative roles in their careers.

Programme Outcome (PO)

PO1 Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Problem Analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Design/development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 Modern Tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6 The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Syllabus of Courses

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering		Academic Year		2023-24				
		B. E. (Mechanical Engineering): Regular Programme								
Year	II	Core / Elective / Foundation MEC1312CS: Theory of Machines - I		Credits / Hours per week		Lectures: 04 Practicals: 02				
Semester	I	Year of Introduction: Year of Syllabus Revision:		Maximum Marks / Grade		Theory: 100 PR/TW/VIVA: 50				
Mode of Transaction: Lectures and Practicals										
Course Outcome (CO) MEC1312CS										
CO1 Understand different mechanisms used in real life application.										
CO2 Analyze velocity and acceleration of mechanisms.										
CO3 Synthesis mechanisms for particular application.										
CO4 Understand power transmission arrangement for different orientation, speed, torque and application.										
CO5 Understand and Analyze friction and utilizing it for engineering application.										
Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PSO	PO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/ Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)

1	Introduction to Mechanisms and Machines Kinematics and dynamics of machines; Kinematic pairs and chains in planer mechanism; Degree of freedom and Mobility criterion; Inversions of mechanisms; Straight-line, Pantograph, Steering and Universal joint mechanisms; Transmission angle and Mechanical advantage.	06	13	1, 2, 3	CO1	PSO1	PO1, PO12, PO5			
2	Analysis of Mechanisms Position, Displacement, Velocity and Acceleration analysis by graphical and analytical techniques.	11	16	2, 3, 4	CO2	PSO1	PO1, PO2, PO3			
3	Synthesis of Mechanisms Dimensional synthesis of four-links and crank-slider mechanism for motion; Path and function generation by graphical and analytical methods; Chebychev spacing and Freudenstein's equation for two and three position synthesis for function generation.	11	16	3, 4, 6	CO3	PSO1	PO3, PO5			
4	Cams and Cam Dynamics Types of cams and followers; Synthesis of profiles; Kinematics and Dynamics of Cam and Followers.	06	14	1, 2, 4	CO3	PSO1	PO1, PO3, PO4			
5	Gears and Gear Trains Law of gearing; Tooth profiles and Terminologies; Contact ratio; Interference and Undercutting; Spur, Helical, Bevel and Worm gears; Simple, Compound, Reverted and Epicyclic Gear Trains.	14	22	1, 2, 3, 5	CO4	PSO1	PO1, PO4, PO5, PO12			
6	Friction Friction in kinematic pairs; Friction Belt Drives; Thrust Bearings; Brakes, Dynamometers and Clutches.	12	19	2, 3, 5	CO5	PSO1	PO1, PO2, PO3			
Experiments										
1.	Inversion of four-bar chain, single slider crank and double slider crank mechanism	04	10	1, 2, 3	CO1	PSO1	PO3			
2.	To find co-efficient of friction between metallic surfaces using oscillating motion	02	9	3, 4	CO5	PSO1	PO2			
3.	To find out mass moment of inertia of connecting rod using compound pendulum method	02	9	3, 4	CO4	PSO1	PO2			
4.	To find out mass moment of inertia of connecting rod using bifilar suspension method	02	9	3, 4	CO4	PSO1	PO2			

5.	Verification of mass moment of inertia of connecting rod using tri-filler pendulum method	02	9	3, 4	CO4	PSO1	PO1			
6.	To generate Gear Profiles	04	12	2, 3	CO4	PSO1	PO2			
7.	To analyze velocities in the mechanisms graphically.	02	9		CO1	PSO1	PO5			
8.	To analyze acceleration in the mechanism graphically.	04	12	4, 5	CO2	PSO1	PO5			
9.	To synthesize and draw Cam profile	04	9	4, 5	CO2	PSO1	PO5			
10.	To synthesize four bar mechanism for function generation	04	12	4, 5, 6	CO3	PSO1	PO5			

Reference Books

1.	Thomas, B., 'Theory of Machines', Pearson
2.	Uicker, J. J., 'Theory of Machines and Mechanisms', Oxford University Press
3.	Rattan, S. S., 'Theory of Machines', Tata McGraw Hill
4.	Myszka, D. H., 'Machines and Mechanisms', Prentice Hall

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: B.E.-Mechanical

PSO1 Apply fundamentals of design, thermo-fluids and production engineering knowledge for innovative and critical thinking, problem-solving and Experimental skills with integrity and inclusivity in professional engineering practice or business.

PSO2 Achieve further career development through graduate education, professional development courses and/or on-the-job training and experience.

PSO3 Develop leadership and collaborative roles in their careers.

Programme Outcome (PO)

PO1 Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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Syllabus of Courses

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering		Academic Year: 2023-24						
		B. E. (Mechanical Engineering): Regular Programme								
Year	II	Core / Elective / Foundation MEC1313CS: Thermal Engineering - I		Credits / Hours per week		Lectures: 04 Practical: 02				
Semester	I	Year of Introduction: Year of Syllabus Revision:		Maximum Marks / Grade		Theory: 100 PR/TW/VIVA: 50				
Mode of Transaction: Lectures and Practical										
COURSE OUTCOME (CO) MEC1313CS										
CO1 Understand and Remember basics of Boilers, types of Boilers and their working.										
CO2 Understand and Analyze Efficiency and performance of Boilers, Heat Balance Sheet, Boiler draught.										
CO3 Understand Concept of Engine, I C Engine and its components and terminology. Application of I C Engines, Understand Otto and Diesel cycles and Thermodynamic Analysis of I C Engines.										
CO4 Understand Concept of Positive displacement type of Compressors, Reciprocating Compressors, its working and thermodynamic Analysis.										
CO5 Understand various systems of I C Engines, Performance Analysis of I C Engines.										
Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PO	PSO	Elements of Employability (Emp)/Entrepreneurs hip (Ent)/Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)

1	Boilers: Classification, Cochran, Lancashire, Locomotive and Babcock and Wilcox boiler, Functioning of different mountings and accessories Equivalent evaporation and efficiency of boilers, Heat balance sheet and performance of Boilers, Types of boiler draughts, Height of chimney.	08	20	1,2	CO1 & CO2	PO1, PO2, PO3	PSO1			
2	Concept of power producing systems and power absorbing systems. Introduction of IC Engine, Basic components, and terminology of IC engines, working of four stroke/two stroke - petrol/diesel engine, classification, and application of IC engines.	04	5	2,3,4	CO3	PO1, PO2, PO3	PSO1			
3	Positive Displacement Compressors: Reciprocating Compressors, Various Parts, operations, work done during isothermal, polytropic & adiabatic compression process, PV diagram, Multistage compressors.	04	10	2,4	CO4	PO1, PO2, PO3	PSO1			
4	Analysis of Reciprocating Compressor: Isothermal, Volumetric and Mechanical efficiency, effect of clearance, condition for minimum work input, capacity control, actual indicator diagram. Single stage compressor, indicator diagram and power requirement, effect of clearance volume, volumetric efficiency, indicator diagram with and without clearance, effect of intercooling, power requirement, mean effective pressure.	08	15	2,4	CO4	PO1, PO2, PO3	PSO1			
5	Air standard Cycles and Actual Cycles of I C Engine: Assumptions, dissociation, comparison of different cycles, effect of operating variables, effect of time loss, heat loss and exhaust loss in Petrol and Diesel engines, valve and port timing diagrams, engine performance and emission parameters	06	15	2,4	CO5	PO1, PO2, PO4	PSO1			
6	Various systems of I C Engines: Fuels and its supply system for SI and CI engine, Important qualities of IC engine fuels, rating of fuels, Carburation, mixture requirement for different loads and speeds, simple carburetor and its working, types of carburetors, MPFI, types of injection systems in CI engine, fuel pumps and injectors, types of nozzles, spray formation,	08	15	2,4	CO5	PO1, PO2, PO3	PSO1			

	Ignition and Governing System, Battery and magneto ignition system, spark plug, firing order, quality, quantity & hit and miss governing, Cooling systems of I C Engines									
7	Combustion in SI and CI Engines: Stages of combustion in SI engines, abnormal combustion and knocking in SI engines, factors affecting knocking, effects of knocking, control of knocking, combustion chambers for SI engines, Stages of combustion in CI engines, detonation in C.I. engines, factors affecting detonation, controlling detonation	06	15	1,2,3	CO5	PO1, PO2, PO3	PSO1			
8	IC Engine Emission and their control: Air pollution due to IC engines, Euro I to VI norms, HC, CO and NOx emission, catalytic convertor	04	5	1,4,5	CO5	PO1, PO2, PO6 PO7	PSO1			
	Total	48	100%							
EXPERIMENTS										
1	Mountings and Accessories of the boilers	04	15	2,3	CO1	PO1 PO2	PSO1			
2	Cochran Boiler	02	10	2,3	CO1	PO1 PO2	PSO1			
3	Lancashire Boiler	02	10	2,3	CO1	PO1 PO2	PSO1			
4	Babcock and Wilcox Boiler	02	10	2,3	CO1	PO1 PO2	PSO1			
5	Internal Combustion Engine	04	15	2,3,4	CO1, CO2	PO1 PO2	PSO1			
6	Valve Timing Diagram	04	15	2,3,4	CO1, CO2	PO1 PO2	PSO1			
7	Reciprocating Air Compressor	04	15	2,3,4	CO1, CO2	PO1 PO2	PSO1			
8	Gas Producer	02	10	2,3	CO1	PO1 PO2	PSO1			
	Total	24	100%							

Reference Books

- (1) I C Engines by Mathur and Sharma Dhanpat rai Publication
- (2) Internal Combustion Engines by V Ganesan Tata McGraw Hills
- (3) Thermal Engineering by R K Rajput Laxmi Publications
- (4) Basic Engineering Thermodynamics by Rayner Joel by Pearson Education
- (5) A Course in Thermal Engineering by Domkundwar and Kothandaraman by Dhanpat rai Publication

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: B.E.-Mechanical

PSO1 Apply fundamentals of design, thermo-fluids and production engineering knowledge for innovative and critical thinking, problem-solving and Experimental skills with integrity and inclusivity in professional engineering practice or business.

PSO2 Achieve further career development through graduate education, professional development courses and/or on-the-job training and experience.

PSO3 Develop leadership and collaborative roles in their careers.

Programme Outcome (PO)

PO1 Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Problem Analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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PO4 Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 Modern Tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6 The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

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PO11 Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Syllabus of Courses

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Textile Engineering			Academic Year		2023-24					
B.E (Mechanical Engineering): Regular Program												
Year	II	Core / Elective/ Foundation ELE1424CS: <u>Elements of Mechatronics</u>		Credits / Hours per week		04 + 02						
Semester	VI	Year of Introduction: 2022 Year of Syllabus Revision:		Maximum Marks / Grade		100 + 50						
Mode of Transaction		Lectures and Tutorials										
Course Outcome (CO) ELE1424CS												
CO1 Explain feedback control systems and describe control of various machines												
CO2 Describe digital control of machines and interfacing with peripherals.												
CO3 Explain transducers, actuators and instrumentation systems.												
CO4 Illustrate industrial robots and its applications												
Unit No.	Topic			Contact Hours	Weightage (%)	BT Level	CO	PSO	PO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	Open-loop and closed-loop control systems. Mathematical modelling – transfer functions and state-space models. Control system components like servomotors, synchros, gyros, valves, gears etc and their models. Servomechanisms.			08	20	2,3,4	CO1, CO3	PSO1, PSO2	PO1,2,3,4,5			
2	AC and DC Drives : Introduction to drives, Various methods of speed control of DC motors, breaking methods of DC motors, introduction of			08	20	2,3	CO2 CO 1	PSO1, PSO2	PO1,2,3,4,5			

	AC motor drives, Various methods of speed control of AC motors, block diagram of advanced control of induction motor drives									
3	Microprocessor and controllers: Architecture of microcontroller, basic programming of microcontroller, interfacing of peripheral devices like ADC/DAC, LCD, Timers etc	08	20	2,3	CO1, CO2	PSO1, PSO2	PO1,2,3,4,5			
4	Transducers for measuring humidity, pressure, flow, temperature, force, displacement, current, voltage etc. PLC-based Data Acquisition Systems (DAS).	05	20	2,3	CO3, CO4	PSO1, PSO2	PO1,2,3,4,5			
5	PLC, its programming and PLC based Controller	08	10	2,3	CO3, CO2	PSO1, PSO2	PO1,2,3,4,5			
6	Industrial robots. Flexible versus hard Automation. Classification of robotic systems based on a geometry and applications. Basics of Kinematics, Dynamics, and Trajectory planning.	05	10	1,2,3	CO1, CO4	PSO1, PSO2	PO1,2,3,4,5			
Reference Books										
1.	'Instrumentation', by Rangan, Sharma and Mani									
2.	'Control Systems-Principles and Design', by M Gopal									
3.	'Robotics for Engineers', by YoramKoren									
4.	'Industrial Robotics', by: Groover, Weiss, Nagel Odrey									
5.	'PC-based Instrumentation', by N Mathivanan, PHI									
6.	'Programmable Logic Controllers', by D Petruzella, TMH									
7.	8 bit Microcontroller by Keneth J Ayala									
8.	The 8051 Microller and Embedded Systems by Mohammad Ali Mazidi & Mazidi									
9.	Microprocessor Architecture, Programming and Applications with the 8085, by Ramesh Gaonkar									
10	Electrical Drives by G. K. Dubey									

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: B E (Mechanical Engineering)

- PSO1 Apply fundamentals of design, thermo-fluids and production engineering knowledge for innovative and critical thinking, problem-solving and Experimental skills with integrity and inclusivity in professional engineering practice or business.
- PSO2 Achieve further career development through graduate education, professional development courses and/or on-the-job training and experience.
- PSO3 Develop leadership and collaborative roles in their careers.

Programme Outcomes (POs)

- PO1 Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO2 Problem Analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- PO3 Design/development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO4 Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- PO5 Modern Tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
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- PO10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
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- PO12 Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Syllabus of the Course

 सत्यं शिवं सुन्दरम्		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering.			Academic Year			2023-2024				
	B. E. (Mechanical Engineering): Regular Programme											
Year	II	Core / Elective / Foundation MEC1409CS : Machine Drawing			Credits / Hours per week			Lectures: 02 Practical/Lab: 02				
Semester	II in Mechanical Engineering	Year of Introduction: 2023 Year of Syllabus Revision:			Maximum Marks / Grade			Theory: 50 PR/TW/VIVA: 50				
Mode of Transaction: Lectures and Practical/Laboratory teaching												
Course Outcome (CO) MEC1409CS CO1 Observe, analyze and correlate two-dimensional (Orthographic views) and three dimensional (Isometric view) CO2 Make free-hand sketches and/or with instruments for presenting communicating mechanical engineering ideas. CO3 Create sectional views of various type for revealing details of projections. CO4 Learn dimensioning and tolerancing in production drawings based on functionality, selection of manufacturing process and procedure. CO5 Use of digital technology for making 2D-3D drawings.												
Un it No.	Topic			Contact Hours	Weigh tage (%)	BT Level	CO	PSO	PO	Elements of Employability (Emp)/ Entrepreneurs hip (Ent)/ Skill Development (SD)	Relevance to Local (L)/Nation al (N)/Region al(R)/Glob al (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)
1	Imagination of objects in 2 & 3 dimensions; missing lines & views in projections.			03	12	1, 2	CO1	PSO1	PO1	Emp, Ent, SD	L.N, R, G	G, ES, HV, PE
2	Intersection of solids and development of surfaces.			04	12	1, 2	CO1 CO2	PSO1 PSO2	PO2			
3	Presentation and interpretation of orthographic, isometric, & oblique projections and their full, half, offset, broken, revolved & removed sectional views.			04	14	3, 4	CO2 CO3	PSO1 PSO2	PO3			
4	Elements of production drawing. Parts and assembly of machine components views with sections, dimensioning, tolerancing & surface finish. Exploded view of assemblies.			04	14	2, 3, 4	CO2 CO3 CO4	PSO2	PO3, PO4			

5	Fits, Limits, and Tolerances: Types & selection of fits; Linear & angular dimensions. Deviations, Limits & Tolerances grades & selection.	03	10	2, 3	CO4	PSO1 PSO2	PO5			
6	Geometrical Dimensioning and Tolerancing (GD & T); Terminology & symbols; Datums, Maximum & Least Material conditions. Tolerance characteristics and modifiers, Achieving and confirming. Surface texture and symbols, relation with machining.	04	14	2, 4	CO4	PSO1 PSO2	PO6			
7	Study of machine components & assemblies. Parts and assembly drawing with schematics-sketches-symbols drawings with nomenclature of; Threaded fasteners and power screws, Rolling & sliding contact bearings, Shafts, hubs, keys, & couplings, Friction drives; flat, V, rope, & pulleys; Pipe fittings, valves & joints, Positive drives; spur, helical, bevel, & worm gears. Chain-sprocket & timing belt – pulley, Variable speed drives, reciprocating machine parts; piston, cylinder, valves, connecting rod, crank shaft,	04	12	3, 4	CO2 CO3	PSO1 PSO2 PSO3	PO9 PO10 PO12			
8	Introduction to software for 2D-3D drawing.	04	10	4, 5	CO5	PSO3				
Experiments										
1.	Missing lines and views in orthographic projections.	04	10	1,2	CO1		PO1	Emp, Ent, SD	L.N, R, G	G, ES, HV, PE
2.	Intersection of solids and development of surfaces	04	12	1, 2 ,6	CO3		PO1			
3.	Sectional drawings of orthographic & isometric projections	04	15	2,3,5	CO2		PO5			
4.	Surface texture and GD & T symbols	02	10	2,4,5	CO2		PO6			
5.	Sketches/Drawings of real Machine components with projections and sectional views	06	12	3,4,6	CO4		PO3			
6.	Part drawing with tolerances and surface texture	06	12	1,2,4	CO4		PO4			
7.	Assembly drawing and exploded views of assembly	06	15	1,2,6	CO4		PO2			
8.	Hands-on drafting software for 2D-3D drawing	04	14	4, 5, 6	CO5		PO6			
Reference Books										
1.	Bhatt, N.D., ‘Machine Drawing’, Charotar Publication									
2.	Shah, P. J., ‘Machine Drawing’, S. Chand & Co.									
3.	BIS SP 46 2003. ‘Engineering Drawing Practice for Schools & Colleges,									
4.	Puncochar D. E., ‘Interpretation of Geometric Dimensioning and Tolerancing’, Industrial Press New York									
5.	Madsen D. A., 'Engineering Drawing & Design', Cengage Learning									
6.	Henzold G., ‘Geometrical Dimensioning and Tolerancing for Design, Manufacturing and Inspection’, Butterworth-Heinemann									
7.	Engineering Drawing Practices - ASME Y14.100-2013									
8.	Lockhart S., ‘Tutorial Guide to AutoCAD’, SDC Publications									

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: B.E.-Mechanical

PSO1 Apply fundamentals of design, thermo-fluids and production engineering knowledge for innovative and critical thinking, problem-solving and Experimental skills with integrity and inclusivity in professional engineering practice or business.

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PO2 Problem Analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Design/development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 Modern Tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering			Academic Year			2023-24			
B. E. (Mechanical Engineering): Regular Programme											
Year	II	Core / Elective / Foundation MEC1410CS: Production Technology II		Credits / Hours per week			Lectures: 04 Practicals: 02				
Semester	II	Year of Introduction: 2023		Maximum Marks / Grade			Theory: 100 PR/TW/VIVA: 50				
Mode of Transaction: Lectures and Lab exercises											
Course Outcome (CO) MEC1410CS											
CO-01 To study General purpose machine tools and cutting tools. CO-02 To understand grinding and other finishing process, study grinding machines. CO-03 To understand Mechanics of metal cutting analyze cutting forces. CO-04 To study various types Jigs and Fixture, understand location and clamping. CO-05 To study various Press tools, their mechanisms, press operations and their applications.											
Unit No.	Topic			Contact Hours	Weightage (%)	BT Level	CO	PSO	Employability (Emp)/ Entrepreneurs hip (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/ Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	General Purpose Machine Tools: Classification of machining processes and machine tools.			30	50	1, 2, 3	CO1	PSO1	Emp	L	ES

	Lathe: Types, Construction, parts of lathe, mechanisms, accessories, cutting tools, work and tool holding, attachments, common operations, applications, Speed, feed & depth of cut, power, Taper turning and thread cutting on lathe. Capstan, turret lathe and automates: construction, operations, tool layout. Single point cutting tool: Tool geometry, tool designation systems as per standards, cutting tool materials, cutting fluids. Drilling machine: Drilling and allied operations, tools- Drills, reamers, taps. Twist drill geometry. Boring machine: boring and related operations Shaping, planing, and slotting machines: working principles, mechanisms and related operations. Milling machines: Types, construction, working. Types of milling, Tool and work holding, types of milling cutters, milling cutter geometry. Attachments, Indexing mechanism and dividing head. Broaching: Process, machines, applications, broaching tool geometry. Sawing: process, blades.						Ent SD	N R G	PE
2	Grinding machines: Grinding requirement, characteristics of process, Types of grinding machines, Grinding wheels, shapes, materials, bonds, specifications. Balancing, truing & dressing of grinding wheel. Super finishing processes: Requirement, Lapping, Honing, Polishing, Buffing, process mechanism and applications.	08	13	2,3,4	CO2	PSO1			
3	Mechanics of metal cutting: Orthogonal and oblique cutting, Chip formation, Types of chips, Cutting forces and measurement of forces, heat generation, Merchant's analysis, Machinability, Specific cutting energy, Tool wear and tool life, economics of cutting.	10	16	2,3,4	CO3	PSO1			
4	Jigs and Fixture: Location principle and methods to achieve, devices, diamond pin and morse taper, clamping. Jigs, Fixtures and types of fixtures.	04	7	2,3,4	CO4	PSO1			
5	Press tools and press operations:	08	14	2,3,4	CO5	PSO1			

	Press tool, types and mechanisms, various press operations and applications, Die set and related elements,punch-die clearance, types of dies, strip layout.								
	Total	60	100						
Lab exercises list (Study exercises/Performanceexperiments)									
1.	Study of Lathe, working mechanism, various parts, accessories and attachments.	02					Emp Ent SD	L N R G	ES PE
2.	Demonstration of various different operations on lathe and Job on lathe.	02							
3.	Study of turret lathe, parts, demonstration of job and tool layout	02							
4	Single spindle automate, understand cam controlled mechanism, job demonstration.	02							
5.	Study of Drilling machine, parts, related operations, Twist drill geometry.	02							
6.	Study of shaper, planer and slotting machines, their mechanisms andworking demonstration								
7.	Study of Milling machines, different types of milling cutters, indexing mechanism, demonstration of operationson milling machine	02							
8.	Study of Grinding machine and grinding wheels, understanding designation of grinding wheel, demonstration of surface grinding operation.	02							
9..	Study of single point cutting tools, tool geometry and designations, various types of cutting tool inserts.	02							
10.	Study on types of chips, cutting fluid, and tool wear.	02							
11.	Cutting forces, their measurement, merchant circle plot and related calculations.	02							
12.	Study of Jigs and fixtures, Design exercise for given job.	02							
13.	Study of press tools and various press operations.	02							
	Total	26	100						
Reference Books									
1	Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., “Elements of Workshop Technology”, Vol.II Media promoters and publishers private limited, Mumbai.								
2	Kalpakjian S. And Steven S. Schmid, “Manufacturing processes for Engineering Materials”, Pearson Education India Edition.								
3	Rao P.N., “Manufacturing Technology”, Vol. I &II Tata McGrawHill								

4	G. Boothroyd Fundamentals of Metal Machining and Machine Tools –, Taylor and Francis,
5.	A. Ghosh and A.K. Mallik Manufacturing Science , East West Press
6.	M. H. A. Kempster Introduction to Jig and Tool design Butterworth-Heinemann
7.	Joshi P.H, “Jigs& Fixtures”, Tata McGraw-Hill

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: B.E.-Mechanical

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Syllabus of Courses

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering		Academic Year		2023-24						
B. E. (Mechanical Engineering): Regular Programme												
Year	II	Core / Elective / Foundation MEC1411CS: Theory of Machines - II		Credits / Hours per week		Lectures: 04 Practicals: 02						
Semester	II	Year of Introduction: Year of Syllabus Revision: 2018		Maximum Marks / Grade		Theory: 100 PR/TW/VIVA: 50						
Mode of Transaction: Lectures and Practicals												
Course Outcome (CO) MEC1411CS												
CO1 Analyze static and dynamic forces. CO2 Analyze the effects of unbalanced masses. CO3 Analyze vibration and its effect in mechanical systems. CO4 Evaluate gyroscopic couple and using it for stability for different vehicles. CO5 Understand the need and working of governor												
Unit No.	Topic			Contact Hours	Weight age %	BT Level	CO	PSO	PO	Elements of Employ ability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	Static Force Analysis Graphical and analytical methods for static force analysis, principle of super position, method of virtual works, friction in mechanisms.			12	15	2, 3, 4	CO1	PSO1	PO1, PO12, PO5	Emp, Ent, SD	L,N,R,G	G, ES, HV, PE

2	Dynamic Force Analysis D’alembert principles, Graphical and analytical methods for dynamic force analysis.	12	15	2, 3, 4	CO1	PSO1	PO1, PO2, PO3			
3	Balancing Balancing of rotating masses, Static and dynamic balancing, Graphical and analytical methods, balancing of reciprocating masses, Balancing Machines.	12	15	2, 3, 4, 6	CO2	PSO1	PO1, PO2, PO3, PO5			
4	Vibrations Classification of vibrations, Terminology of vibrations, Undamped force vibration analysis; Equivalent spring, Dashpots and shaft length; Damped force Vibration; Logarithmic decrement; Forced vibrations; Vibration isolation and transmissibility; Whirling of shafts; Critical speed; Longitudinal and transverse vibration; Torsional vibration.	12	24	1, 2, 4, 5, 6	CO2, CO3	PSO1	PO1, PO3, PO4			
5	Gyroscope Gyroscopic couple, Gyroscopic effect on airplane and ship, Stability analysis of four wheel and two wheel vehicles, Gyroscopic ship stabilization.	06	13	2, 3, 4	CO4	PSO1	PO1, PO4, PO5, PO12			
6	Governors Type of governors, Terminology of governors, Watt governors, Porter governor, Proell governor, Inertia governor, Quality of governors.	06	13	1, 2, 3, 5	CO5	PSO1	PO1, PO2, PO3, PO12			
	Total	60	100							
	Experiments									
1.	To determine the natural frequency of free torsional vibration using single rotor system.	04	10	1, 2	CO3	PSO1	PO1	Emp, Ent, SD	L,N,R,G	G, ES, HV, PE
2.	To find node position of free torsional vibration for two rotor system.	02	10	1, 2, 3	CO3	PSO1	PO3			
3.	To find damping frequency of torsional vibration system.	02	10	3, 4	CO3	PSO1	PO2			
4.	To study speed variation of the driven shaft for Hook’s Joint.	02	10	3, 4	CO1	PSO1	PO2			
5.	To find whirling or critical speed or shaft.	02	10	3, 4	CO2, CO3	PSO1	PO1			
6.	To carry out the static balancing.	02	10	2, 3	CO1, CO2	PSO1	PO2			
7.	To carry out dynamic balancing.	04	10	2, 3	CO1, CO2	PSO1	PO1			

8.	Analyzing forces on machine graphically and numerically neglecting inertia effects.	06	10	1,2	CO1	PSO1	PO5			
9.	Analyzing forces on machine graphically and numerically considering inertia effects.	06	10	4, 5	CO2	PSO1	PO5			
	Total	30	100							

Reference Books

1.	Thomas, B., 'Theory of Machines', Pearson
2.	Uicker, J. J., 'Theory of Machines and Mechanisms', Oxford University Press
3.	Rattan, S. S., 'Theory of Machines', Tata McGraw Hill
4.	Myszka, D. H., 'Machines and Mechanisms', Prentice Hall

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: B.E.-Mechanical

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Syllabus of Courses

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering				Academic Year			2023-24		
	B. E. (Mechanical Engineering): Regular Programme									
Year	II MECH	Core / Elective / Foundation MEC1412CS:Fluid Mechanics		Credits / Hours per week				Lectures: 04 Practical:- 02		
Semester	IV	Year of Introduction: 2024 Year of Syllabus Revision:		Maximum Marks / Grade				Theory: 100 PR/TW/VIVA: 50		
Mode of Transaction: Lectures and Practical										
Course Outcome (CO) MEC1412CS CO1 Understand the basic concept of fluid mechanics. CO2 Understand statics, dynamics and various approaches to fluid mechanics. CO3 Correlate fundamentals of fluid mechanics with various mechanical systems. CO4 Understand fundamentals of internal and external flow. CO5 Understanding of Non-dimensional number and dimensional analysis										
Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PSO	PO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)

1	Fluids and Their Properties: Introduction of fluid, fluid classifications, hypothesis of continuum, Shear stress, fluid density, viscosity, surface tension, capillary effect, vapor pressure, cavitation, compressibility and the bulk modulus	05	10	1,2,3	CO1	PSO1	PO1, PO2, PO3, PO12	All	All	ES,PE
2	Fluid Statics: Types of Pressure, Pascal's law of pressure at a point, variation of pressure vertically in a fluid under gravity, equality of pressure at the same level in a static fluid, general equation for the variation of pressure due to gravity from a point to point in a static fluid, pressure and head, the hydrostatic paradox. Meta center, stability of floating body. Submerged bodies. Calculation of metacenter height. Stability analysis and applications.	07	15	1,2,3	CO1, CO2	PSO1	PO1, PO2, PO3, PO4			
3	Fluid Kinematics: Motion of Fluid: Different types of flow, frames of reference, analyzing fluid flow, motion of a fluid particle, acceleration of a fluid particle, discharge and mean velocity, continuity of flow, continuity equations for 2-D and 3-D flow in Cartesian coordinates of system.	06	15	1,2,3	CO1, CO2	PSO1	PO1, PO2, PO3, PO4			
4	Potential flow: Introduction, circulation and vorticity, Stream line, path line and streak lines and stream tube. Stream function and velocity potential function, differences and relation between them. Condition for irrotational flow, flow net, source and sink, doublet and vortex flow	05	10	1,2,3	CO1, CO2	PSO1	PO1, PO2, PO5, PO6			
5	Fluid dynamics: Surface and body forces –Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its applications	07	10	2,3,4	CO2, CO3	PSO1	PO1, PO2, PO3, PO4			
6	Closed conduit flow: Reynolds number and Reynold's experiment- Viscous fluid through circular pipe- Hagen Poiseuille formula. Darcy Weisbach equation- Moody diagram. Minor losses in pipes- pipes in series and pipes in parallel- total energy line- Hydraulic gradient and total energy lines, Pipes in series and parallel, Equivalent pipes, Siphon, power	07	15	2,3,4,5	CO2, CO4	PSO1	PO1, PO2, PO3, PO6			

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	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Textile Engineering					Academic Year		2025-26	
B.E. (ALL BRANCHES) and B. Architecture : Regular Programme									
Year	II	Core / Elective / Foundation FTE XXXX: Universal Human Values – II				Hours per week (L-T-P) & Credit 02-01-00, 03 Credits			
Semester	II	Year of Introduction: 2025 Year of Syllabus Revision: --				Maximum Marks / Grade 100			
Mode of Transaction		Lectures, Tutorials							
Course Outcome (CO)									
CO1: Understand and analyze the self, and surroundings i.e. family, society and nature									
CO2: Understand the responsibility in life and to handle problems with sustainable solutions while keeping human relationships and human nature in mind.									
CO3: Improvement in critical ability									
CO4: Improvement in commitment towards human values, human relationship and human society									
Unit No.	Topic/Unit	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G) developmental needs	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)

1	Introduction to Value Education	9	20%		CO1, CO2	----	Emp, Ent, SD	L, N, R, G	G, ES, HV, PE
2	Harmony in the Human Being	9	20%		CO2, CO3				
3	Harmony in the Family and Society	9	20%		CO2, CO3				
4	Harmony in the Nature/Existence	9	20%		CO3, CO4				
5	Implications of the Holistic Understanding	9	20%		CO3, CO4				

Reference Books:

1.	A foundation course in Human Values and Professional Ethics by R R Gaur, R. Ashthana and G P Bagaria, 2 nd and 3 rd Edition (2019 and 2023).
2.	Universal Human Values and Professional Ethics by Dr. Saroj Kumar, Prof. Sheenu Nayyer, Thakur Publication Pvt Ltd, (2020)
3	Rediscovering India - by Dharampal
4	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
5	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
6	Slow is Beautiful - Cecile Andrews
7	Economy of Permanence - J C Kumarappa
8	Bharat Mein Angreji Raj – Pandit Sunderlal
9	JeevanVidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, Amarkantak, 1999
10	Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11	India Wins Freedom - Maulana Abdul Kalam Azad
12	Vivekananda - Romain Rolland
13	Gandhi - Romain Rolland
14	Online Universal Human Values material of AICTE.

DEPARTMENT OF MECHANICAL
ENGINEERING FACULTY OF TECHNOLOGY
AND ENGINEERING THE M S UNIVERSITY OF
BARODA

UG TEACHING SCHEME

BE - CRS MECHANICAL ENGINEERING

BE-III CRS (MECHANICAL ENGINEERING)											
Semester	Sub Code Theory	Sub Code TW/Viva	Subject Name	Teaching Scheme				Examination Scheme			
				L	T	P	Credit	Theory		Practical	
								IA	UA	IA	UA
FS BE-III	MECXXXX	---	Institute Elective (Table 1)	3	0	0	3	30	70		
	MEC1508CS	MEC1508LCS	Measurements and Metrology	4	0	2	5	30	70		50
	MEC1504CS	MEC1504LCS	Industrial Engineering-I	4	0	2	5	30	70		50
	MEC1503CS	MEC1503LCS	Design of Machine Elements-I	4	0	2	5	30	70		50
	MEC1502CS	MEC1502LCS	Heat and Mass Transfer	4	0	2	5	30	70		50
	MECXXXX	----	Elective 1 (Table 2)	3	1	0	4	30	70		
Total (Semester 5)				22	1	8	27	180	420		200
SS BE-III	MEC1601CS	MEC1601LCS	Design of Machine Elements-II	4	0	2	5	30	70		50
	MEC1602CS	---	Industrial Engineering-II	4	0	0	4	30	70		
	MEC1603CS	MEC1603LCS	Thermal Engineering-II	4	0	2	5	30	70		50
	MEC1609CS	MEC1609LCS	Production Technology-III	4	0	2	5	30	70		50
	MEC1614CS	MEC1614LCS	Hydraulic Machines	4	0	2	5	30	70		50
Total (Semester 6)				20	0	8	24	150	350		200
TOTAL (YEAR 3)							51				1500

Table 1 Institute Elective	
Sub Code	Subject Name
ACH1581IECS	Chemistry for Engineers
APH1581IECS	Nanotechnology and its Applications
APH1582IECS	Space Technology
CSE1582IECS	Python Programming
WRE1581IECS	Water Conservation Concepts
ACH1582IECS	Chemistry for Materials

Table 2 Elective 1	
Sub Code	Subject Name
MEC1551DECS	Hydraulic and Pneumatic Systems
MEC1552DECS	Computational Fluid Dynamics
MEC1553DECS	Industrial Management and Engineering Economics
MEC1554DECS	Automobile Systems

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PO1 Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Problem Analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Design/development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 Modern Tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6 The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering			Academic Year			2024-25				
B. E. (Mechanical Engineering): Regular Programme												
Year	III	Core / Elective / Foundation MEC1508CS: Measurements and Metrology			Credits / Hours per week			Lectures: 04 Practicals: 02				
Semester	I	Year of Introduction: 2024			Maximum Marks / Grade			Theory: 100 PR/TW/VIVA: 50				
Mode of Transaction: Lectures and Practical												
Course Outcome (CO) MEC XXXX												
CO 01 Explain the basics knowledge of measurements, metrology and measuring devices. CO 02 Explain measurement systems of transducers, sensors, intermediate modifying devices, and associated parameters. CO 03 Describe methods of measurements for force, torque, pressure, flow, strain and temperature measuring devices. CO 04 Understand the principle and measurement methods of linear, angular and geometrical parameters measuring instruments CO 05 Describe measurement methods for gears, screw threads, surface finish and general purpose machine tools												
Unit No.	Topic				Contact Hours	Weight age (%)	BT Level	CO	PSO	Employability (Emp)/ Entrepreneurs hip (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/ Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	Fundamental of Mechanical Measurements: Significance of measurement, Fundamental and derived quantities and units, international standards, Primary, secondary and working standards.				04	7%	1,2,3	CO1		Emp Ent SD	L N R G	ES PE
2	Generalized Measurement Systems: (i)Sensors & Transduces: Elastic members, variable resistance, capacitance & inductance				08	13%	1,2,3,4	CO1, CO2	PSO1			

	(ii) Signal Conditioners: Amplifiers & attenuators, analog to digital and digital to analog conversion (iii) Displays, recorders and controllers: Analog, digital, CRT, LCD etc. Mass storage devices								
3	Performance Characteristics: Transducers: Static characteristics, sensitivity, reproducibility, linearity, stability etc. Instruments: Accuracy, precision, range, resolution, readability etc.	04	7%	1,2,3	CO1, CO2	PSO1			
4	Measurement Methods and Devices: (a) Strain measurement: Strain gauges, bridge circuit and gauge configuration, bridge output, temperature compensation, orientation of strain gauges for force and torque (b) Force, torque, speed measurement: Spring gauges and load cells, dynamometers, tachometers, stroboscope (c) Pressure measurement: Manometers, bourdon tube gauges, vacuum gauges, McLeod gauge, Pirani, Ionization gauges (d) Flow measurement: Rate and quantity flow meters, obstruction and positive displacement type, other types of flow meters (e) Temperature measurement: Fluid and solid expansion thermometers, resistance temperature detector, thermistors and thermocouples, thermocouple laws, optical and radiation pyrometers (f) Sound and Vibration: microphones and accelerometers (g) Miscellaneous: level, turbidity, viscosity, LVDT, Photoelectric transducer, Piezoelectric transducer	14	23%	1,2,3,4	CO1, CO3	PSO1			
5	Basics of Metrology: Introduction to Metrology, Need for Inspection, Methods and Errors in Measurement, Calibration, Concept of Interchangeability, selective assembly, Standards and requirements of metrology laboratory.	3	5%	1,2,3	CO1	PSO1			
6	Linear, Angular and geometrical parameters Measurement: (a) Limit gauges: design of Limit gauges, Taylor's principle of gauge design. Measurement of large internal diameters and external radius. (b) Linear measurement:	14	23%	1,2,3,4	CO1, CO4				

	Vernier and micrometer instruments, Slip gauges, Length bars, precision balls. (c) Angular measurement: Bevel protector, angle gauges, Principle of Sine bars, Sine Centers, Sine table. Precision level, Clinometers. Auto Collimator, Precision polygons. (d) Comparators: Principles, applications and Types, Mechanical, Optical, Electrical and Pneumatic comparators. (e) Interferometry: Principle of Interferometry, Flatness testing by interferometry. (f) Measurement of Straightness, Flatness and Circularity, Modern roundness testers and their capabilities.								
7	Metrology of Gears, screw threads and surface finish and measuring machines (a) Measurement of Surface Roughness: Terminologies, surface profiles and filters, Numerical values to surface roughness, Machining process capabilities and symbols, Standards for roughness evaluation, Surface roughness assessment methods, Comparative methods, Direct instrument Measurement, 2D contact instruments, Profilometer, 3D surface roughness parameters, 3D areal measurement methods (Contact & non-contact). (b) Measurement of Gear: Errors in Gears, Gear Tooth Vernier & Micrometer, Composite Error Testing of Gears. (c) Measurement of Screw Thread: Errors in Screw Threads, Screw Thread Micrometer, Two & Three Wire System of Measurement, Best size wire. (d) Machine Vision & its Applications in Metrology. (e) Co-ordinate Measuring Machines: Types, Applications, Principle, Probing system, Error involved, calculations.	11	18%	1,2,3,4	CO1, CO5				
8	Machine tool testing: Standards, procedures, and acceptance tests for Lathe, Drilling and Milling machines.	2	4%	1,2,3	CO1, CO5				
	Total	60	100						

Reference Books:	
1	Engineering Metrology and Measurement, N V Raghavendra and Krishnamurthy, Oxford University Press
2	Engineering Metrology and Measurements, Bentley, Pearson Education
3	Mechanical Measurement and Metrology by R K Jain, Khanna Publisher
4	Metrology for Engineers, Gayler and Shotbolt.
5.	Engineering Metrology, Gupta I.C., Dhanpat Rai Publications
6.	Indian standards: TEST CODE FOR MACHINE TOOLS PART 1 IS 2063 (Part 1) :2002

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: B E (Mechanical Engineering)

PSO1 Apply fundamentals of design, thermo-fluids and production engineering knowledge for innovative and critical thinking, problem-solving and experimental skills with integrity and inclusivity in professional engineering practice or business.

PSO2 Achieve further career development through graduate education, professional development courses and/or on-the-job training and experience.

PSO3 Develop leadership and collaborative roles in their careers.

Programme Outcomes (POs)

PO1 Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Problem Analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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PO4 Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 Modern Tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6 The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

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Syllabus of Courses

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering			Academic Year	2024-25
	B. E. (Mechanical Engineering): Regular Programme				
Year	III	Core / Elective / Foundation MEC1504CS:Industrial Engineering -1		Credits / Hours per week	Lectures : 04 Practical : 02
Semester	I	Year of Introduction: 1960 Year of Syllabus Revision:2024		Maximum Marks / Grade	Theory: 100 PR/TW/VIVA: 50
Mode of Transaction: Lectures and Practicals					
Course Outcome (CO) MEC XXXX CO1 Understanding concept of productivity and method study CO2 Understanding work measurement and ergonomics. CO3 Discussing plant layout, plant location and material handling. CO4 Discussing importance of plant maintenance, human safety in industry & occupational health. CO5 Discussing industrial legislation and value engineering.					

Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PSO	PO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/ Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)
1	Introduction to Industrial Engineering: Scope, history, Functions, Applications, Productivity, Importance, measurement, Productivity Index, Means of increasing productivity, Factors affecting, Reducing work content, management techniques, Japanese approach for Productivity enhancement.	07	12	1, 2, 3	CO1	PSO 1	PO1, PO5	ALL	ALL	ALL
2	Method Study: Basic procedures/steps; Process Chart: Recording techniques, Various information depicted & inferences, Operation process, Flow Process, Flow diagrams, String diagrams, Travel chart, Gang Process, Two Handed, SIMO, Multiple Activity Chart, Man & Machine Chart; Micro motion & Memo Motion study: Therbligs, Principles of motion economy, Design of work station, Photographic techniques needed in work simplification, Cyclograph & Chronocycle graph.	08	14	1,2,3,6	CO1	PSO3	PO1			

3	Work Measurement: Work measurement Techniques, Procedure, Equipments; Time study forms, Allowances, Performance Rating, Various techniques of rating (Westing house method, synthetic rating method, etc), Estimation of standard time, Work Sampling, Predetermined Motion Time & Systems (PMTS), Method Time Measurement (MTM), Synthesis of work study data, Use of time study data in wage incentives.	08	14	1,2,3,5	CO2	PSO 3	PO1			
4	Ergonomics: Definition & Concept, Objectives, Areas Covered, Systems approach of ergonomics model; Man machine system: Characteristics; Man Vs machine; Work capabilities of industrial worker, Control members: Types of Displays, Location (shape & size, coding & control size etc.), Ergonomic design consideration; Anthropometry functional anatomy data; Working environment (Light, Humidity, Fatigue, Noise, Thermal Conditions, Radiation etc.).	07	10	1,2,3	CO2	PSO2	PO1, PO3,			
5	Plant Location and Plant Layout: Importance, Factors for selection; Plant Layout: Objectives, Principles, Types, Advantages & Limitations, Effects of automation, Symptoms of bad layout; Types of flow (I, S, O, U etc.); Factory Building: Types, Single storey Vs Multistorey type of construction.	07	12	1,2,3	CO3	PSO 2	PO1			
6	Material Handling: Introduction, Functions, Factors, Principles, Equipment, Selection of material handling Equipment; Relationship to Plant Layout; Warehousing & distribution.	07	12	1,2, 3	CO3	PSO 2	PO1			

7	Plant Maintenance and Replacement: Types (Corrective, Preventive, Predictive, Scheduled etc.) Scope, Advantages, Planning & scheduling; Total Productive Maintenance (evolution of TPM), Basic concept of TPM, Various losses, MAPI Method.	06	10	1,2,3,5	CO4	PSO 2	PO1			
8	Industrial Safety and Occupational Health: Introduction, Legal & social aspects, Accidents & accident prevention; Health: Occupational health & Industrial hygiene.	04	08	1,2,3	CO4	PSO 3	PO1, PO8, PO12			
9	Industry and Legislation: Necessity, Features & Provisions of various Acts, Indian Factories Act, Industrial Disputes and Trade Union.	03	04	1,2,3	CO5	PSO 3	PO1			
10.	Value Engineering: Introduction, Types of Value, Value Engineering Job Plan, Phases of Job Plan, Function Analysis and FAST Diagram.	03	04	1,2,3	CO5	PSO 3	PO1			
		60	100							
	Experiments									
1	Pin board Study	02	16	1,2,3	CO1, CO2	PSO2	PO1, PO9	ALL	ALL	ALL
2	Normal & maximum working area	02	10	1,2,3	CO1	PSO2	PO1, PO9			
3	'Pressure' & 'Hook' grasp	04	16	1,2,3	CO1, CO2	PSO2	PO1, PO9			

4	Assembly of bolt, washer & nut	04	16	1,2,3	CO1, CO2	PSO2	PO1, PO9			
5	Rating study of walking	02	07	1,2,3	CO1, CO2	PSO2	PO1,			
6	Study of different charts	02	07	1,2,3	CO1	PSO1	PO1			
7	Study of material handling & warehouses	02	07	1,2,3	CO3	Pso1	PO1			
8	Study of industrial safety & occupational health	02	07	1,2,3	CO4	PSO1	PO7			
9	Study of plant layout & location	03	07	1,2,3	CO3	PSO1	PO1			
10	Value Engineering exercise	03	07	1,2,3	CO5	PSO3	PO1			
		26	100							

Text & Reference Books

1	Introduction to work study	Edited by George Knawaty, ILO Geneva
2	Motion & Time study	Benjamin W. Niebel, R. D. Irwblications
3	Motion & Time study: Design and Measurement of Work	Ralph M. Barnes, John Wiley & Sons
4	Facilities Planning; Tompkins, James A., White, John A., Bozer, Yavuz A., and Tanchoco, J. M. A.	John Wiley & Sons
5	Introduction to Ergonomics; R. S. Bridger; McGraw Hill	
6	Human Factors in Engineering and Design; Mark S. Sanders, Ernest J. McCormick; McGraw Hill	

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Program Name: B E (Mechanical Engineering)

Program Specific Outcome (PSO)

PSO1: Apply fundamentals of design, thermo-fluids and production engineering knowledge for innovative and critical thinking, problem-solving and experimental skills with integrity and inclusivity in professional engineering practice or business.

PSO2: Achieve further career development through graduate education, professional development courses and/or on-the-job training and experience.

PSO3: Develop leadership and collaborative roles in their careers.

Program Outcomes (POs)

- PO1 Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO2 Problem Analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
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Syllabus of Courses

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering				Academic Year				2024-25		
B. E. (Mechanical Engineering): Regular Program												
Year	III	MEC1503CS: Design of Machine Elements - I				Credits / Hours per week				Lectures: 04 Practical:- 02		
Semester	I	Year of Introduction: 1960 Year of Syllabus Revision: 2005, 2012, 2018, 2021				Maximum Marks / Grade				Theory: 100 PR/TW/VIVA: 50		
Mode of Transaction: Lectures and Practical												
Course Outcome (CO) MEC xxxx CO 1 Review of basics of mechanics, materials, manufacturing & considerations for design of machine components applications. CO 2 Understanding functional analysis, geometry required, failure modes, and force & stress for synthesis of dimensions. CO 3 Analyzing and solving simple design problems like mechanical joining of parts; selection basis and finding critical dimensions. CO 4 Evaluation of designs involving more parts; shafts and related components viz. bearings, hubs, keys, and couplings. CO 5 Understanding various springs types & design, selecting, calculating dimensions, and building modules for applications.												
Unit No.	Topic			Contact Hours	Weightage (%)	BT Level	CO	PO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)
1	Machine elements basics:Machines & components; General design procedure and considerations; Functional geometries, dimensions, materials of construction; standards & codes; Manufacturing & assembly criteria.			12	20	1, 2, 3, 4, 5	1	1, 2, 3, 5, 9, 12	1, 2, 3	Emp, Ent, SD	L, N, R, G	G, ES, HV, PE
2	Failure prevention: Failure modes; Strength & stiffness of parts against static & dynamic loading; Offset & curved beams; Factor of safety; Theories of static and fatigue failures.			12	20	1, 2, 3, 4, 5, 6	2	1, 2, 3, 4, 5, 9, 12	1, 2, 3			
3	Mechanically joined elements: Joining by pin, bolt, and weld; Threaded fasteners and power screws. Specialty fasteners and Adhesives.			12	20	1, 2, 3, 4, 5, 6	3	1, 2, 3, 4, 5, 9, 12	1, 2, 3			
4	Shafts & related components: Power transmission shafts, axles, and spindles; Sliding and rolling contact bearings; Lubrication; Hub-shaft locking: keys, splines, and keyless; Couplings.			14	23	1, 2, 3, 4, 5, 6	4	1, 2, 3, 4, 5, 9, 12	1, 2, 3			

5	Springs: Helical compression, tension, and torsion springs; Spiral, leaf, disk, and specialty springs. Application techniques.	10	17	1, 2, 3, 4, 5, 6	5	1, 2, 3, 4, 5, 9, 12	1, 2, 3			
		60	100							

Course Outcome (CO-L) MEC xxxxL FOR LABORATORY

xxxxL.01 Understanding and making drawings of parts and assemblies of simple devices.

xxxxL.02 Qualitative analysis, considerations, & synthesis for general shapes of components for functionality and selection of material of construction.

xxxxL.03 Quantitative analysis & synthesis of component dimensions to prevent failure using strength equations and properties of construction material.

xxxxL.04 Analysis of devices around and components involved in.

Experiments

Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO-L	PO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)
1.	Drawing sheets on parts and assembly of a simple devices/assemblies	4	13	1, 2, 3, 5	1, 4	1, 2, 9, 12	1, 2, 3	Emp, Ent, SD	L, N, R, G	G, ES, HV, PE
2.	Design of pin jointed links: Sketches, calculations and drawing on sheet	6	20	All	1, 2, 3, 4	1, 2, 3, 4, 5, 9, 12	1, 2, 3			
3.	Design of a jacking devices: Sketch, calculations and drawing on sheet	8	27	All	1, 2, 3, 4	1, 2, 3, 4, 5, 9, 12	1, 2, 3			
4.	ICT based learning and reporting of various machine components	6	20	All	1, 2, 3, 4	1, 2, 3, 4, 5, 9, 12	1, 2, 3			
5.	Extended assignments on component design in small groups	6	20	All	1, 2, 3, 4	1, 2, 3, 4, 5, 9, 12	1, 2, 3			
		30	100							

Reference Books

1.	Budynas R. G., 'Shigley's Mechanical Engineering Design,' McGraw-Hill
2.	Collins J. A., 'Mechanical Design of Machine Elements and Machines,' Wiley
3.	Norton R. L., 'Machine Design, An Integrated Approach', Pearson
4.	Schmidt S. R., 'Fundamentals of Machine Elements', CRC Press
5	Bhandari V. B., 'Machine Design,' McGraw-Hill

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	--	--	--	2	--	--	3	3	1	1
CO2	3	3	3	2	3	--	--	--	1	--	--	3	3	2	1
CO3	3	3	3	3	3	--	--	--	1	--	--	3	3	2	1
CO4	3	3	3	3	3	--	--	--	2	--	--	3	3	2	1
CO5	3	3	3	3	3	--	--	--	1	--	--	3	3	2	1

3 – Most

2 – Medium

1 - Less

CO	PO	Weightage	Justification
1	1	3	Application of engineering basics for the design of machine elements
1	2	2	Identification and formulation of design problems at moderate level
1	3	2	Developing solutions of design problems at moderate level
1	4	2	Understanding design considerations for real-world machine elements
1	5	3	Use of internet-based resources related to the topic for similar & beyond classroom & laboratory transactions, spreadsheets for calculations.
1	9	2	Preparing students for both individual and teamwork ready at medium level
1	12	3	Teaching methodology aims for lifelong learning
2	1	3	Application of engineering basics for the design of machine elements
2	2	3	Identification and formulation of design problems at moderate level
2	3	3	Developing solutions of design problems at moderate level
2	4	2	Understanding design considerations for real-world machine elements
2	5	3	Use of internet-based resources related to the topic for similar & beyond classroom & laboratory transactions, spreadsheets for calculations.
2	9	1	Preparing students for both individual and teamwork ready at medium level
2	12	3	Teaching methodology aims for lifelong learning
3	1	3	Application of engineering basics for the design of machine elements
3	2	3	
3	3	3	Developing solutions of design problems at moderate level
3	4	3	Understanding design considerations for real-world machine elements
3	5	3	Use of internet based resources related to the topic for similar & beyond classroom & laboratory transactions, spreadsheets for calculations.
3	9	1	Preparing students for both individual and teamwork ready at medium level
3	12	3	Teaching methodology aims for lifelong learning
4	1	3	Application of engineering basics for the design of machine elements
4	2	3	Identification and formulation of design problems at moderate level
4	3	3	Developing solutions of design problems at moderate level
4	4	3	Understanding design considerations for real-world machine elements
4	5	3	Use of internet-based resources related to the topic for similar & beyond classroom & laboratory transactions, spreadsheets for calculations.
4	9	2	Preparing students for both individual and teamwork ready at medium level
4	12	3	Teaching methodology aims for lifelong learning
5	1	3	Application of engineering basics for the design of machine elements
5	2	3	Identification and formulation of design problems at moderate level
5	3	3	Developing solutions of design problems at moderate level

5	4	3	Understanding design considerations for real-world machine elements
5	5	3	Use of internet based resources related to the topic for similar & beyond classroom & laboratory transactions, spreadsheets for calculations.
5	9	1	Preparing students for both individual and teamwork ready at medium level
5	12	3	Teaching methodology aims for lifelong learning

CO	PSO	Weightage	Justification
1	1	3	Application of engineering basics for the design of machine elements
1	2	1	May develop useful futuristic technical learning
1	3	1	Limited to subject related lab exercises
2	1	3	Application of engineering basics for the design of machine elements
2	2	2	May develop useful futuristic technical learning
2	3	1	Limited to subject related lab exercises
3	1	3	Application of engineering basics for the design of machine elements
3	2	2	May develop useful futuristic technical learning
3	3	1	Limited to subject related lab exercises
4	1	3	Application of engineering basics for the design of machine elements
4	2	2	May develop useful futuristic technical learning
4	3	1	Limited to subject related lab exercises
5	1	3	Application of engineering basics for the design of machine elements
5	2	2	May develop useful futuristic technical learning
5	3	1	Limited to subject related lab exercises

Bloom's Taxonomy Levels:

1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: B E (Mechanical Engineering)

PSO1 Apply fundamentals of design, thermo-fluids and production engineering knowledge for innovative and critical thinking, problem-solving and Experimental skills with integrity and inclusivity in professional engineering practice or business.

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Syllabus of Courses

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering		Academic Year			2023-24		
B. E. (Mechanical Engineering): Regular Programme									
Year	III MECH	Core MEC1502CS: Heat and Mass Transfer		Credits / Hours per week			Lectures: 04 Practical:- 02		
Semester	I	Year of Introduction: 1960 Year of Syllabus Revision:2022		Maximum Marks / Grade			Theory: 100 PR/TW/VIVA: 50		
Mode of Transaction: Lectures and Practical									
Course Outcome (CO) MEC XXXX CO1. Understand the basic laws of heat transfer. CO2. Understand the fundamentals of different modes of heat transfer process. CO3. Analyze problems involving steady state as well as transient in nature for simple geometries. CO4. Obtain numerical solutions for different industrial heat transfer process. CO5. Evaluate thermal performance of different modes of heat transfer process.									
Unit No.	Topic		Contact Hours	Weightage (%)	BT Level	CO	PO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD) Relevance to Local (L)/ National (N)/ Regional(R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	Fundamentals of Heat Conduction: General Equation: Modes of heat transfer, conduction, convection and radiation, Fourier’s law of heat conduction and thermal conductivity, General heat conduction equation (Unsteady three-dimensional heat conduction equation with generation) in Cartesian coordinates, thermal diffusivity, Reduction of general equation for various cases of unsteady and steady heat conduction with and without heat generation. General heat conduction equation in cylindrical and spherical coordinates.		05	09	1,2,3,	CO1,C O2,		Emp/Ent/SD	ES,HV,PE
2	Steady State Heat Conduction: One dimensional steady state heat conduction through simple or composite plane, cylindrical and spherical walls with uniform non - uniform thermal conductivity without heat		08	14	2,4,5,	CO1,C O2		Emp/Ent/SD	

	generation, Thermal contact resistance, one dimensional steady state, heat conduction in plane, cylindrical and spherical bodies with heat generation. Heat transfer between fluids separated by simple or composite plane, cylindrical and spherical walls, Overall heat transfer coefficient, heat insulation, materials for heat insulation, critical thickness of insulation on cylindrical and spherical systems, extended surfaces- Fins, types of fins, heat transfer from straight fin of uniform cross section, effectiveness and efficiency of fins.							
3	Unsteady State Heat Conduction: Unsteady state heat conduction process, Heating or cooling with known temperature distribution, unsteady state system with negligible internal thermal resistance (Lumped heat capacity analysis). Transient heat conduction in bodies with finite internal and surface resistance.	04	07	2,3	CO3,C O4		Emp/Ent/SD	
4	Radiation: Electromagnetic spectrum and thermal radiation, Absorptivity, Reflectivity and Transitivity, Black, white, transparent and opaque bodies, specular diffuse reflection, Emissive power, Monochromatic emissive power, Planck's law Wien's displacement law, Stefan-Boltzmann's law, Emissivity, Monochromatic emissivity, Gray Body, Kirchhoff's law, solid angle and radiation intensity, Lambert's cosine law, heat exchange by radiation between two infinite parallel surfaces, two infinitely long concentric cylinders, and two concentric spheres, Heat exchange by radiation between two finite surfaces, shape factor and its properties, Radiation shields. Heat exchange by radiation between three gray finite surfaces.	09	16	2,5	CO4,C O5		Emp/Ent/SD	
5	Diffusion Mass Transfer: Mass transfer process, classification of mass transfer operations, Molecular diffusion, Fick's law of diffusion, Molecular diffusion in solids, liquids and gases, Diffusion in binary gas mixtures, Equimolar counter diffusion in gases,	02	04	5,6	CO4, CO5		Emp/Ent/SD	
6	Fundamentals of Convective Heat and Mass Transfer Introduction to convective heat transfer, Boundary layer theory and types, heat transfer coefficient, friction coefficient, mass transfer coefficient, Reynolds number and flow regimes, Boundary layer governing equations, non-dimensionalization of BL governing equations, functional form of these equations, non-dimensional numbers and their physical significance, Heat and momentum transfer analogies	04	07	1, 2	CO1	PO1, PO2, PO3		

7	Forced Convective Heat and Mass Transfer: External Flow: Method to derive empirical correlations, Correlations for Friction Coefficient and Nusselt number: laminar, turbulent and mixed flow boundary layer over a flat plate as well as cylinder and sphere, analogy between convective heat transfer and mass transfer. Internal Flow: Hydrodynamic entry length and fully developed flow in case of internal flow, Mean velocity, Moody's and Fanning friction factor and correlations, Moody's chart Thermal boundary layer development in internal flow, mean temperature, constant surface heat flux and surface temperature boundary conditions, log mean temperature difference (LMTD), Nusselt number correlations for fully developed laminar flow and turbulent flow, Flow through non-circular geometry	12	21	2, 3, 4, 5	CO2	PO1, PO2, PO3			
8	Natural (Free) Convection Governing equation for laminar free convection on a vertical flat plate, non-dimensional numbers and flow regimes, Correlations for Nusselt number, Free convection over inclined plate, horizontal plate or cylinder-cold surface or hot surface	03	05	2, 3, 4, 5	CO3	PO1, PO2, PO3			
9	Heat Exchangers Classification, Overall heat transfer coefficient, Heat exchanger analysis for parallel and counter-flow: LMTD method, correction factor for cross-flow and shell and tube heat exchangers, Effectiveness-NTU method, Use of equations and charts for shell and tube as well as crossflow heat exchangers, plate-fin heat exchanger	06	11	2, 3, 4, 5, 6	CO4	PO1, PO2, PO3, PO4			
10	Boiling and Condensation Pool boiling and boiling curve, nucleate boiling correlations, Forced convection boiling regimes Condensation-physical mechanism, condensation over a vertical flat plate and flow regimes, condensation on cylinder surface, dropwise condensation: advantages and limitations	03	05	2, 3, 4, 5	CO5	PO1, PO2, PO3			

	Experiments									
1.	Experiment On Thermal Conductivity Of Oil	2	10	1	CO1,CO2,	PSO1, PSO2	PO1,PO2,PO3	All	All	ES, HV, PE
2.	Determination Of Thermal Conductivity Of Metallic Rod	2	10	1,2	CO2,CO3	PSO1, PSO2	PO3,PO4			
3.	Thermal Conductivity Of Powder Material	2	10	2	CO1,CO2,	PSO1, PSO2	PO1,PO2,PO3			
4.	Experiments With Thermal Radiation Using Electric Bulb	4	10	2	CO2,CO3	PSO1, PSO2	PO5			

5.	Determination Of Emissivity Of Metallic Material	2	10	1,2,3,4	CO3,CO4, CO5	PSO1, PSO2	PO2,PO3,			
6.	Heat Exchanger Analysis	4	10	3,4	CO1,CO2,	PSO1, PSO2	PO1,PO2,PO3			
7.	Predicting Nature Convection Heat Transfer Coefficient Using Condensation Of Steam	2	10	4,6	CO1,CO2,	PSO1, PSO 3	PO1,PO2,PO3			
8.	Natural Convection Experiment	4	10	2,1	CO4,CO5	PSO1, PSO 3	PO5			
9.	Pin Fin Analysis	2	10	2,5	CO4, CO5	PSO1, PSO 3	PO2,PO3,PO5			
10.	Transient Convection	2	10	5	CO4,CO5, CO1,CO2	PSO1, PSO 3	PO2,PO4			
		26	100							
		Reference Books								
1.		Heat & Mass Transfer by P.K. Nag, McGraw Hill								
2.		Heat and Mass Transfer: Fundamentals and Application by YunusCengel, McGraw Hill								
3.		Fundamental of Heat and Mass Transfer by Incropera and Dewitt, Wiley Publication								
4.		Heat and Mass Transfer by R K Rajput, S.Chand Publication								
5.		Heat & Mass Transfer by Dr D S Kumar, S.K. Kataria & Sons								

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: B.E.-Mechanical

PSO1 Apply fundamentals of design, thermo-fluids and production engineering knowledge for innovative and critical thinking, problem-solving and Experimental skills with integrity and inclusivity in professional engineering practice or business.

PSO2 Achieve further career development through graduate education, professional development courses and/or on-the-job training and experience.

PSO3 Develop leadership and collaborative roles in their careers.

Programme Outcome (PO)

PO1 Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Problem Analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Design/development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 Modern Tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6 The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering			Academic Year			2024-25				
B. E. (Mechanical Engineering): Regular Programme												
Year	III	Core / Elective / Foundation MEC1609CS : Production Technology-III			Credits / Hours per week			Lectures: 04 Practicals: 02				
Semester	II	Year of Introduction: 2024			Maximum Marks / Grade			Theory: 100 PR/TW/VIVA: 50				
Mode of Transaction: Lectures and Lab exercises												
Course Outcome (CO) MEC XXXX CO-01 Understand the basics of Powder metallurgy and manufacturing processes of powder metallurgy product, plastic products and composite products CO-02 Describe different unconventional manufacturing processes in manufacturing and apply the knowledge to select appropriate process as per application CO-03 Explain different types of metal forming methods and their applications. CO-04 Understand different gear manufacturing processes and additive manufacturing CO-05 Explain manufacturing processes for semiconductor and MEMS devices.												
Unit No.	Topic				Contact Hours	Weightage(%)	BT Level	CO	PSO	Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/ Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Professional Ethics (PE)

1	Powder metallurgy: Applications of powder Metallurgy parts. Advantages and limitations of powder Metallurgy, Manufacturing of Metal powders and their characteristics, Mixing and blending, Compacting, Sintering, and Secondary Operations.	08	13				SD	R G	
2	Plastic Product manufacturing processes: Types of plastics, Plastic product manufacturing processes: Injection moulding, blow moulding, extrusion, calendaring, compression moulding. Manufacturing methods for Glass, Ceramic and Rubber products. Composite product manufacturing processes: Types, Forms, Manufacturing Methods, Compression moulding, Vacuum Bag Moulding, Pultrusion and filament Winding.	10	17						
3	Unconventional machining processes Need for non-Traditional Manufacturing, Classification, Process selection, Principles, Advantages, Limitations, Process parameters and applications for different Unconventional Processes: Abrasive jet machining, Ultrasonic machining, Electro discharge machining, Electro Chemical Machining, Laser beam machining, Water jet and Abrasive water jet Machining, Electron Beam machining, Ion beam machining, forming.	14	23						
4	Metal forming processes: Classification, Introduction to plastic deformation, stress, strain, strain rate, Hot working, cold working, annealing. Bulk deformation processes: rolling, types, analysis of strip rolling, and defects in rolled products. Extrusion, types, defects, Wire and tube drawing processes, Forging, elementary analysis, defects. Sheet metal forming processes, deep drawing, bending, Advance forming (Incremental forming, High velocity forming. High energy rate forming)	12	20						
5	Gear manufacturing: Overview of gears, range, types, materials, Manufacturing methods, Casting, Injection molding, Bulk deformation processes, Sheet metal processes, powder metallurgical process, Gear Machining processes: different Gear Forming processes and Generative processes, tooling. Gear Finishing processes, Deburring and edge finishing, Modern processes for gear manufacturing.	06	10						

6	Additive manufacturing: History, Basic concepts, steps, Capabilities and advantages, Limitations, Materials and Processes, Important Liquid based, and Powder based processes.	04	7						
7	Manufacturing processes related to Semiconductors, Fabrication of IC and MEMS devices: Introduction, General fabrication sequence for ICs, Clean rooms, Silicon crystal growing, Wafer preparation, Thin films and Film deposition methods, Sputtering, Chemical vapour deposition, Oxidation, Lithography and types, Etching, wet and dry and types, Diffusion and Ion implantation, Metallization, Wire bonding, printed Circuit boards manufacturing, LIGA processes.	06	10						
	Total	60	100						

Reference Books	
1	Kalpakjian S. And Steven S. Schmid, “Manufacturing processes for Engineering Materials”, Pearson Education India Edition.
2	Non-Traditional machining By P K Mishra
3	Non-Traditional machining By V K Jain
4	Handbook of Metal Forming, Kurt Lange; Society of Manufacturing Engineers
5	Handbook of Metal-forming Processes Betzalel Avitzur; John Wiley.
6	Advanced Gear Manufacturing and Finishing: Classical and Modern Processes, Kapil Gupta, Neelesh Kumar Jain, Rolf Laubscher, Academic Press
7	Design for manufacturability handbook / James G. Bralla, (Editor), 2nd ed. McGraw Hill
8	Rapid Prototyping Principles and Applications, By: Chee Kai Chua, Kah Fai Leong and Chu Sing Lim; World Scientific
9	Additive Manufacturing Technologies by Ian Gibson, David Rosen & Brent Stucker; Springer
10	Additive Manufacturing by P.C.Paul and A.N.Jinoop; McGraw Hill
11	Fundamentals of Semiconductor manufacturing and process control, Gary S. May and Costas J. Spanos, John Wiley & Sons
12	Silicon Micromachining, H. V. Jansen, M. Elwenspoek; Cambridge University Press
13	Microchip Fabrication: A Practical Guide to Semiconductor Processing, Peter van Zant, McGrAw Hill

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: B E (Mechanical Engineering)

PSO1: Apply fundamentals of design, thermo-fluids and production engineering knowledge for innovative and critical thinking, problem-solving and experimental skills with integrity and inclusivity in professional engineering practice or business.

PSO2: Achieve further career development through graduate education, professional development courses and/or on-the-job training and experience.

PSO3: Develop leadership and collaborative roles in their careers.

Programme Outcomes (POs)

PO1 Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Problem Analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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PO6 The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

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Syllabus of Courses

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering				Academic Year				2024-25		
	B. E. (Mechanical Engineering): Regular Programme										
Year	III	Core MEC1602CS: Industrial engineering -II			Credits / Hours per week				Lectures: 04 Practicals:		
Semester	II	Year of Introduction: 1960 Year of Syllabus Revision:2024			Maximum Marks / Grade				Theory: 100 PR/TW/V IVA:		
Mode of Transaction: Lectures and Practicals											
Course Outcome (CO) MEC XXXX											
CO1 Understanding the concept and functions of Production, Planning and Control.											
CO2 Discussing Sales forecasting techniques.											
CO3 Study and analyzing Inventory Control and Breakeven Analysis.											
CO4 Understanding Statistical Quality Control (SQC)											
CO5 An insight into acceptance sampling and Quality management.											
Unit No.	Topic	Contact Hours	Weight age (%)	BT Level	CO	PO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)	

1	Production Planning and Control: Production Planning: Objectives, Functions, Organization, Routing, Scheduling: Machine loading, Dispatching, Production Control, Types of Production, Process Planning, Make/Buy decision, Sequencing Models, Loading & Scheduling techniques, Gantt Chart/Bar Chart, Network Analysis, CPM & PERT, Plant capacity, MPS, ERP, MRP, MRP-II, Production lines and Line Balancing, Supply Chain Management and logistics.	12	20	1, 2, 3, 5	CO1	3,9,10,	1,3	ALL	ALL	ALL
2	Sales forecasting: Market Research, Sales Forecasting: Objective, Factors Affecting, Methods (Jury, Delphi, Collective Opinion Method, Time Series, Analysis, Method of Least Squares, Moving Average Method, Exponential Smoothing Method)	6	10	1,2,3,5	CO2	1,2,10	1			
3	Breakeven Analysis: Assumptions, Plotting, Effect of Increase or decrease in Fixed cost and variable costs, sales price on BEP, Managerial Uses, and Limitations.	05	08	1,2,3,5	CO3	1,2	3			

4	Inventory Control: Inventory Control: Characteristics, Importance, Types, Reason For Holding, Causes of Poor Inventory, Function, Cost Factor, Factor Affecting, Advantages; Procurement Cost/Cost of Ordering, Set Up Cost/ Cost of Manufacturing, Inventory Carrying Cost, Cost of Shortages, Terms & Definitions: Demand, Lead Time, Quantity Discount, Safety Stock, Lot Size or Economic Order Quantity (EOQ), Procedure For Setting Up Inventory Control System, ABC Analysis, VED Analysis, Factor Affecting Inventory Control Policy Of Organization, Inventory Performance Measures, JIT.	07	12	1,2 ,3, 5	CO3	1,2,10	2,3			
5.	Quality Control: Introduction and brief history of Quality Control, Describing Variation, Data presentation. Important Discrete and Continuous Probability distribution Models.	8	10	1,2,3	CO4	1,2,12	1,2			
6.	Statistical inference and sampling distributions, Chance and Assignable causes of variations, statistical basis of Control Charts, Variable Control Charts, attributes Control Charts, Process Capability Studies.	8	14	1,2,3,4,5	CO4	1,2,10	1,2			
7.	Acceptance sampling: Various terms, OC curve, AQL, LTPD, AOQ, AOQL, Single, Double, Multiple and Sequential sampling plans. Standardized Sampling	8	14	1,2,3,4,5	CO5	1,2,10	3			

	Plan MIL STD 105.									
8.	Quality Management: TQM & it's tools, ISO 9000, ISO 14000, Poka-Yoka, Kaizen. Introduction to Six sigma.	6	12	1,2,3	CO5	1,9,10	1,2			
	Total	60	100							

	Reference Books:
1.	Engineering Statistics Handbook NIST SEMATECH
2.	Factory Physics; Wallace J. Hopp; Mark L. Spearman; Third Edition, 2008 McGraw Hill
3.	Introduction to Material Management, Eighth Edition; Stephen N. Chapman, J. R. Tony Arlond Ann K. Gatewood; 2018, Pearson India Education
4.	The Fundamentals of Production, planning and Control; Stephen N. Chapman; 2006, Pearson Education
5.	Introduction to Statistical Quality Control; Douglas C. Montgomery; Seventh Edition, 2013, John Wiley & sons.
6.	Quality and Reliability in Engineering; Tirupathi R. Chandrupatla, 2009, Cambridge University Press
7.	JURAN'S QUALITY HANDBOOK; Joseph .M. Juran, Joseph A. De Feo; Sixth Edition, 2010, Tata McGraw hill

List of Experiments										
		Conta ct Hours	Weig htage (%)	BT Level	CO	PO	PS O			
1.	Network Analysis (PERT/CPM)	4	13	1,2,3,5	CO 1	PO2,PO1 1	1,2	AL L	ALL	ALL
2.	Sales forecasting	4	13	1,2,3,5	CO 2	PO2,PO4	1,2			
3.	Master Production Schedule									
4.	MRP, MRP-II , and ERP	2	7	1,2,3	CO 1	PO2,PO3	1,2			
5.	Sequencing Problem	4	13	1,2,3,5	CO 1	PO2,PO3 ,PO4	1,2			
6.	Inventory control with example	2	7	1,2,3,5	CO 3	PO2,PO4	1,2			
7.	Exercises of Probability distributions	2	7	1,2,3	CO 1	PO1,PO6	1,2			
8.	Problem on control charts	2	7	1,2,3	CO 4	PO1,PO1 2	1,2			
9.	Exercises on acceptance Sampling	2	7	1,2,3	CO 5	PO1,PO1 2	1,2, 3			
10.	ISO 9000, ISO 14000	2	7	1,2,3	CO 5	PO3,PO1 1,PO12	1,2			
11.	Six Sigma	4	13	1,2,3,5	CO 4	PO2,PO3	1,2			

1.	Factory Physics; Wallace J. Hopp; Mark L. Spearman; Third Edition, 2008 McGraw Hill
2.	Introduction to Material Management, Eighth Edition; Stephen N. Chapman, J. R. Tony Arlond Ann K. Gatewood; 2018, Pearson India Education
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Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Program Name: B E (Mechanical Engineering)

Program Specific Outcome (PSO)

PSO1: Apply fundamentals of design, thermo-fluids and production engineering knowledge for innovative and critical thinking, problem-solving and experimental skills with integrity and inclusivity in professional engineering practice or business.

PSO2: Achieve further career development through graduate education, professional development courses and/or on-the-job training and experience.

PSO3: Develop leadership and collaborative roles in their careers.

Program Outcomes (POs)

- PO1 Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO2 Problem Analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- PO3 Design/development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO4 Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- PO5 Modern Tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- PO6 The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
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- PO10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- PO11 Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- PO12 Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Syllabus of Courses

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering				Academic Year				2024-25		
B. E. (Mechanical Engineering): Regular Program												
Year		III	MEC 1601 CS: Design of Machine Elements - II				Credits / Hours per week				Lectures: 04 Practical: 02	
Semester		II	Year of Introduction: 1960 Year of Syllabus Revision: 2005, 2012, 2018, 2021				Maximum Marks / Grade				Theory: 100 PR/TW/VIVA: 50	
Mode of Transaction: Lectures and Practical												
Course Outcome (CO) MEC xxxx CO 1 Review of construction & components of internal combustion engines and other crank-slider based reciprocating machines. CO 2 Understanding types of automotive brakes and clutches, actuation mechanisms, and analysis for design & application. CO 3 Analysis and design of belt and gear drives. Electric motors for machines. Drive trains for all electric & hybrid vehicles. CO 4 Analysis and design of hydrodynamic & hydrostatic bearings, lubricating systems, and sealing techniques of pressurized fluid joints CO 5 Design & fabrication of Unfired pressured vessel (UFPV) shell-ends, openings, and supports. Codes & Standards for UFPV												
Unit No.	Topic			Contact Hours	Weightage (%)	BT Level	CO	PO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/ Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	Internal combustion engines parts: Piston, connecting rod, cylinder-block, head, crank shaft, camshaft, valves train, & flywheel. Similarity with reciprocating pumps & compressors.			14	25	All	1	1, 2, 3, 4, 5, 12	1, 2, 3	Emp, Ent, SD	L, N, R, G	G, ES, HV, PE
2	Clutches: Cone, single & multi disk, and centrifugal; Brakes: Block, band, internally expanding shoes on drum, and disk brakes; Actuation techniques.			10	15	All	2	1, 2, 3, 4, 5, 12	1, 2, 3			
3	Power transmission drives: Design of Gears; spur, helical, bevel & worm & gear trains; Belts & pulleys; Flat, V, & toothed. CVT. Electric motors & Electric Vehicle power train.			16	30	All	3	1, 2, 3, 4, 5, 12	1, 2, 3			
4	Film lubricated bearings: Hydrodynamic and Hydrostatic bearings; Mechanical sealing of pressurized fluid joints.			10	15	All	4	1, 2, 3, 4, 5, 12	1, 2, 3			

5	Pressured vessels: Design of unfired pressure vessels as per ASME BPVC Sect VIII Div I/BIS IS 2825-1969 codes. Openings and supports. Fabrication and Testing requirements.	10	15	All	5	1, 2, 3, 4, 5, 12	1, 2, 3			
		60	100							

Course Outcome (CO-L) MEC xxxL FOR LABORATORY

- xxxxL.01 Understanding and making drawings of parts and assemblies of devices & machines of complex shapes.
- xxxxL.02 Qualitative analysis, considerations, & synthesis for general shapes of components for functionality and selection of material of construction.
- xxxxL.03 Quantitative analysis & synthesis of component dimensions to prevent failure using strength equations and properties of construction material.
- xxxxL.04 Analysis & synthesis of unfired pressure vessels geometry & dimensions.
- xxxxL.05 Analysis of devices and components involved around us.

Experiments

Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO-L	PO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/ Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)
1.	Drawing sheets on parts and assembly of mechanical devices	6	20	1, 2, 3	All	1, 5, 10	All	Emp, Ent, SD	L, N, R, G	G, ES, HV, PE
2.	Design of piston and connecting rod	6	20	All	All	1, 2, 3, 4, 5, 10				
3.	Design of a hand operated drum brake.	6	20	All	All	1, 2, 3, 4, 5, 10				
4.	ICT based learning and reporting of various automobile components.	6	20	All	All	1, 2, 3, 4, 5, 10				
5.	Extended assignments on simple machines in small groups.	6	20	All	All	1, 2, 3, 4, 5, 10, 12				
		30	100							

Reference Books

1.	Basshuysen R., 'Internal Combustion Engine Handbook', S.A.E. International
2.	Bhandari V. B., 'Machine Design'; McGraw-Hill
3.	Norton R. L., "Machine Design, An Integrated Approach"; Pearson
4.	Schmidt S. R., 'Fundamentals of Machine Elements', CRC Press
5.	Chau K.T., 'Electric Vehicle Machines and Drives: Design, Analysis and Application', Wiley

6,	Moss D. R., 'Pressure Vessel Design Manual', Butterworth-Heinemann
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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	-	-		2	-	-	3	3	1	1
CO2	3	3	3	3	2	-	-	--	1	-	-	3	3	2	1
CO3	3	3	3	3	2	-	-	--	1	-	-	3	3	2	1
CO4	3	3	3	2	2	-	-	--	2	-	-	3	3	2	1
CO5	3	3	3	2	3	-	-	--	1	-	-	3	3	2	1

3 – Most

2 – Medium

1 – Less

CO	PO	Weightage	Justification
1	1	3	Application of engineering basics for the design of machine elements
1	2	2	Identification and formulation of design problems at moderate level
1	3	2	Developing solutions of design problems at moderate level
1	4	2	Understanding design considerations for real-world machine elements
1	5	3	Use of internet web resources to relate matter covered in class & laboratory and spreadsheets for calculations etc.
1	9	2	Preparing students for both individual and teamwork ready at medium level
1	12	3	Classroom and laboratory sessions are embedded with lifelong learning
2	1	3	Application of engineering basics for the design of machine elements
2	2	3	Identification and formulation of design problems at moderate level
2	3	3	Developing solutions of design problems at moderate level
2	4	3	Understanding failure modes of machine elements and prevention against.
2	5	2	Use of internet web resources to relate matter covered in class & laboratory and spreadsheets for calculations etc.
2	9	1	Preparing students for both individual and teamwork ready at medium level
2	12	3	Classroom and laboratory sessions are embedded with lifelong learning
3	1	3	Application of engineering basics for the design of machine elements
3	2	3	Identification and formulation of design problems at moderate level
3	3	3	Developing solutions of design problems at moderate level
3	4	3	Design or selection of element for general & specific application
3	5	2	Use of internet web resources to relate matter covered in class & laboratory and spreadsheets for calculations etc.
3	9	1	Preparing students for both individual and teamwork ready at medium level
3	12	3	Lifelong learnings are blended in the subject content.
4	1	3	Application of engineering basics for the design of machine elements
4	2	3	Identification and formulation of design problems at moderate level
4	3	3	Developing solutions of design problems at moderate level
4	4	3	Design or selection for multi-elements applications
4	5	2	Use of internet web resources to relate matter covered in class & laboratory and spreadsheets for calculations etc.
4	9	2	Preparing students for both individual and teamwork ready at medium level
4	12	3	Lifelong learnings are blended in the subject content.

5	1	3	Application of engineering basics for the design of machine elements
5	2	3	Identification and formulation of design problems at moderate level
5	3	3	Developing solutions of design problems at moderate level
5	4	2	Various application in machines and devices
5	5	3	Use of internet web resources to relate matter covered in class & laboratory and spreadsheets for calculations etc.
5	9	1	Preparing students for both individual and teamwork ready at medium level
5	12	3	Teaching methodology includes lifelong learning of importance

CO	PSO	Weightage	Justification
1	1	3	Application of engineering basics for the design of machine elements
1	2	1	May develop useful futuristic technical learning
1	3	1	Limited to subject related lab exercises
2	1	3	Application of engineering basics for the design of machine elements
2	2	2	May develop useful futuristic technical learning
2	3	1	Limited to subject related lab exercises
3	1	3	Application of engineering basics for the design of machine elements
3	2	2	May develop useful futuristic technical learning
3	3	1	Limited to subject related lab exercises
4	1	3	Application of engineering basics for the design of machine elements
4	2	2	May develop useful futuristic technical learning
4	3	1	Limited to subject related lab exercises
5	1	3	Application of engineering basics for the design of machine elements
5	2	2	May develop useful futuristic technical learning
5	3	1	Limited to subject related lab exercises

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering			Academic Year					2023-24		
		B. E. (Mechanical Engineering): Regular Programme									
Year	III	Core MEC 1614 CS: Hydraulics Machines		Credits / Hours per week					Lectures: 04 Practical:- 02		
Semester	II	Year of Introduction: 1960 Year of Syllabus Revision:2006		Maximum Marks / Grade					Theory: 100 PR/TW/VIVA: 50		
Mode of Transaction: Lectures and Practical											
Course Outcome (CO) MEC XXXX CO 1 Determine the forces exerted by a jet of fluid on stationary and moving vanes of different shapes. CO 2 Distinguish different classes of turbines and further analyze their working principles. CO 3 Assess the performance of hydraulic turbines CO 4 Distinguish between different classes of pumps, their construction features and further Analyze their performance. CO 5 Explain the working principles of various hydraulic systems, hydraulic control systems and fluidics and select a suitable hydraulic device for a particular application.											
Unit No.	Topic		Contact Hours	Weightage (%)	BT Level	CO	PO	PSO	Elements of Employability (Emp)/Entrepreneurs hip (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	Impact of Jet: Introduction, Force exerted on stationary		05	10%	1	CO1	PO1,PO2	PSO1	ALL	All	ES,HV,PE

	plate held normal and inclined to jet, Force exerted on curved plate, force exerted on moving plate held normal and inclined in direction of moving jet, Force on a plate when vane is moving in direction of jet, jet striking on curved vane tangentially at one tip and leaving at other end, jet propulsion in ships									
2	Hydraulic Turbines: Historical review, classifications, Pelton turbine-components, work and efficiencies. Francis turbine-construction features, work and efficiencies, draft tube theory, Axial flow turbine – Kaplan turbine-constructional features, work and efficiencies. Unit quantities and their significance, specific speed of turbines, performance characteristic	10	20	2,3,5	CO1, CO2, CO3	PO2,PO3,PO4	PSO1			

	curves-constant head, constant speed and constant efficiency curves, model testing of turbines, cavitation in turbines, selection of turbines, governing of turbines. Water hammer, speed rise, Determination of power, cavitation and run away speed of turbine wheel.									
3	Hydropower Plant: Introduction, Major applications of hydropower plant, Classification of hydropower plant, Essential components of hydropower plant, Advantages and disadvantages of hydropower plant, selection of site for a hydropower plant	5	10%	2,3,5	CO1, CO2, CO3	PO2,PO3,P O7	PSO1			
4	Reciprocating Pumps: Classification, Main parts, , work done by pumps, coefficient of discharge, slip, negative slip, Indicator diagram, acceleration head and its effects in suction and delivery pipes, effect of friction, air vessels-construction,	10	20	2,4	CO4	PO2,PO3,P O4	PSO1			

	Constructional features and working of machines like accumulator, intensifier, lift, crane, press, hydro ram.						PSO1			
7	Hydraulic Power Transmission: Elementary idea about hydraulic power transmission systems like fluid coupling, torque converters etc.	4	8%	2,4,6	CO5	PO4,PO5	PSO1			
8	Hydraulic Sealing: Static and dynamic sealing requirements, gaskets, O-rings, lip seals, soft packing, face seals or mechanical seals, clearance seals or labyrinth seals.	4	8%	1,2	CO5	PO4,PO5	PSO1			
		52	100							
Experiments										
1.	Study of Amsler’s pitot tube	4	15	1,2	CO1	PO2 ,PO3	PSO1	All	All	ES,HV, PE
2.	Study of Cup type current meter	4	15	1,2,3	CO1	PO2, Po3	PSO1			
3.	Trial on two stage reciprocating pump	4	15	2,3	CO4	PO3, PO4	PSO1			
4.	Study and performance of centrifugal pump	4	10	2,3,5	CO4	PO3,PO4	PSO1			

5.	Determination of Cavitation in Centrifugal Pump.	2	10	1,5	CO4	PO3,PO4	PSO1			
6.	Study of Water wheels & hydraulic turbines	2	10	2,6	CO2,C O3	PO1,PO2	PSO1			
7.	Detailed study of hydroelectric Power plant	2	15	3,6	CO1	PO1,PO2	PSO1			
8.	Performance of Hydraulic Ram	4	10	1,4	CO5	PO3,PO4	PSO1			
		26	100							
		Reference Books								
1.		“Fluid Mechanics and Hydraulic Machines” by R.K. Bansal, Laxmi Publications								
2.		“Fluid Mechanics and Hydraulic Machines by R.K. Rajput, S.Chand & Co.								
3.		“Fluid Mechanics Fundamentals and Applications”, by Yunus A.Cengel, McGraw Hill Publishing Company Ltd.								

Bloom's Taxonomy Levels:

1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: B E (Mechanical Engineering)

PSO1 Apply fundamentals of design, thermo-fluids and production engineering knowledge for innovative and critical thinking, problem-solving and Experimental skills with integrity and inclusivity in professional engineering practice or business.

PSO2 Achieve further career development through graduate education, professional development courses and/or on-the-job training and experience.

PSO3 Develop leadership and collaborative roles in their careers.

Programme Outcomes (POs)

- PO1 Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO2 Problem Analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- PO3 Design/development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO4 Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- PO5 Modern Tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- PO6 The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- PO7 Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- PO8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- PO9 Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- PO10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- PO11 Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- PO12 Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering			Academic Year				2022-23				
	B. E. (Mechanical Engineering): Regular Programme											
Year	III	Core / Elective / Foundation MEC1603CS : Thermal Engineering - II			Credits / Hours per week				Lectures: 04 Practicals: 02			
Semester	II	Year of Introduction: 1960 Year of Syllabus Revision:2006			Maximum Marks / Grade				Theory: 100 PR/TW/VIVA: 50			
Mode of Transaction: Lectures and Practicals												
	Course Outcome (CO) MECXXXX CO1 Understand the thermodynamic basis of variation of specific heat and finding the same with charts and tables; Understand the fuels and its combustion phenomenon CO2 Understand EV and its components CO3 Analyze gas turbine cycle, system and its modifications; Evaluate performance parameters like efficiency and work ratio CO4 Analyze Refrigeration cycles like vapour compression, vapour absorption and air refrigeration; Evaluate the performance parameters like COP and capacity CO5 Apply principles of psychrometrics for analysis of air conditioning processes; Know applications of various air conditioning systems and their the components											
Unit No.	Topic			Contact Hours	Weightage (%)	BT Level	CO	PO	PSO	Element s of Employa bility (Emp)/ Entrepre neurship (Ent)/ Skill Develop ment (SD)	Relevan ce to Local (L)/ National (N)/ Regional (R)/Glob al (G)	Relation to Gender (G), Environ ment and Sustaina bility (ES), Human Values (HV)and Professio nal Ethics (PE)

1	Gas Turbine plants: Gas turbine cycles, classification of gas turbine plants, open and closed cycle gas turbine plants, Main components and their constructional details, Methods of improving gas turbine plant efficiency, Power and efficiency of gas turbine plants	10	20	1, 2, 3,5	CO3	PO1 PO3	PSO1	ALL	ALL	ALL
2	Jet Propulsion plants: jet propulsion engines- Classification, atmospheric jet engines and rockets, turboprop, turbofan, turbojet, ramjet and pulse-jet engines, cycles, components, working and performance of turbojet engine.	08	15	1, 2, 3, 5	CO3	PO1 PO3	PSO1			
3	Electric Vehicle: Introduction to Electric Vehicles, Components of Electric Vehicles- Electric Motor, Batteries, Drive Trains, EV Charger and other EV accessories	08	15	1, 2, 3	CO2	PO1 PO7	PSO1			
4	Vapour Compression Refrigeration Cycle and System Applications of refrigeration and Air Conditioning, thermodynamic concepts of heat pump and refrigerator, Carnot refrigeration cycle and practical difficulties in its implementation, Standard vapour compression refrigeration cycle and its components, First law analysis of VCR cycle, Actual VCR cycle, VCR system components, Refrigerants-properties, groups and applications	12	23	2, 3, 4, 5	CO4	PO1 PO2 PO3 PO4 PO7	PSO1			
5	Air Refrigeration Cycle Air standard cycle assumptions, Joule cycle and components and analysis, Simple aircraft air conditioning system	02	04	2, 3, 4, 5	CO4	PO1 PO2 PO3 PO4	PSO1			
6	Vapour Absorption Refrigeration System Thermodynamic analysis, working pairs and desirable properties, Lithium bromide-water, Ammonia-water and three-fluid VAR systems	02	04	2, 3, 4, 5	CO4	PO1 PO2 PO3	PSO1			
7	Air Conditioning Psychrometric properties and chart, various psychrometric processes-analysis, representation on chart and implementation schemes Concept of thermal comfort, cooling loads for comfort air conditioning, various applications of air conditioning, suitable systems and major components like Air Handling Unit, ducting and cooling tower	08	15	2, 3, 4, 5	CO5	PO1 PO2 PO3 PO4 PO7	PSO1			
8	Variable Specific Heat: Factors affecting specification of a gas, Atomacy of gases, degrees of freedom, the law of equipartition of energy and variation in Cp,	02	04	2, 3, 4, 5	CO5	PO1 PO2 PO3 PO4	PSO1			

	Cv and ratio of Cp, & Cv, Integration method, gas tables method & t-u-s chart method for considering variation of specific heats									
		52	100							

	Experiments									
1.	Performance evaluation of Vapour Compression Refrigeration System.	04	15	2, 5	CO4	PO1	PSO1	ALL	ALL	ALL
2.	Performance evaluation of Water Chilling Plant along with field visit	04	15	1, 2, 3, 5	CO4	PO3	PSO1 PSO2 PSO3			
3.	Performance evaluation of Room Air Conditioning System.	04	15	3, 4, 5	CO5	PO2	PSO1			
4.	Performance evaluation of Evaporative Cooling System.	02	08	3, 4, 5	CO4	PO2	PSO1			
5.	Study of VCR system components along with field visit	02	08	2	CO4	PO1	PSO1 PSO2 PSO3			
6.	Study of Himalux Refrigerator.	02	08	2	CO4	PO2	PSO1			
7.	Study of AHU and Cooling Tower along with field visit	02	08	1, 2, 3, 5	CO5	PO1	PSO1 PSO2 PSO3			
8.	To study EV learning platform to understand subsystem	04	15	1,2	CO2	PO7	PSO1			
9.	Study of lab scale gas turbine power plant	02	08	1,2	CO2	PO7	PSO1			
		26	100							

	Reference Books
1.	Ganesan,v. ,Internal Combustion Engines, Tata McGraw Hill
2.	Arora &Domkundwar, Power Plant Engineering, Dhanpat Rai & Sons
3.	Arora,C.P., Refrigeration and Air Conditioning, Tata McGraw Hill
4.	ASHRAE Handbook-Fundamentals
5.	Stoecker and Jones, Refrigeration and Air Conditioning

DEPARTMENT OF MECHANICAL ENGINEERING
FACULTY OF TECHNOLOGY AND ENGINEERING
THE M S UNIVERSITY OF BARODA

UG TEACHING SCHEME

BE - CRS MECHANICAL ENGINEERING

BE-IV CRS (MECHANICAL ENGINEERING)											
Semester	Sub Code Theory	Sub Code TW/Viva	Subject Name	Teaching Scheme				Examination Scheme			
				L	T	P	Credit	Theory		Practical	
								IA	UA	IA	UA
FS BE-IV	MEC1702CS	MEC1702LCS	Computer Aided Design and Manufacturing	4	0	2	5	30	70		50
	MEC1703CS	---	Operation Research and Optimization Techniques	4	0	0	4	30	70		
	MEC1701CS	MEC1701LCS	Dynamics of Compressible Flow and Turbomachines	4	0	2	5	30	70		50
	MEC1704CS	MEC1704LCS	Thermal Engineering-III	4	0	2	5	30	70		50
	MECxxxxCS	---	Elective 2 (Table 3)	3	1	0	4	30	70		
Total (Semester 7)				19	20	6	23	150	350		150
SS BE-IV	Group 1										
	MECxxxxCS	---	Elective 3 (Table 4)	3	1	0	4	30	70		
	MECxxxxCS	---	Elective 4 (Table 5)	3	1	0	4	30	70		
	MEC1802CS	---	Institute Project	0	0	8	4				
	Group 2										
	MEC1801CS	---	Industry Project/Internship/ Research Project	0	0	24	12				
	Note: Students will select any one group as per their choice										
Total (Semester 8)											
TOTAL (YEAR 4)							35				1050

DEPARTMENT OF MECHANICAL ENGINEERING
FACULTY OF TECHNOLOGY AND ENGINEERING
THE M S UNIVERSITY OF BARODA

UG TEACHING SCHEME

BE - CRS MECHANICAL E2ENGINEERING

Table 3 Elective 2	
MEC1705DECS	Automobile Mechanisms
MEC1706DECS	Fundamental of Aeronautics
MEC1707DECS	AI and ML for Mechanical Engineers
MEC1708DECS	Aircraft Propulsion
MEC1709DECS	IC Engine Design and Performances
MEC1710DECS	Maintenance Engineering & Management
MEC1711DECS	Sustainable Energy Sources and Conversion Technologies
MEC1712DECS	Product Design and Development

Table 4 Elective 3	
MEC1803DECS	Advanced and Green Air Conditioning Technology
MEC1804DECS	PLM Fundamentals
MEC1805DECS	Thermal Power and Propulsion Systems
MEC1806DECS	Computational Fluid Dynamics Modelling
MEC1807DECS	Aircraft Design
MEC1808DECS	Fundamentals of Combustion

Table 5 Elective 4	
MEC1809DECS	Advanced and Green Refrigeration Technology
MEC1810DECS	Digital Manufacturing
MEC1811DECS	Modern Power Plant Systems and Load Management
MEC1812DECS	Multiphase Flow Physics
MEC1813DECS	Jet Propulsion Systems
MEC1814DECS	Advanced Heat and Mass Transfer

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Program Name: B E (Mechanical Engineering)

Program Specific Outcome (PSO)

PSO1: Apply fundamentals of design, thermo-fluids and production engineering knowledge for innovative and critical thinking, problem-solving and experimental skills with integrity and inclusivity in professional engineering practice or business.

PSO2: Achieve further career development through graduate education, professional development courses and/or on-the-job training and experience.

PSO3: Develop leadership and collaborative roles in their careers.

Program Outcomes (POs)

- PO1 Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO2 Problem Analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- PO3 Design/development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO4 Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
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Syllabus of Courses

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering				Academic Year				2025-26				
B. E. (Mechanical Engineering): Regular Program														
Year		IV	MEC 1702CS: CAD & CAM				Credits / Hours per week				Lectures: 04 Practical:- 02			
Semester		I	Year of Introduction: 2025-2026 Year of Syllabus Revision:				Maximum Marks / Grade				Theory: 100 PR/TW/VIVA: 50			
Mode of Transaction: Lectures and Practical														
Course Outcome (CO) MEC 17XXDECS CO1 Understand CAD process and concept of geometric modelling CO2 Understand concepts of wireframe, surface and solid modelling CO3 Carry out geometric transformations, data exchange in various CAD formats and assembly representations CO4 Understand CAM methodology and advances CAM methods and technologies CO5 Develop CNC part programs														
Unit No.	Topic				Contact Hours	Weightage (%)	BT Level	CO	PO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)	
1	Introduction to CAD: Role of CAD, CAD system architecture, Hardware and software for CAD, Software modules, ICG, Graphics Software, Ground rules for design of GS, functions of GS, modeling and simulation, Overview of modeling software like UG/NX, Solid Works, Autodesk Inventor, Professional, AutoCAD, PRO/E, CATIA: Capabilities, Modules, Coordinate systems, Sketching tools, solid modeling tools, surface modeling tools, expression/parameters toolbox, data exchange tools, API and customization facilities.				05	08	1, 2, 3	1, 2	1, 2, 3, 12	1,2,3	Emp, Ent, SD	L, N, R, G	G, ES, HV, PE	
2	Computer Graphics and Standards: 2D and 3D; transformations of geometric models like translation, scaling, rotation, reflection, shear; homogeneous				10	17	1, 2, 3	1, 2	1, 2, 3, 4	1,2				

	representations, concatenated representation; Orthographic projections CAD/CAM Data exchange and data storage: Introduction, graphics and computing standards, data exchange standards like IGES, STEP, Model storage - Data structures - Data base considerations - Object oriented representations - Organizing data for CIM applications - Design information system									
3	Mathematical Representation of Geometric Entities: Fundamentals, Solid models, Classification of methods of representations, half spaces, boundary representation, CSG, sweep representations, Octree representations, primitive instancing, cell decomposition, spatial occupancy enumeration, Curve representation, parametric representation of analytic and synthetic curves; Surface models, Surface representations, parametric representation of analytic and synthetic surfaces	10	17	All	2, 3	1, 2, 3, 4	1,2			
4	Assembly modeling: Representation, mating conditions, representation schemes, generation of assembling sequences Visualization, Visualization data, light weight representations techniques such as tessellation / voxalization their motivation, how visual representation can be obtained from tessellated, voxelized data, reverse engineering, evolutionAI approaches and applications in CAD, Knowledge Based Engineering, OpenGL, Modern representation schemes like FBM, PM, Feature recognition, Design by features, Tolerance modeling, System customization and design automation, Open Source CAD like Open CASCADE	05	08	All	2, 3	1, 2, 3, 4	1,2			
5	Introduction to CAM: Computer Aided Manufacturing tools, digital manufacturing, digitalization of manufacturing, techniques	10	16	All	4, 5	1, 2, 3, 4	1,2			
	NC/CNC Machine Tools, Configuration, Axes Identification, Controller, Encoders, Manual And Computer Aided Part Programming	10	17	All	4, 5	1, 2, 3, 4	1,2			
	Advanced CAM Technologies: Rapid Prototyping, Digital Twin, Industry 4.0/Smart Manufacturing, IIoT, AR/VR in Manufacturing	10	17	All	4, 5	1, 2, 3, 4	1,2			
		60	100							

Experiments										
1.	Survey of CAD softwares	6	10	All	1	1, 10	1,2	Emp, Ent, SD	L, N, R, G	G, ES, HV, PE
2.	Part Modelling	9	30	All	3, 4	1, 2, 3, 10	1,2			
3.	Assembly Modelling	12	30	All	3, 4	1, 2, 3, 10	1,2			
4.	Computer Graphics Assignments	9	15	All	All	1, 2, 10, 12	1,2			
5.	CNC Part Programming	9	15	All	All	1, 2, 10, 12	1,2			
		45	100							
Reference Books										
1.	CAD/CAM Concepts and Applications/ Alavala/ PHI.									
2.	Mastering CAD/CAM / IbrhimZeid / McGraw Hill International.									
3.	CAD/CAM Principles and Applications/ P.N. Rao/TMH/3rd Edition									
4.	CAD/CAM /Groover M.P./ Pearson education									
5	CAD / CAM / CIM, Radhakrishnan and Subramanian/ New Age									
6	Principles of Computer Aided Design and Manufacturing/ Farid Amirouche/ Pearson									
7	Computer Numerical Control Concepts and programming/ Warren S Seames/ Thomson.									

Bloom's Taxonomy Levels:

1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: B E (Mechanical Engineering)

PSO1: Apply fundamentals of design, thermo-fluids and production engineering knowledge for innovative and critical thinking, problem- solving and experimental skills with integrity and inclusivity in professional engineering practice or business.

PSO2: Achieve further career development through graduate education, professional development courses and/or on-the-job training and experience.

PSO3: Develop leadership and collaborative roles in their careers.

Programme Outcomes(POs)

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- PO2 Problem Analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- PO3 Design/development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO4 Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- PO5 Modern Tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- PO6 The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- PO7 Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- PO8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- PO9 Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- PO10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- PO11 Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- PO12 Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering		Academic Year	2025-26
B. E. (Mechanical Engineering): Regular Programme				
Year	IV	Core / Elective / Foundation MEC 1703:Operations research and optimization techniques	Credits / Hours per week	Lectures + Tutorial : 04 Practical: 00
Semester	I	Year of Introduction: 1970 Year of Syllabus Revision:2025	Maximum Marks / Grade	Theory marks: 100 PR/TW/VIVA: --
Mode of Transaction: Lectures				
Course Outcome (CO) MEC XXXX				
CO1 Know about history, development and current status of operation research.				
CO2 Understand and apply linear programming and inventory models.				
CO3 Understand and apply basics of decision and game theory.				
CO4 Understand queuing theory replacement models.				
CO5 Understand and apply of dynamic programming.				

Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/ Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)
1	Introduction to Operation Research and Optimization: History, definition, characteristics, scope of O.R. in industry, O.R. methodology, models in O.R., Role of computers in O.R., limitations of O.R. Concept of optimization, Classification of optimization problems.	4	6	1, 2	CO1	PO1, PO12, PO5	Emp	L N	ES HV
2	Linear Programming: Linear programming theory, Graphical method, Algorithms for solutions, Simplex algorithm, Big-M and Two phase method, special situations in LP, Duality in LP problems. Transportation Technique, Initial feasible solution, N.W. corner, Inspection and VAM, stepping stone and MODI method for testing the optimality, Degeneracy and redundancy, Special situations.	14	22	2, 4, 5	CO2	PO1, PO4, PO5, PO12	Ent SD	R G	PE

	Assignment problems, Hungarian method.								
3	Decision Theory: Decision-making under risk, decision making under uncertainty, posterior probabilities, expected Value of perfect information, Expected value of sample information, decision trees.	7	12	2, 3, 4	CO3	PO1, PO2, PO3, PO11			
4	Game Theory: Characteristics, important terms, Two-person-zero-sum games, Pure and mixed strategies games, Minimax theorem, Arithmetic, Algebraic, sub game, method of matrices, Graphical, and simplex methods for solving game theory problems.	7	12	2, 4, 5	CO3	PO1, PO3, PO5			
5	Inventory control: Inventory costs, Deterministic models without and with shortages, E.O.Q., E.B.Q., Effect of discount on E.O.Q.	7	12	2, 4, 5	CO2	PO1, PO3, PO11			
6	Replacement Theory: Equipment replacement policy, Money values not changing with time and money value changing with time considerations, Group replacement policy.	7	12	2, 4, 5	CO4	PO1, PO2, PO3			
7	Queuing Theory: Elements of a queuing system, Queue discipline, service mechanism, Kendall's notations, M/M/1, M/M/C models, finite queue, finite calling population, optimization of costs.	7	12	2, 4, 5	CO4	PO1 PO3			
8	Dynamic Programming:	7	12	2, 4, 5	CO5	PO2 PO5			

	Characteristics of Dynamic programming, Bellman's principle of optimality, Recursive equations with backward and forward treatments.								
	Total	52	100						
Reference Books									
1.	Operations Research: An Introduction by Hamdy A. Taha, 10th Ed. Pearson								
2.	Hillier F.S., Lieberman G.J., Introduction to Operations Research, 10th Ed. Tata McGraw-Hill								
3.	Winston Wyne L., Operations Research applications and Algorithms. 4th Ed. Duxbury publ.								
4.	Operations Research, Principles and applications, G. Srinivasan, Prentice hall of India.								
5	Optimization in operations research, Ronald Rardrin, 2 nd Edition, Pearson.								

Bloom's Taxonomy Levels:

1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: B E (Mechanical Engineering)**Programme Outcomes (POs)**

- PO1 Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO2 Problem Analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- PO3 Design/development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO4 Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- PO5 Modern Tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- PO6 The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- PO7 Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- PO8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- PO9 Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- PO10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- PO11 Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- PO12 Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering	Academic Year	2025-26	
B. E. (Mechanical Engineering):				
Year	IV	Core / Elective / Foundation MEC1704 Thermal Engineering III	Credits / Hours per week	Lectures: 04 Practicals: 02
Semester	I	Year of Syllabus Revision: 2025-2026	Maximum Marks / Grade	Theory:100 PR/TW/VIVA: 50
Mode of Transaction: Lectures				
Course Outcome (CO) ELEXXXX CO1: Analyze the behavior and thermodynamic principles of modern steam boilers, including La Mont, Benson, Loeffler, and Velox boilers, and evaluate their efficiency and heat transfer mechanisms. CO2: Evaluate different types of draught equipment, including natural and artificial draughts, and perform calculations for draught resistance, fan power requirements, and choice of fan types. CO3: Compare pulverized fuel systems, including their classification, advantages, disadvantages, handling methods, and components such as mills and burners. CO4: Assess the performance of binary vapor cycles using different working mediums, including steam and mercury, and analyze their properties, efficiency, and flow diagrams. CO5: Understand the principles of nuclear power generation, including nuclear fusion and fission, reactor components, nuclear fuels, and different reactor types and their operations.				

Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/ Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)
1	Modern Steam Boilers: Behaviour of steam at critical and super critical pressures, thermodynamic principles underlying working of high pressure boilers such as forced circulation, generation of steam at critical and above pressures, indirect heating and circulation of flue gases at supersonic velocity. Study of La Mont, Benson, Loffler and Velox boilers. Location of heat transfer units and efficient heat transfer, trial of boilers and heat balance sheet.	5	13	1, 2	CO1	PSO1	Emp Ent SD	L N R G	ES
2	Draught Equipment: Types of draughts used and calculation of resistance offered, Natural draught and its calculation, various chimneys, Artificial draught – forced, induced and balanced, choice of fan, power required to drive the fan.	5	13	2, 3	CO2	PSO1			
3	Pulverized Fuel: Classification of solid fuel firing, pulverized fuel and its advantages and disadvantages, pulverized fuel handling (firing) systems – unit and bin (or central), pulverizing mills, pulverized fuel burners (furnaces) and dust collectors.	5	13	2, 3, 4	CO3	PSO1			
4	Binary Vapour Cycle: Desirable properties of working medium for vapour power cycle, steam & mercury as working medium, possible combinations of working mediums & their limitations, flow & t-s diagram, rate of flow of vapour, power & efficiency of Binary vapour cycle.	4	10	3, 4	CO4	PSO1, PSO2			
5	Nuclear Power: Nuclear fusion and fission, Fission chain reaction, components of a nuclear reactor, nuclear fuels, fertile materials, main types of reactors and their operation.	5	13	2, 3	CO5	PSO1			

6	Steam Nozzles: Flow of steam in convergent and in convergent-divergent nozzles, pressure of steam at throat for maximum discharge with initially wet, saturated and superheated steam, effect of friction, effect of variation of back pressure, supersaturated flow of steam in nozzles, Wilson line.	3	8	3, 4	CO5	PSO1, PSO2			
7	Steam Turbines: Principles of working, main types and their salient features, compounding velocity diagrams for velocity compounded impulse turbines and reaction turbines, Axial thrust, work done and efficiencies, Rankine cycle with internal and external irreversibility, Reheat factor, Reheating, Regeneration feed heating, Effect of important parameters on performance of turbines, Methods of governing and their limitations, Back pressure and pass out turbines, Constructional features – Methods of fixing blades, materials for blades and rotors, construction of rotors, Types of glands used, balancing of thrust.	6	20	2, 3	CO5	PSO1			
8	Power Plant Economics.	4	10	2, 3, 4	CO5	PSO1, PSO2			
		40							
Experiments									
1.									
2.									
3.									
4.									
References									
1	"Thermal Engineering" by R.K. Rajput								
2	"Power Plant Engineering" by P. K. Nag								
3	"Engineering Thermodynamics" by Y. A. Cengel								
4	"Nuclear Reactor Physics, Second Edition: An Introduction" by Serge								
5	"Fundamentals of Thermodynamics" by Richard E. Sonntag, Claus. J. A. Borgnakke, and Gordon J. Van Wylen								

Syllabus of Courses

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering			Academic Year			2025-26			
		B. E. (Mechanical Engineering): Regular Program									
Year	IV	Core / Elective/ Foundation MEC 1701: Dynamics of Compressible flow & Turbomachines			Credits / Hours per week			Lectures: 04 Practical:- 02			
Semester	I	Year of Introduction: 2025-2026			Maximum Marks / Grade			Theory: 100 PR/TW/VIVA: 50			
Mode of Transaction: Lectures and Practical											
		Course Outcome (CO) MEC XXXX CO1 Understanding of compressible flow and shock waves CO2 Understanding of 1D isentropic flow and flow with friction CO3 Understanding of flow with heating and cooling CO4 Understanding of energy transfer and fluid flow mechanism in turbomachine CO5 Apply cascade theory to radial and axial turbomachines									
Unit No.	Topic		Contact Hours	W	BT Level	CO	PSO	PO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	Introduction to compressible flow & Shock wave: The velocity of sound, incompressible and compressible flows, subsonic and supersonic flows, Mach number, Mach angle and Mach cone, classification of compressible flows, Classification of shocks, governing relations of the normal shocks, working formulas, tables, charts, brief idea about oblique and curved shocks		06	1 5	2,3	CO1	PSO1	PO1, PO2, PO3	All	All	ES, PE

2	1-D Isentropic Flow: General features of Isentropic flow, their governing and working relations, flow of a perfect gas, Isentropic flow of a perfect gas, operation of convergent and convergent-divergent nozzles under varying flow conditions, Choking in isentropic flow, performance of blades nozzles, diffuser.	06	15	2,3	CO2	PSO1	PO1, PO2, PO3			
3	Flow with friction in constant area duct: Introduction, governing equations, assumptions, analysis of Fanno line on h-s diagram, working equations, parameters related to fluid friction, effect of friction on various parameters, working formulas, tables.	06	10	4	CO3	PSO1	PO1, PO2, PO3			
4	Flow with heating and cooling in a constant area duct: Introduction, governing equations, assumptions, analysis of Rayleigh line on the h-s diagram, working equations, working formulas and tables, effects of changes in stagnation temperature, Analysis of normal shock, Fanno line and Rayleigh line on h-s diagram.	06	10	4	CO3	PSO1	PO1, PO2, PO3, PO4			
5	Energy Transfer in Turbomachines: Energy transfer between fluid and rotor, Euler turbine equation and its limitations and applications. Components of energy transfer and their concepts. Impulse and reaction concept.	07	10	2,3	CO4	PSO1	PO1, PO2, PO3, PO4			
6	Flow of fluids in Turbomachines: Flow over immersed bodies, Flow over flat plate, sphere and air foil, Pressure distribution over a symmetrical and inclined air foil, Blade terminology, Blade cascades and nomenclature, Lift and drag characteristics, Elementary concept of three-dimensional flow. Introduction to Wind tunnel and its type.	07	10	2,3	CO4	PSO1	PO1, PO2, PO3, PO4, PO5			
7	Radial Turbomachines: Elements of centrifugal compressor, Stage velocity triangles, h-S diagram, slip factor, Elements of radial	07	15	3,4	CO5	PSO1	PO1, PO2, PO3, PO4, PO5			

	turbine, stage velocity triangle, h-S diagram, Types of centrifugal fans, centrifugal fan stage parameters, Design parameters.									
8	Axial Turbomachines: Axial flow compressor, stage velocity triangles, h-s diagram, work done, degree of reaction, efficiency, stalling & surging.	07	15	3,4	CO5	PSO1	PO1, PO2, PO3, PO4, PO5, PO7			
		52								
	List of Experiments									
1	Study and performance of subsonic wind tunnel	02	10	3,4	CO1					
2	Performance of nozzles with varying back pressure, keeping inlet pressure constant	02	10	3,4	CO2					
3	Performance of nozzles with varying inlet pressure, keeping back pressure constant	02	10	4,5	CO2					
4	Determination of Nozzle Efficiency at different pressure ratios	02	10	4,5	CO2					
5	Shock Visualization and Mach number determination in Supersonic wind tunnel	02	10	2,3	CO1					
6	Plotting of Fanno flow lines for air at different mass fluxes	02	10	2,3	CO3					
7	Plotting of Fanno flow line, Rayleigh flow line and Normal Shock line for Superheated steam on Mollier chart	02	10	2,3	CO3					
8	Performance Characteristics of a Centrifugal Blower	04	10	3,4	CO5					
9	Test on Flow systems of Centrifugal Blower	02	10	3,4	CO5					
10	Non-dimensional Performance presentation for a Ducted Axial Flow Fan	04	10	3,4	CO5					
	Total	24	100							
Reference Books										
1.	“Modern compressible flow with historic perspective” by J. D. Anderson, McGraw-Hill International Edition									
2.	“Fundamental of compressible flow with aircraft and rocket propulsion”, S.M.Yahya, New Age International publication									
3.	“The Dynamics and Thermodynamics of Compressible Fluid Flow Volume – I, II”, Shapiro, A.H., Ronald Press									
4.	“Gas Turbine Theory”, Cohen. Rogers, C.F.G., Sarvanamuttoo, H.I.H., Pearson Edu.									
5.	“Turbines, Compressors and Fans”, Yahya, S.M., McGraw Hill									

Bloom's Taxonomy Levels: 1. Remember

2. Understand

3. Application

4. Analysis

5. Evaluation

6. Creation

Program Name: B E (Mechanical Engineering)

Program Specific Outcome (PSO)

PSO1: Apply fundamentals of design, thermo-fluids and production engineering knowledge for innovative and critical thinking, problem-solving and experimental skills with integrity and inclusivity in professional engineering practice or business.

PSO2: Achieve further career development through graduate education, professional development courses and/or on-the-job training and experience.

PSO3: Develop leadership and collaborative roles in their careers.

Program Outcomes (POs)

- PO1 Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO2 Problem Analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- PO3 Design/development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO4 Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- PO5 Modern Tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- PO6 The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- PO7 Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
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Syllabus of Courses

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering				Academic Year				2025-26			
B. E. (Mechanical Engineering): Regular Program													
Year		IV MECH	MEC1707DECS AI and ML for Mechanical Engineering				Credits / Hours per week				Lectures: 03 Tutorial: 01		
Semester		I	Year of Introduction: 2025-26				Maximum Marks / Grade				Theory: 100 PR/TW/VIVA: 00		
Mode of Transaction: Lectures and Tutorial													
Course Outcome (CO) MEC 17XXDECS CO 1 Demonstrate fundamentals of AI&ML, apply feature extraction and selection techniques CO 2 Apply machine learning algorithms for classification and regression problems CO 3 Explain concepts of reinforced and deep learning CO 4 Familiarizing with Industrial Internet of things for planning to embark in the industrial sector. CO 5 Designing of intelligent robots using sensors with understanding of basic components of robots, differentiate between types of robots and robot grippers.													
Unit No.	Topic		Contact Hours	Weightage (%)	BT Level	CO	PO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)		
1	History of AI, Comparison of AI with Data Science, Need of AI in Mechanical Engineering, Machine Learning Basics: Reasoning, problem solving, Knowledge representation, Planning, Learning, Perception, Motion and manipulation. Approaches to AI: Cybernetics and brain simulation, Symbolic, Sub-symbolic, Statistical. Approaches to ML: Supervised learning, Unsupervised learning, Reinforcement learning.		06	14	1, 2, 3	1, 2	1, 2, 3, 12	1,2,3	Emp, Ent, SD	L, N, R, G	G, ES, HV, PE		
2	Problem identification: Classification, Clustering, Regression, Ranking. Steps in ML modelling: Data Collection, Data pre-processing, Model Selection, Feature Extraction (Statistical features, Principal Component Analysis), Feature Selection (Ranking, Decision tree - Entropy reduction & information gain, Exhaustive, best		06	18	1, 2, 3	1, 2	1, 2, 3, 4	1,2					

[illegible]

1.	Tom M. Mitchell, “Machine Learning”, McGraw-Hill, 1997
2.	Shai Shalev-Shwartz and Shai Ben-David, “Understanding Machine Learning”, Cambridge University Press, 2017.
3.	Mehryar Mohri, Afshin Rostamizadeh and Ameet Talwalkar, “Foundations of Machine Learning”, MIT Press, 2012
4.	P. Flach, “Machine Learning: The Art and Science of Algorithms that Make Sense of Data. First Edition”, Cambridge University Press, 2012.
5.	Kumar, Zindani, Davim, Artificial Intelligence in Mechanical and Industrial Engineering, CRC Press, 2021.
6.	Dilip Kumar Pratihari, Fundamentals of Robotics, Narosa Publishing House, (2019)
7.	R. D. Klafter, Thomas A. Chmielewski, and Michael Negin, Robotic Engineering – An Integrated Approach, EEE, Prentice Hall India, Pearson Education Inc. (20090029
8.	S. B. Nikku, Introduction to Robotics – Analysis, Control, Applications, 3rd edition, John Wiley & Sons Ltd., (2020)
9.	Mikell Groover, Mitchell Weiss, Roger N. Nagel, Nicholas Odrey, Ashish Dutta, Industrial Robotics 2nd edition, SIE , McGraw Hill Education (India) Pvt Ltd (2012)
10.	Daniel Minoli, “Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications”, ISBN: 978-1-118-47347-4, Willy Publications.
11.	Michahelles, “Architecting the Internet of Things”, ISBN 978-3- 642-19156-5 e-ISBN 978-3 642-19157-2, Springer.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	--	--	--	1	--	2	--	--	3	3	1	2
CO2	3	3	3	--	--	--	1	--	1	--	--	3	3	2	1
CO3	3	3	3	--	--	--	2	--	1	--	--	3	3	2	--
CO4	3	3	3	--	--	--	2	--	2	--	--	3	3	2	--
CO5	3	3	3	--	--	--	1	--	1	--	--	3	3	2	--

3 – Most

2 – Medium

1 - Less

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering				Academic Year			2025-26		
		B. E. (Mechanical Engineering): Regular Programme									
Year	IV MECH	Elective MEC1708DECS :Aircraft Propulsion		Credits / Hours per week					Lectures: 04 Practical:- 00		
Semester	VII	Year of Introduction: 2025 Year of Syllabus: 2024		Maximum Marks / Grade					Theory: 100 PR/TW/VIVA: 00		
Mode of Transaction: Lectures and Practical											
		Course Outcome (CO) MEC CO 1 Determine the Various Aircraft Engines. CO 2 Performance of Aircraft engines. CO 3 Analysis of Various Components Parameters. CO 4 Determining Propulsions systems. CO 5 Determining aircraft control and Instrument system. .									
Unit No.	Topic	Contact Hours	Weightage (%)	B T Level	CO	PO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)	
1	Basic Mechanics: Principles of jet propulsion. Methods of jet Propulsion.	05	10%	1	CO1	PO1,PO2	PSO1				
2	Working Cycle. Performance Parameters. Components of Engines.	10	20	2,3,5	CO1, CO2, CO3	PO2,PO3,P O4	PSO1				

	Compressor, Combustion Chambers, Turbines, Exhaust System.									
3	Fuel System. Starting and Ignition. Accessory drives. Lubrication. Internal air System.	5	10%	2,3,5	CO1, CO2, CO3	PO2,PO3,PO7	PSO1	ALL	All	ES,HV,PE
4	Controls and Instrumentation. Synchronizing.	10	20	2,4	CO4	PO2,PO3,PO4	PSO1			
5	Ice Protection. Hot air system. Electrical system.	10	20	1,2,3,4	CO4	PO2, PO5	PSO1			
6	Fire Protection. Prevention of engine fire ignition. Fire detection, containment, extinguishing and engine overheat detection.	4	8%	1,2	CO3	PO2,PO3	PSO1			
7	Thrust Reversal. Principles of operation. Construction and materials.	4	8%	2,4,6	CO3	PO4,PO5	PSO1			
8	Thrust Augmentation, Thrust distribution.	4	8%	1,2	CO5	PO4,PO5	PSO1			
	. Vertical take -off and landing.									
		52	100							

		Reference Books
1.		The Jet Engines By-Rolls-Royce plc
2.		Introduction to Flight By – Anderson
3.		Aircraft Propulsion Systems Technology and Design By- Gordon C Oates

Syllabus of Course

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering			Academic Year					2025 -26			
B. E. (Mechanical Engineering): Regular Programme													
Year		IV	Elective MEC1705DECS :Automobile Mechanism				Credits / Hours per week					Lectures: 04 Practical: 00	
Semester		I	Year of Introduction: 2024 Year of Syllabus Revision:				Maximum Marks / Grade					Theory: 100 PR/TW/V IVA: 00	
Mode of Transaction: Lectures and practical's													
Course Outcome (CO) MEC CO1 Remember basic concepts of an automobile CO2 Analyze performance characteristics of an automobile. CO3 Understanding of the components and its construction of reciprocating engine . CO4 Analyze cooling , lubrication and carburetion in IC Engine. CO5 Apply knowledge of IC Engine in garages and service station.													
Unit No.	Topic			Contact Hours	Weightage (%)	BT Level	CO	PS O	PO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Profession	

								(SD)		al Ethics (PE)
1	Transmission Mechanism: Its purposes and components, Clutch – its function, principle working, types of clutch, single plate, multi-plate wet and dry, semi-centrifugal, centrifugal and diaphragm clutch, Calculation of power transmitted and dimensions of clutch components, Fluid fly wheel Gear and Gearbox, sliding mesh, constant mesh and synchromesh gearboxes. Epicyclic gearbox, Calculation of gear ratios, sizes and	06	10	1, 2, 3	CO1	PS O1	PO 1 PO 3	Emp Ent SD	L N R G	ES PE
2	Brakes and Braking Mechanism: Functions, principle, direct and indirect braking system, Hydraulic brake system, Master cylinder, Disc brakes, comparison of drum and disc brakes, Brake drums, brake shoes, brake linings and brake fluids, Servo and power brakes, Braking of vehicles problems..	06	10	2, 3, 4	CO2	PS O1 PS O2	PO 1			
3	Wheels and Tyres: Wheel assembly, Types of wheel, Tyres and their types, Desirable Tyre properties, Construction of a Tyre and materials, Tyre inflation pressure, Tyre life	06	10	2, 3, 4	CO2	PS O1 PS O2	PO 1			

4	Suspension Mechanism: Necessity, basic requirements, sprung and unsprung weights, Conventional and independent suspension systems, Advantages of independent suspension, Spring – Leaf, coil & torsion bars, Helix springs, Shock absorbers, Stabilizer or anti roll device.	08	13	3, 4, 5	CO3	PS O1 PS O2	PO 1 PO 3			
5	Body and Safety Considerations: Vehicle body, requirements of body design, streamlining of vehicle body, types of bodies, rust protection, safety considerations	07	13	3, 4, 5	CO3	PS O1 PS O2	PO 1 PO 2 PO 3			
6	Wheel Alignment and Steering System: Front axle assembly – axle beam, stubs axle and wheel. Front and geometry – camber, king pin inclination, included angle, caster. Toe-in and Toe-out, necessity of steering, Ackerman and Davis steering mechanism, Steering linkages, Power steering, fundamental condition for true rolling and steering calculations.	08	13	3, 4, 5	CO4	PS O1 PS O2	PO 1 PO 2			

7	Engine Emission and it's Control: Major Pollutants, Mechanism of pollutant formation, control strategies, Crankcase Emission Control, Evaporative emission control, Exhaust emission testing, Engine management and control system	08	13	3,4,6	CO4	PS O1 PS O2 PO 1 PO 2 P O 3
8	Miscellaneous Topics: Automobile air conditioning requirements, Car and bus air conditioning – components, layout and working, Laboratory testing and road testing of motor vehicles, R.T.O. rules, Automobile emission and	07	13	3,4,5	CO5	PS O3 PO 1 PO 7

Reference Book:-

Automobile Technology, N.K. Giri, Khanna Publishers, 2011.

Automobile Mechanical and Electrical Systems Automotive Technology: Vehicle Maintenance and Repair, Tom Denton, Butterworth Heinemann, 2011.

Automobile Engineering by K K Jain and R B asthana, Tata McGraw Hill publication

								PO1, PO2				
								PO1, PO2				
								PO1, PO2				
								PO1, PO2				
Reference Books												
1												
2												
3												
4												
5												

Bloom's Taxonomy Levels:

1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: B E (Mechanical Engineering)**Programme Outcomes (POs)**

- PO1 Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO2 Problem Analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- PO3 Design/development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO4 Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- PO5 Modern Tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- PO6 The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- PO7 Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- PO8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- PO9 Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- PO10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- PO11 Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- PO12 Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Syllabus of Courses

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering		Academic Year					2025-26		
B. E. (Mechanical Engineering): Regular Program											
Year	IV	Elective: MEC 1709DECS I.C. Engines: Design and Performance		Credits / Hours per week					Lectures: 03 Practicals: 00		
Semester	I	Year of Introduction: 2025		Maximum Marks / Grade					Theory: 100 PR/TW/VIVA: 50		
Mode of Transaction: Lectures											
Unit No.	Topic			Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/ Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional

									onal Ethics (PE)
1	Performance of I.C. engines, Basic performance parameters, calculation of performance parameters and heat balance sheet, performance curves, comparison of S.I. & C.I. engines.	8	15	1, 2, 3	CO1	PO1 PO3	Emp, Ent, SD	L,N,R,G	G, ES, HV, PE
2	Measurement of performance parameters of I.C. engines, Basic measurement parameters, Measurement of air fuel, speed, exhaust emission and smoke, F.P., I.P, B.P.	8	15	2, 3	CO1	PO1			
3	Supercharging and Turbocharging – objects, Thermodynamic cycles, supercharging of S.I. & C.I. engines, superchargers, parameters of supercharging, comparison of power of supercharged and undercharged engines, Turbocharging.	8	15	2, 3	CO2	PO1			
4	Cooling and Lubrication of I.C. engines, necessity of cooling, effect of over cooling, heat transfer, cooling systems, water cooling methods, effect of various parameters on piston temperature, Lubricating functions, principles of lubrication, properties of Lubricants, Lubricating Systems.	8	15	1, 2, 3	CO2	PO1 PO3			
5	Fuels for S.I. & C.I. engines, L.P.G. as S.I. engine fuel, non-petroleum fuels, additives.	4	8	1, 2, 3	CO3	PO1 PO2 PO3			
6	I.C. engine emission and its control.	4	8	2, 3, 4	CO3	PO1 PO2			

7	Principle of similitude, operating parameters for I.C. engine design.	4	8	2,3,4,5	CO4	PO1 PO2 PO3			
8	Thermal design of I.C. engines & design of main components of I.C. engines.	4	8	1,2	CO4	PO1 PO7			
9	Recent developments in I.C. engines.	4	8	1,2,4	CO5	PO1 PO2			
		52	100						

Course Outcome (CO) MEC1708

1708.01 Understand basic performance measurements and performance parameters of IC engine.

1708.02 Understand basic of supercharging, turbocharging, cooling and lubrication of IC engine.

1708.03 Understand basic of fuels for SI and CI engine and their emission control.

1708.04 Understand basic of Thermal design of IC engine and operating parameters for that.

1708.05 Understand basic of Recent development in IC engine and diesel power plants.

Reference Books

1.	Thermal Engineering by R. K. Rajput, Laxmi publication.
2.	Nag, P.K. Power Plant Engineering, Tata McGraw Hill
3.	Arora & Domkundwar, Power Plant Engineering, Dhanpat Rai & Sons

Syllabus of Courses

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Program Name: B E (Mechanical Engineering)

Program Specific Outcome (PSO)

PSO1: Apply fundamentals of mechanical engineering & concepts of management for problem solving and critical thinking skills with integrity and inclusivity in professional practice or business organization.

PSO2: Achieve engineering career through graduate education, professional courses and/or on-the-job training and experience.

PSO3: Develop leadership, collaborative roles, and resource management in their careers.

Program Outcomes (POs)

PO1 Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Problem Analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Design/development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 Modern Tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6 The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

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PO12 Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering				Academic Year				2025-26		
B. E. (Mechanical Engineering): Regular Program												
Year	IV	MEC1710DECSCRS: Maintenance Engineering & Management (Elective)				Credits / Hours per week				Lectures: 03 Practical: 01		
Semester	I	Year of Introduction: 2025 Year of Syllabus Revision: N.A.				Maximum Marks / Grade				Theory: 100 PR/TW/VIVA: 50		
Mode of Transaction: Lectures and Practical												
Course Outcome (CO) CO 1 Industrial Maintenance requirement. Break down, Preventive, and Predictive maintenance and associated terminology. CO 2 Condition based Maintenance (CBM) by measurement & analysis of machine-system performance parameters. CO 3 CO 4 Repair, revamp & restoration of machinery & equipment Planning, Scheduling, and allocation of resources for maintenance programs. CO 4 Fault diagnosis & failure analysis Concepts of Total Productive Maintenance (TPM) & Reliability Centered Maintenance (RCM).												
Unit No.	Topic			Contact Hours	Weightage (%)	BT Level	CO	PO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/ Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)
1	Requirement of Engineering Maintenance in industries. for Breakdown-Reactive, Preventive & Predictive-Proactive maintenance activities. Terminology; Maintainability, Availability, Reliability, etc.			10	20	1, 2, 3, 4, 5	1	1, 2, 3, 4, 5, 7, 12	1, 2, 3	Emp, Ent, SD	L, N, R, G	G, ES, HV, PE
2	Condition Based Maintenance (CBM): Monitoring machine health parameters viz. temperature, pressure, flow, noise, lubricant status, etc. by measurements and analysis. Applications with case studies.			10	25	1, 2, 3, 4, 5	2	1, 2, 3, 4, 5, 12	1, 2, 3			
3	Repair, revamp, restoration of machines & equipment, and techniques. Planning, scheduling, and allocation of man-machine-money for the maintenance activities. Cost & time consideration.			10	30	1, 2, 3, 4, 5	3	1, 2, 3, 4, 5, 12	1, 2, 3			
4	Mechanical Fault diagnosis & Failure analysis. Failure modes and effect Analysis & Root cause analysis. Concepts of TPM (Total Productive Maintenance) & RCM (Reliability Centered Maintenance).			10	25	1, 2, 3, 4, 5	4	1, 2, 3, 4, 5, 7, 12	1, 2, 3			
				40	100							

Practical

1	Study of maintenance activities in industry with case studies.	2	15	All	1	1, 2, 3, 4, 5, 12	1, 2	Emp, Ent, SD	L, N, R, G	G, ES, HV, PE
2	Instruments for measuring machine health parameters.	2	20	All	2	1, 2, 3, 4, 5, 12	1, 2			
3	Analyzing machine condition data and interpretation for action.t	2	20	All	2	1, 2, 3, 4, 5, 12	1, 2			
4	Virtual maintenance program: Creating planning & execution.	2	20	All	3	1, 2, 3, 4, 5, 12	1, 2			
5	Failure analysis case studies and TPM for an industry	2	25	All	4	1, 2, 3, 4, 5, 12	1, 2, 3			
		10	100							

Reference Books

1.	Mishra R.C. & Pathak K., ‘Maintenance Engineering and management’, PHI
2.	Venkataraman V., ‘Maintenance Engineering and management’, PHI
3.	Ben-Daya, ‘Introduction to Maintenance Engineering’, Wiley
4.	Mobley K., ‘Maintenance Engineering Handbook’, McGraw-Hill
5.	Bloch H. P. & Geitner F. K., ‘Machinery Component Maintenance and Repair’, Gulf Professional Publishing
6.	Collacott R, A., ‘Mechanical Fault Diagnosis and condition monitoring’, Chapman & Hall

Bloom's Taxonomy Levels:

1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: B E (Mechanical Engineering)

Programme Outcomes (POs)

- PO1 Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
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Syllabus of Courses

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering			Academic Year	2019-20
	B. E. (Mechanical Engineering): Regular Programme				
Year	IV	Core-/ Dept Elective / Foundation MEC 1711DECS : Sustainable Energy Sources and Conversion Technologies		Credits / Hours per week	Lectures: 03 Tutorial: 01
Semester	I	Year of Introduction:		Maximum Marks / Grade	Theory: 100 PR/TW/VIVA: 00
Mode of Transaction: Lectures and Tutorials					
	Course Outcome (CO) MEC 1303 CO1 Make students familiar with current energy scenarios, understand impact on environment, make them aware about the plans for development of sustainable energy sources by India and the world. CO2 Know, understand and evaluate the availability of solar radiation and the parameters affecting it. Solar thermal applications and equipment. Evaluate performance of such equipment CO3 Know and understand technologies for conversion of energy from wind. Analyse the performance and evaluate the potential for energy production and performance parameters CO4 Know and understand potential of hydrogen energy, biomass energy, as well as energy storage need and application. CO5 Evaluate economic feasibility and environmental benefits of green energy solutions				

Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PO	PSO	Elements of Employability (Emp) / Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/ Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)
1	Energy, economy, and environment Classification of energy sources, Primary and electrical energy consumption and development indices, Environment impact of energy consumption, climate change and need for sustainable energy sources	04	07	1, 2, 3, 4	CO1	PO 1, PO 6, PO 7	PSO1			
2	Solar Energy Solar Geometry and Solar radiation – Extra-terrestrial solar radiation flux, solar radiation on earth's surface, Sun-earth geometry, Solar radiation measurement instruments: pyranometer, pyrheliometer, models for solar radiation estimation. Solar Energy Utilization – Constructional features	15	27	1, 2, 3, 4, 5	CO2	PO 1, PO 2,	PSO1			

	and pPrinciple of working of solar flat plate collectors and concentrating collectors, Testing of solar collector and efficiency plot, Applications of solar thermal collectors, solar photovoltaic technology, solar rooftop and solar PV power plants					PO 6, PO7		Emp/E nt/ SD	L, N, G	G, ES
3	Wind Energy Classification, Dimensionless parameters for wind energy, Linear momentum theorem and Betz limit, theory of drag machines, Aerofoil theory related to wind turbine, Constructional details and functioning of horizontal axis propeller type wind turbine, Wind farm, Wind energy potential and site selection, Wind energy scenario for India and the world	11	20	1, 2, 3, 4	CO3	PO1, PO2, PO3, PO4, PO7	PSO1			
4	Hydrogen Energy Generation of hydrogen, storage of hydrogen, conversion of hydrogen into useful energy, future of hydrogen as an energy source	08	14	1, 2, 3, 4, 5		PO 1, PO 2, PO 3, PO 7				
5	Energy Storage Materials and Systems Sensible heat storage, Latent heat storage-Phase Change Materials Potential Energy Storage, Chemical energy storage	04	07	1, 2, 3, 4, 5		PO 1, PO 2, PO 3, PO7				
6	Biomass Energy and Other Sources Bio energy sources, Suitable Site for Production and main									

[illegible]

	Reference Books	
1.		Solar Energy, Sukhatme and Nayak, Tata McGraw Hill Edu.
		Solar Engineering of Thermal Processes, Duffie and Beckman, John Wiley & Sons
2.		Renewable Energy Resources, Twidell & Weir, Taylor and Francis
3.		Non-conventional Energy Sources, G. D. Rai, Khanna Pub.
4.		Solar radiant energy over India Edited by Ajit P. Tyagi, MNRE, 2009
5.		Ch. Pavan Kalyan and M. Pavan Das, Future Energy Scenario: A Better Planet with Renewable Energy, 2020
6.		R. Pendse, “Energy Storage Science and Technology”, SBS Publishers & Distributors Pvt. Ltd., New Delhi, (ISBN - 13:9789380090122), 2011

Bloom's Taxonomy Levels:

1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: B E (Mechanical Engineering)**Program Specific Outcome (PSO)**

PSO1 :Apply fundamentals of design, thermo-fluids and production engineering knowledge for innovative and critical thinking, problem-solving and experimental skills with integrity and inclusivity in professional engineering practice or business.

PSO2: Achieve further career development through graduate education, professional development courses and/or on-the-job training and experience. PSO3: Develop leadership and collaborative roles in their careers.

Programme Outcomes(POs)

- PO1 Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO2 Problem Analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
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Syllabus of Courses

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering				Academic Year				2025-26				
	B. E. (Mechanical Engineering): Regular Programme												
Year	IV	Core/ Elective/ Foundation MEC 1712DECS: Product Design and Development				Credits / Hours per week				Lectures: 03 Tutorial: 01			
Semester	I	Year of Introduction: 2025 Year of Syllabus Revision:				Maximum Marks / Grade				Theory: 100 PR/TW/VIVA: Nil			
Mode of Transaction: Lectures and Practicals													
	Course Outcome (CO): Course Outcomes: At the end of the course, the student will be able to CO1: Design and development of product by applying engineering design principles. CO2: Apply structural approach to concept generation, embodiment design, detailed design and material selection in design. CO3: Implement value engineering job plan and value analysis for various products for optimal product cost. CO4: Implement aspects of design for manufacture, design for assembly and design for reliability. CO5: Appy principles of human factors, ethics and environmental factors in product design.												
Unit No.	Topic				Contact Hours	Weightage (%)	BT Level	CO	PO	PSO	Elements of Employability (Emp)/ Entrepreneurs hip (Ent)/	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G)	Relation to Gender (G), Environment and Sustainability

								Skill Development (SD)		(ES), Human Values (HV) and Professional Ethics (PE)
1	Product Design and Development Process: Product Life cycle, Definition of product, Types of Products, Introduction to Product design, Essential factors of Product design, ASIMOV's Morphology of Design, Primary design phases and flow of work, Modern product development process, Product design specifications, challenges of product development	6	10	1, 2,3,4	CO1	PO1 PO2	PSO1	Emp Ent SD	L N R G	ES HV PE
2	Concept Design: Generation, selection & realisation of concept. Product architecture. Industrial design: Need and process. Robust Design: Taguchi Designs & DOE. Theory of inventive problem solving (TRIZ tools),	6	10	1,2	CO1, CO2	PO1, PO2	PSO1			
3	Product design and development tools: Concurrent Engineering, need of concurrent engineering, tools and techniques of concurrent engineering, Quality Function Deployment, Phases of House of Quality, Case studies related to QFD, Rapid prototyping Technique in industrial design, Failure mode and effect analysis (DFMEA & PFMEA) and related case studies, Fault tree analysis	8	13	1,2,3	CO1, CO2	PO1, PO3, PO4	PSO1			
4	Value Engineering: Introduction to value engineering, Value analysis, Types of value, VE job plan, Phases in VE, Functional analysis and FAST diagram, Quantitative analysis of value, Case studies.	10	17	1,2,3,4	CO3	PO1, PO2 PO3, PO4, PO9	PSO1 PSO2			
5	Design for Reliability:	6	10	1,2,3	CO4	PO1, PO3	PSO1 PSO2			

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering			Academic Year			2025-26			
		B. E. (Mechanical Engineering): Regular Programme									
Year	IV MECH	Core / Elective/ Foundation MEC 1706DECS: Fundamental of Aeronautics			Credits / Hours per week			Lectures: 04 Practical:- 00			
Semester	I	Year of Introduction: 2024 Year of Syllabus Revision:			Maximum Marks / Grade			Theory: 100 PR/TW/VIVA: 00			
Mode of Transaction: Lectures and Tutorials											
		Course Outcome (CO) MEC XXXX CO1 To identify the unique terminology associated with aircraft and its background CO2 To understand behavior and effects of air over aircraft body CO3 To understand propulsion system of arial vehicle CO4 To understand airframe components and loads applied on aircraft structures. CO5 To explain fundamentals of avionics systems of an airplane									
Unit No.	Topic		Contact Hours	Weightage (%)	BT Level	CO	PSO	PO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)
1	Introduction to aeronautics: History of flight, types of arial vehicles, Types of aircrafts, Anatomy of the airplane, Ailerons, Elevators, Rudder, Flaps, Trim Tabs, Air brakes, Spoilers		08	10	1,2	CO1	PSO1	PO1, PO2	All	All	ES, PE
2	Airplane Aerodynamics: Basic Aerodynamics, Aerofoil nomenclature, Lift, Drag, and moment co-efficient, pressure co-efficient, critical pressure co-efficient, critical Mach number,		10	25	1,2	CO1	PSO1	PO1, PO2			

	drag-divergence Mach number, Wave drag, Induced drag, Drag polar curve, Finite wing, Swept and delta wing, High lift devices.									
3	Airplane Propulsion: Fundamentals of Propulsion, Propeller, Reciprocating engine, Jet propulsion, Turbojet, Turbofan, Ramjet, Scram jet engines. Rocket engine	10	25	1,2	CO2	PSO1	PO1,PO2			
4	Airplane structure: Introduction to aircraft structure, Basic function of aircraft structure, Aircraft configuration and principle types of Construction, Stress-Strain diagrams, Plane and Space, Trusses, loads on airplane components. Introduction to Landing gears	08	20	1,2,3	CO3	PSO1	PO1,PO2,P O3			
5	Aircraft Instruments: Air speed indicators, Altimeters, Rate of climb/descent meter, Basic instruments in Avionics. Elementary ideas about Hydraulic and pneumatic systems, pressurization, temperature control and oxygen system	08	20	1,2,3	CO3	PSO1	PO1, PO2			
	Total	44	100							
	List of Tutorials									
1	Historic evolution in the aircraft design	02	25	3,4	CO1					
2	Role of CFD in aircraft design	02	25	3,4	CO2					
3	Preparation guidance of manufacturing of RC plane	02	25	4,5	CO2					
4	Case study on flow measuring instruments	02	25	4,5	CO5					
	Total	08	100							
Reference Books										
1.	“Aerodynamics” by L.J.Clancy, Published by Sterling Book House, Indian Edition									
2.	“Fundamentals of Aerodynamics” by John D. Anderson, Jr. McGraw Hill Inc.									
3.	“Introduction to Flight” by John D. Anderson, Jr. McGraw Hill Inc.									
4.	“Gas Turbine” by V. Ganesan, Tata-McGraw Hill Publishing Company Ltd, New Delhi									
5.	“Theory and Analysis of Flight Structure” by R M Rivello, McGrawHill Book Co.									
6.	“Avionics Systems” by D H Middleton, Longman Scientific & Technical.									

Bloom's Taxonomy Levels:

1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: B E (Mechanical Engineering)

Programme Outcomes (POs)

- PO1 Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
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- PO8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
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- PO10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- PO11 Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- PO12 Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Syllabus of Courses

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering			Academic Year			2019-20					
B. E. (Mechanical Engineering): Regular Programme													
Year	IV	Core/ Department Elective / Foundation MEC1803DECS : Advanced and Green Air Conditioning Technology			Credits / Hours per week				Lectures: 03 Tutorials: 01				
Semester	II	Year of Introduction:			Maximum Marks / Grade				Theory: 100 PR/TW/VIVA: 00				
Mode of Transaction: Lectures and Practicals													
Course Outcome (CO) MEC 1303 CO1 Make students familiar with current and future growth scenario of air conditioning systems. CO2 Understand concept of thermal comfort and Indoor Air Quality CO3 Analyze and evaluate cooling loads on an air-conditioned space. CO4 Know and understand various air conditioning systems and their applications, standards and codes CO5 Understand and evaluate green technologies in the field of air conditioning													
Unit No.	Topic				Contact Hours	Weightage (%)	BT Level	CO	PO	PSO	Element s of Employa bility (Emp)/ Entrepre neurship (Ent)/ Skill Develop ment (SD)	Relevan ce to Local (L)/ National (N)/ Regional (R)/Glob al (G)	Relation to Gender (G), Environ ment and Sustaina bility (ES), Human Values (HV)and Professio nal Ethics (PE)
1	India Climatic Conditions Cooling Demand Current and future scenario, environmental impact				03	05	1, 2	CO1	PO1, PO6, PO7	PSO1	Emp/Ent/ SD	L, N, G	G, ES

2	Thermal Comfort and IAQ ASHRAE and other standards, Adaptive thermal comfort, Indoor air quality and parameters affecting it, case studies		07	13	1, 2, 3, 4, 5	CO2	PO1, PO2, PO6, PO7	PSO1			
3	Cooling Load in a Conditioned Space Cooling load calculation for conditioned space: internal and external, Reducing Cooling Demand in Buildings by Passive Cooling Methodologies		16	29	1, 2, 3, 4, 5	CO3	PO1, PO2, PO3, PO4, PO5	PSO1			
4	Air Conditioning Systems and Components Various types of air conditioning systems, their components, Air distribution and Ventilation, recent developments and applications		12	21	1, 2, 3, 4, 5	CO4	PO1, PO2, PO3, PO4				
5	Energy Saving and Not-in-kind Air Conditioning Technologies Methods increase energy efficiency, DEC, IEC, DPC, Multistage cooling systems, Desiccant based AC systems, Non-conventional cold distribution methods, use of renewable energy sources		12	21	1, 2, 3, 4, 5	CO5	PO1, PO2, PO3, PO4, PO5, PO7				
6	India Cooling Action Plan, Building codes, labelling and certification		04	07	1, 2, 5	CO4	PO1, PO2, PO3, PO4, PO7	PSO1			
	Reference Books										
1.		ASHRAE Handbook, Fundamentals									
2.		ASHRAE Handbook, HVAC applications									
3.		Refrigeration and Air conditioning- C P Arora, Tata McGraw Hill Publication									
4.		ISHRAE handbooks, standards, Journals and booklets									
5.		Principles of Heating Ventilating and Air Conditioning, Howell, Coad and Sauer, ASHRAE publication									
6.		NPTEL notes on Air Conditioning									

Bloom's Taxonomy Levels: 1. Remember

2. Understand

3. Application

4. Analysis

5. Evaluation

6. Creation

Program Name: B E (Mechanical Engineering)

Program Specific Outcome (PSO)

PSO1: Apply fundamentals of design, thermo-fluids and production engineering knowledge for innovative and critical thinking, problem-solving and experimental skills with integrity and inclusivity in professional engineering practice or business.

PSO2: Achieve further career development through graduate education, professional development courses and/or on-the-job training and experience.

PSO3: Develop leadership and collaborative roles in their careers.

Program Outcomes (POs)

- PO1 Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO2 Problem Analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- PO3 Design/development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO4 Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- PO5 Modern Tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- PO6 The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- PO7 Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- PO8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- PO9 Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- PO10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
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- PO12 Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Syllabus of Courses

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering				Academic Year				2025-26		
B. E. (Mechanical Engineering): Regular Program												
Year	IV MECH	MEC1804DECS: PLM Fundamentals				Credits / Hours per week				Lectures: 03 Tutorial:- 01		
Semester	II	Year of Introduction: 2025-2026 Year of Syllabus Revision:				Maximum Marks / Grade				Theory: 100 PR/TW/VIVA: 00		
Mode of Transaction: Lectures and Practical												
Course Outcome (CO) MEC 18XXDECS CO1 Justify importance and need of various components/elements of PLM. CO2 Able to demonstrate the benefits of PLM implementation/deployment. CO3 Distinguish various tasks terminologies used in domain of PLM. CO4 Apply and design the various strategies for process and product data management. CO5 Build /configure organisations, product structures, bill of materials, workflow, projects and requisite tasks in PLM.												
Unit No.	Topic			Contact Hours	Weightage (%)	BT Level	CO	PO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	Introduction: Overview, Need, Benefits, Concept of Product Life Cycle, Components / Elements of PLM, Emergence and Significance of PLM, PLM implementation cases in various industry verticals.			10	16	1, 2, 3	1, 2	1, 2, 3, 12	1,2,3	Emp, Ent, SD	L, N, R, G	G, ES, HV, PE
2	PLM Strategy and Vision: Company’s PLM vision, PLM Strategy, Principles for PLM strategy, Preparing for the PLM strategy, Developing a PLM strategy, Strategy identification and selection, PLM business goals.			10	16	1, 2, 3	1, 2	1, 2, 3, 4	1,2			
3	Information, Tools, Information systems and people involved in PLM. Product data and processes like New Product Development, Change Management,			10	16	All	2, 3	1, 2, 3, 4	1,2			

	Concurrent Design & Process Management, product data linkages across the domain.									
4	PLM Solutions: Different phases of product lifecycle and corresponding technologies, Enterprise information, knowledge and IP, Change Process, Product Structure & Configuration, Bill of Material, Requirement, Portfolio, Program & Project, Engineering Process, Supplier Relationship, Manufacturing Process, Maintenance Repair & Overhaul process and Simulation Process Management.	20	34	All	2, 3	1, 2, 3, 4	1,2			
5	Human resources in product lifecycle, Methods, Techniques, Practices, Methodologies, Processes, System components in lifecycle, slicing and dicing the systems, Interfaces, Information Standards, Vendors of PLM Systems and Components.	10	16	All	4, 5	1, 2, 3, 4	1,2			
		60	100							

Reference Books

1.	Grieves, Michael, Product Lifecycle Management, McGraw-Hill, 2006. ISBN 0071452303
2.	Antti Saaksvuori, Anselmilmonen, Product Life Cycle Management - Springer, 1st Edition (Nov.5, 2003)
3.	Stark, John. Product Lifecycle Management: Paradigm for 21st Century Product Realization, Springer- Verlag, 2004. ISBN 1852338105
4.	Kari Ulrich and Steven D. Eppinger, Product Design & Development, McGraw Hill International Edns, 1999.

Bloom's Taxonomy Levels:

1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: B E (Mechanical Engineering)**Programme Outcomes(POs)**

- PO1 Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO2 Problem Analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- PO3 Design/development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO4 Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- PO5 Modern Tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- PO6 The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- PO7 Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- PO8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- PO9 Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- PO10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- PO11 Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- PO12 Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda		Academic Year					2025-26		
	Faculty Technology and Engineering									
	Department of Mechanical Engineering									
B. E. (Mechanical Engineering): Regular Programme										
Year	IV	MEC1805DECS: Thermal Power and Propulsion Systems	Credits / Hours per week					Lectures: 04 Practicals: 00		
Semester	II	Year of Introduction: 2025-26	Maximum Marks / Grade					Theory: 100 PR/TW/VIVA: 00		
Mode of Transaction: Lectures										
Unit No.	Topic		Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/ Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional

									Ethics (PE)
1	Gas Turbine Plants: Review of gas turbine cycles and gas turbine plants, Analysis of gas turbine plants, Analysis of gas turbine cycles, performance curves, Actual gas turbine plants, Determination of output and efficiency, Applications, Economics of Gas turbine plants.	14	20	1, 2	CO1	PO1, PO12, PO5	Emp Ent SD	L N R G	ES HV PE
2	Combustion Chambers of Gas Turbines: Process of combustion, types of combustion chamber – performance and operating characteristics of combustion chambers.	7	20	2, 3, 4	CO1	PO1, PO2, PO3			
3	Jet Propulsion Engines: Air breathing engines and Rocket engines, types of Jet engine, Fuels, Determination of thrust and propulsion efficiency performance curves.	7	20	2, 4, 5	CO3	PO1, PO3, PO11			
4	Steam Turbine Plants; Review of steam turbine cycles and general layout of steam power plants, Dual purpose steam turbines, Applications, economics of steam power plants.	14	20	2, 4, 5	CO4	PO1, PO4			

5	Combined Gas – Steam Power Plants: Advantages, applications, power developed and efficiency, economics of such plants.	10	20	2, 4, 5	CO4	PO1, PO2, PO3			
		52	100						
Course Outcome (CO) MEC 3XX2 3XX2.01 Understand basic of gas turbine plant and it's combustion chamber. 3XX2.02 Understand basic of Compressors. 3XX2.03 Understand basic of jet propulsion engines. 3XX2.04 Understand basic of steam turbine plant and combined cycle plants. 3XX2.05 Understand basic of nuclear power plant.									
Reference Books									
1.	Thermal Engineering by R. K. Rajput, Laxmi publication.								
2.	Nag, P.K. Power Plant Engineering, Tata McGraw Hill								
3.	Arora & Domkundwar, Power Plant Engineering, Dhanpat Rai & Sons								

Syllabus of Courses

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering			Academic Year			2025-26			
		B. E. (Mechanical Engineering): Regular Programme									
Year	IV	Core / Elective/Foundation MEC1806DECS: Computational Fluid Dynamics Modelling			Credits / Hours per week			Lectures: 04 Practical:- 00			
Semester	II	Year of Introduction: 2025 Year of Syllabus Revision:			Maximum Marks / Grade			Theory: 100 PR/TW/VIVA: 00			
Mode of Transaction: Lectures and Tutorials											
		Course Outcome (CO) MEC XXXX CO1 Demonstrate proficiency in advanced CFD tools for fluid flow simulation. CO2 Analyze and optimize complex fluid systems using CFD. CO3 Simulate cavitation, multiphase flows, and heat transfer problems. CO4 Apply CFD techniques to solve industry-relevant problems.									
Unit No.	Topic		Contact Hours	Weightage (%)	BT Level	CO	PSO	PO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	Advanced CFD Fundamentals: Overview of CFD tools: ANSYS Fluent, Open-FOAM. Meshing techniques: Structured, unstructured, and hybrid.		10	20	1,2	CO1	PSO1	PO1, PO2	All	All	ES, PE
2	Turbulence Modeling in CFD Software: Overview of turbulence models: RANS, LES, and DNS. Application of turbulence models in CFD software. Practical sessions: Comparing turbulence models for flow over a cylinder.		10	20	1,2, 3	CO2	PSO1	PO1,PO2			

3	Multiphase Flow and Cavitation Modeling: Modeling multiphase flows using VOF and Eulerian approaches. Simulation of cavitation in pumps and nozzles. Case study: Bubble dynamics in multiphase systems.	10	20	1,2,3	CO3	PSO1	PO1, PO2			
4	Heat Transfer and Combustion Modeling: Conduction, convection, and radiation modeling. Combustion modeling: Finite-rate chemistry and eddy dissipation models. Case study: Simulation of heat exchangers and combustion chambers.	10	20	1,2,3	CO4	PSO1	PO1, PO2			
5	Industry Applications of CFD: Aerospace: Airfoil and wing analysis. Automotive: Aerodynamics and thermal management. Electronics cooling: Vapor chamber, micro channel. Energy: Wind turbines, heat exchangers, and combustion systems. Etc.	12	20	2,3,4	CO4	PSO1	PO1, PO2, PO3			
	Total	52	100							
Reference Books										
1.	Computational Fluid Dynamics: The Basics with Applications by John D. Anderson									
2.	An Introduction to Computational Fluid Dynamics: The Finite Volume Method by H.K. Versteeg and W. Malalasekera									
3.	CFD Module Reference Manual (ANSYS Fluent Documentation)									
4.	Applied Computational Fluid Dynamics Techniques by Rainald Lohner									
5.	Numerical Heat Transfer and Fluid Flow by Suhas V. Patankar									

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering			Academic Year			2025-26		
		B. E. (Mechanical Engineering): Regular Programme								
Year	IV	Elective MEC1807DECS :Aircraft Design		Credits / Hours per week					Lectures: 04 Practical:- 00	
Semester	II	Year of Introduction: 2025-26		Maximum Marks / Grade					Theory: 100 PR/TW/VIVA: 00	
Mode of Transaction: Lectures and Practical										
		Course Outcome (CO) MEC CO 1 Determine the Various Aircraft Engines design . CO 2 Performance of Aircraft engines range and endurance. CO 3 Analysis of wing design Parameters. CO 4 Determining stability systems. CO 5 Determining aircraft maintenance and cost .								
Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	Overview of the Design Process: wing loading and thrust loading. Basic Design-Lift and Drag	05	10%	1	CO1	PO1,PO2	PSO1			
2	Range and Endurance:	10	20	2,3,5	CO1,	PO2,PO3,P	PSO1			

	Propeller-driven Aircraft, jet driven aircraft. Fuel consumption. L/D for Maximum.				CO2, CO3	O4				
3	Estimation of fuel :Design consideration: power plant, Gross weight, Aerofoil selection and wing.	5	10%	2,3,5	CO1, CO2, CO3	PO2,PO3,PO7	PSO1	ALL	All	ES,HV,PE
4	Wing design: aerofoil, t/c, camber and leading edge radius, aspect ratio, sweep, twist and taper ratio.	10	20	2,4	CO4	PO2,PO3,PO4	PSO1			
5	Wing arrangement, tail arrangements, aircraft structure. Wing loading. Stability considerations.	10	20	1,2,3,4	CO4	PO2, PO5	PSO1			
6	Static stability basics, wing and tail contribution to longitudinal static stability. Conceptual Design Examples	4	8%	1,2	CO3	PO2,PO3	PSO1			
7	Elevator Effectiveness. Elevator Effectiveness Contd.	4	8%	2,4,6	CO3	PO4,PO5	PSO1			

8	Aircraft Maintenance Guidelines, Inspection for Aircraft. Operations and Maintenance cost.	4	8%	1,2	CO5	PO4,PO5	PSO1			
	.									
		52	100							
		Reference Books								
1.		Aircraft Design: A Conceptual Approach by Daniel P. Raymer								
2.		Introduction to Flight By – Anderson								
3.		Aircraft Propulsion Systems Technology and Design By- Gordon C Oates								

Syllabus of Courses

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering			Academic Year			2025-26			
		B. E. (Mechanical Engineering): Regular Program									
Year	IV	Core / Elective/ Foundation MEC1808DECS : Fundamentals of Combustion			Credits / Hours per week				Lectures: 04 Practical:- --		
Semester	I	Year of Introduction: 2025-2026			Maximum Marks / Grade				Theory: 100 PR/TW/VIVA: 50		
Mode of Transaction: Lectures and Practical											
		Course Outcome (CO) MEC XXXX CO1 describe various combustion mechanisms and how these can be efficiently used in engineering applications CO2 Analyze combustion characteristics and measurement of the same CO3 explain basis concepts about combustion processes for efficient designing of burners for different types of fuels CO4 Understanding of energy transfer and fluid flow mechanism in turbomachine CO5 Apply the concepts of combustion and problem solving									
Unit No.	Topic		Contact Hours	Weightage (%)	BT Level	CO	PSO	PO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/ Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)
1	Introduction: Introduction to combustion and its application, Combustion of different fuels and characterisation, Combustion modes and flame types		04	15	2,3	CO1	PSO1	PO1, PO2, PO3	All	All	ES, PE
2	Combustion and Thermochemistry: Thermodynamic properties, reactant and product mixture, Stoichiometry, equivalence ratio combustion equilibrium, Adiabatic flame		06	15	2,3	CO2	PSO1	PO1, PO2, PO3			

	temperature, Laws of thermochemistry									
3	Combustion Kinetics: Basics of reaction, Elementary reaction rates, rates of multistep reactions, chain and chain branching reactions	06	10	4	CO3	PSO1	PO1, PO2, PO3			
4	Conservation Equations for Reacting Flows Fundamental laws, species mass conservation, multicomponent diffusion, momentum conservation, energy conservation, concept of conserved scalar.	06	10	4	CO3	PSO1	PO1, PO2, PO3, PO4			
5	Premixed Flame: Laminar premixed flames, physical description, simplified analysis, factors affecting Flame velocity and thickness, flame stabilization	06	10	2,3	CO4	PSO1	PO1, PO2, PO3, PO4			
6	Diffusion Flame: Gas and liquid fuel combustion, simplified theoretical description, introduction to Spray and solid fuel combustion	06	10	2,3	CO4	PSO1	PO1, PO2, PO3, PO4, PO5			
7	Combustion and Environment: Effects of pollutants, emission from premixed and non-premixed combustion, quantification of emission	02	15	3,4	CO5	PSO1	PO1, PO2, PO3, PO4, PO5			
		36								
Reference Books										
1.	“An Introduction to Combustion” by S. R. Turns, McGraw-Hill Education Edition									
2.	“Understanding Combustion”, H. S. Mukunda, University Press, 2009									
3.	“Fundamentals of Combustion”, D P Mishra., Prentice hall of India									

Bloom's Taxonomy Levels:

1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: B E (Mechanical Engineering)

Programme Outcomes (POs)

- PO1 Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO2 Problem Analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- PO3 Design/development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO4 Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
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- PO10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- PO11 Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- PO12 Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Syllabus of Courses

 मत्स्यं जिवं सुन्दरम्		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering			Academic Year				2024-25			
	B. E. (Mechanical Engineering): Regular Programme											
Year	IV	Core/ Department Elective / Foundation MEC1809DECS : Advanced and Green Refrigeration Technology			Credits / Hours per week				Lectures: 03 Tutorialss: 01			
Semester	II	Year of Introduction:			Maximum Marks / Grade				Theory: 100 PR/TW/VIVA: 00			
Mode of Transaction: Lectures and Practicals												
	Course Outcome (CO) MEC 1303 CO1 Make students familiar with current energy scenarios, understand the impact of refrigeration systems and refrigerants on environment, make them aware of recent developments in refrigerants CO2 Know about various components of VCR systems, anlysis, advancements in technology, evaluate performance CO3 Know and understand needs and application of refrigeration systems. CO4 Understand and analyze alternative refrigeration systems, CO5 Analyze and evaluate various energy storage systems and insulations used in refrigeration field											
Unit No.	Topic			Contact Hours	Weightage (%)	BT Level	CO	PO	PSO	Element s of Employa bility (Emp)/ Entrepre neurship (Ent)/ Skill Develop ment (SD)	Relevan ce to Local (L)/ National (N)/ Regional (R)/Glob al (G)	Relation to Gender (G), Environ ment and Sustaina bility (ES), Human Values (HV)and Professio nal Ethics (PE)
1	Prospects of Future Growth in Refrigeration Industry Current and future growth predictions, Environmental impact			03	09	1, 2, 3, 4	CO1	PO1, PO6, PO7	PSO1	Emp/Ent/ SD	L, N, G	G, ES

2	Refrigerants International Agreements and India's Commitments; Montreal protocol, Kigali agreement etc. Current scenario and future of refrigerants, Factors affecting choice of refrigerants	07	25	1, 2, 3, 4, 5	CO2 CO3	PO1, PO2, PO6, PO7	PSO1			
3	Vapor Compression Refrigeration Systems: Components and Advance features; Energy efficiency of VCR systems Components of VCR systems and recent advancements, Energy efficiency parameters and evaluation	08	16	1, 2, 3, 4, 5	CO5	PO1, PO2, PO3, PO4, PO7	PSO1			
4	Applications of Refrigeration Food processing and storage, Ice-making, Low and ultra-low temperature applications, transport refrigeration	10		1, 2, 3		PO1, PO2, PO3, PO7				
5	Alternative Refrigeration Systems Vapour absorption and adsorption systems, Thermoelectric cooling, use of renewable energy source or waste heat for refrigeration, co-generation and tri-generation	03		1, 2, 3, 4, 5		PO1, PO2, PO3, PO7				
6	Insulation and Thermal Energy Storage Need for insulation, various insulation materials and properties Sensible and Latent heat storage: materials and systems, need and benefits	07	14	1, 2, 3, 5	CO4	PO1, PO2, PO3, PO4, PO7	PSO1			
	Reference Books									
1.		ASHRAE Handbook: Fundamentals								
2.		ASHRAE/ISHRAE Handbook: Refrigeration								
3.		Refrigeration and Air conditioning- C P Arora, Tata McGraw Hill Publication								
4.		Refrigeration and Air Conditioning: Stoecker and Jones								
5.		ISHRAE handbooks, standards, Journals and booklets								
6.		NPTEL notes on Refrigeration								
7.		Ibrahim Dincer and Mark A. Rosen, Thermal Energy Storage Systems and Applications, John Wiley & Sons 2002								
8.		Principles of Refrigeration by Roy.J.Dossat, 1997								

Bloom's Taxonomy Levels: 1. Remember

2. Understand

3. Application

4. Analysis

5. Evaluation

6. Creation

Program Name: B E (Mechanical Engineering)

Program Specific Outcome (PSO)

PSO1: Apply fundamentals of design, thermo-fluids and production engineering knowledge for innovative and critical thinking, problem-solving and experimental skills with integrity and inclusivity in professional engineering practice or business.

PSO2: Achieve further career development through graduate education, professional development courses and/or on-the-job training and experience.

PSO3: Develop leadership and collaborative roles in their careers.

Program Outcomes (POs)

PO1 Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 Problem Analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Design/development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 Modern Tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6 The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Syllabus of Courses

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering				Academic Year				2025-26		
B. E. (Mechanical Engineering): Regular Program												
Year	IV MECH	MEC1810DECS: Digital Manufacturing				Credits / Hours per week				Lectures: 03 Tutorial:- 01		
Semester	II	Year of Introduction: 2025-2026 Year of Syllabus Revision:				Maximum Marks / Grade				Theory: 100 PR/TW/VIVA: 00		
Mode of Transaction: Lectures and Tutorial												
Course Outcome (CO) MEC 18XXDECS CO1 Understand the use of various elements of digital manufacturing tools. CO2 Select proper procedure of validating practical work through digital validation. CO3 Administer for installing, configuring, integrating digital manufacturing tools. CO4 Analyse and optimise various practical manufacturing processes through digital simulation CO5 Model manufacturing problems through digital platforms												
Unit No.	Topic			Contact Hours	Weightage (%)	BT Level	CO	PO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	Introduction to Digital Manufacturing: A Brief History of Manufacturing, Digital Manufacturing Today, Digital Design, Digital Materials, Digital Fabrication, Digital Products, Technology Development, Applications Development, People and Business, The Digital Economy, Transition from Industrial Manufacturing			10	16	1, 2, 3	1, 2	1, 2, 3, 12	1,2,3	Emp, Ent, SD	L, N, R, G	G, ES, HV, PE
2	Process simulation and validation: Assembly and component manufacturing, process simulation and validation, Ergonomic/ human simulation, Robotic simulation and OLP.			10	17	1, 2, 3	1, 2	1, 2, 3, 4	1,2			
3	Plant design, simulation & optimisation: Station / work-cell layout design, Throughput simulation,			10	17	All	2, 3	1, 2, 3, 4	1,2			

	Discrete event simulation, Optimisation of material flow and logistic									
4	Manufacturing process simulation solution customisation: Functionality enhancements as extensions of OOTB software solution, Reports customisation, User interface customisation	15	25	All	2, 3	1, 2, 3, 4	1,2			
5	Special Topics: Informatics platform for designing and deploying e-manufacturing systems, framework for integrated design of Mechatronic systems, Collaborative supplier integration for product design and development. Reconfigurable manufacturing systems design, Virtual Reality based platform for collaborative product review and customisation, managing collaborative process planning activities through extended enterprise, rapid product development, desktop assembly factories, Information sharing in digital manufacturing based on STEP and XML	15	25	All	4, 5	1, 2, 3, 4	1,2			
		60	100							
Reference Books										
1.	Wang, Lihui; Nee, Andrew Y.C. (Eds.) Collaborative Design and Planning for Digital Manufacturing, Springer, 2009									

Bloom's Taxonomy Levels:

1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: B E (Mechanical Engineering)**Programme Outcomes(POs)**

- PO1 Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO2 Problem Analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- PO3 Design/development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO4 Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- PO5 Modern Tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- PO6 The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- PO7 Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- PO8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- PO9 Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- PO10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- PO11 Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- PO12 Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering		Academic Year					2025-26		
B. E. (Mechanical Engineering): Regular Programme										
Year	IV	MEC1811DECS: Modern Power Plant Systems and Load Management	Credits / Hours per week					Lectures: 03 Practicals: 00		
Semester	II	Year of Introduction: 2025	Maximum Marks / Grade					Theory: 100 PR/TW/VIVA: 50		
Mode of Transaction: Lectures										
Unit No.	Topic		Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/ Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional

									Ethics (PE)
1	Nuclear Power Plants: Main elements of a nuclear power plant and their arrangement, types of nuclear furnaces and moderator, heat exchangers, turbines, nuclear reactors, general components of nuclear reactors, types of nuclear reactors, their applications and their relative merits and demerits, special problems with fast reactors, general design consideration, heat transfer problems in nuclear reactors, principles of control and operation, Location of nuclear power plants, nuclear power development, operation and maintenance of nuclear plants, Safety precautions during the operation of nuclear power plants, Nuclear materials, moderating and reflecting materials, control rod materials shielding materials, effects of nuclear radiating, Disposal of nuclear waste, Comparison of nuclear power plants with other types of power plants.	14	20	1, 2	CO1	PO1, PO12, PO5	Emp Ent SD	L N R G	ES HV PE
2	Hydro Power Plant: Essential Features/Elements of Hydro-electric Power Plant, Applications of Hydro-electric Plants, Advantages and Disadvantages of Hydro-electric Plants, Selection of Site for a Hydro-electric Plant, Classification of Hydro-electric Power Plants, Hydraulic Turbines, Plant Layout, Hydro-Plant Auxiliaries	7	18	2, 3, 4	CO1	PO1, PO2, PO3			
3	Disel Power Plant: Heat Engines, Classification of I.C. Engines, Essential Components of a Diesel Power Plant, Operation of a Diesel Power Plant, Application	7	18	2, 4, 5	CO3	PO1, PO3, PO11			

	of Diesel Power Plant, Site Selection, Types of Diesel Engine used for Diesel Power Plants, Layout of a Diesel Power Plant								
4	Fluctuating Load: Introduction, load curves, different terms and definitions, effect of variable load on power plant design and operation, method to meet variable loads.	9	13	2, 4, 5	CO4	PO1, PO4			
5	Peak Load: Requirements, pump storage power plants, economical justification of pump storage plant, their advantages and disadvantages compressed air storage plants, their advantages and limitation.	5	13	2, 4, 5	CO4	PO1, PO2, PO3			
6	Combined Operation of Power Plant Their advantages, load division between power stations storage type hydro electric plant on combination with steam power plant, run-off river plant in combination with steam power plant, coordination hydroelectric and gas turbine plants, coordination of hydroelectric and nuclear power plants.	10	18			PO1, PO2, PO3			
		52	100						

Course Outcome (CO) MEC 3XX3

3XX3.01 Understand basic of gas turbine plant and it's combustion chamber.

3XX3.02 Understand basic of Compressors.

3XX3.03 Understand basic of jet propulsion engines.

3XX3.04 Understand basic of steam turbine plant and combined cycle plants.

3XX3.05 Understand basic of nuclear power plant.

Reference Books

- | | |
|----|---|
| 1. | Thermal Engineering by R. K. Rajput, Laxmi publication. |
| 2. | Nag, P.K. Power Plant Engineering, Tata McGraw Hill |
| 3. | Arora & Domkundwar, Power Plant Engineering, Dhanpat Rai & Sons |

Syllabus of Courses

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering			Academic Year			2025-26				
		B. E. (Mechanical Engineering): Regular Programme										
Year	IV	Core / Elective/ Foundation MEC1812DECS: Multiphase Flow Physics			Credits / Hours per week			Lectures: 04 Practical:- 00				
Semester	II	Year of Introduction: 2025 Year of Syllabus Revision:			Maximum Marks / Grade			Theory: 100 PR/TW/VIVA: 00				
Mode of Transaction: Lectures and Tutorials												
		Course Outcome (CO) MEC XXXX CO1 Classify and analyze different types of multiphase flow regimes and their characteristics. CO2 Understand the mechanics of cavitation and its impact on engineering systems. CO3 Apply computational and experimental techniques to study multiphase flow and cavitation phenomena. CO4 Evaluate and design systems for efficient operation in multiphase and cavitation-prone environments.										
Unit No.	Topic			Contact Hours	Weightage (%)	BT Level	CO	PSO	PO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	Introduction to Multiphase Flow: Types of multiphase flows: Gas-liquid, liquid-liquid, and gas-solid systems. Flow regimes: Stratified, slug, bubble, and annular flows.			10	20	1,2	CO1	PSO1	PO1, PO2	All	All	ES, PE
2	Equations for Multiphase Flows: Continuity, momentum, and energy equations for multiphase systems. Two-fluid and mixture models. Challenges in numerical modeling of multiphase flows.			10	20	1,2,3	CO1	PSO1	PO1, PO2			
3	Fundamentals of Cavitation Technology:			10	20	1,2,3	CO2	PSO1	PO1, PO2			

	Cavitation in pumps, turbines, and marine propellers. Application of hydrodynamic cavitation in water treatment and biodiesel production. Case studies on cavitation in industrial systems.									
4	Applications of Multiphase Flow and Cavitation: Cavitation in pumps, turbines, marine propellers, and water treatment systems. Multiphase flow in oil and gas pipelines, nuclear reactors, and chemical processes. Case studies: Cavitation in multiphase flow environments.	10	10	1,2,3	CO3	PSO1	PO1, PO2			
5	Computational and Experimental Techniques: CFD modeling of multiphase flow and cavitation using VOF and Eulerian approach. Experimental visualization techniques: High-speed photography. Simulation of cavitation in Venturi tubes and orifices. Comparison of experimental and computational results.	12	20	2,3,4	CO4	PSO1	PO1, PO2, PO3			
	Total	52	100							
Reference Books										
1.	Elements of Multiphase Flow by C.T. Crowe									
2.	Cavitation and Bubble Dynamics by Christopher E. Brennen									
3.	Hydrodynamic Cavitation by Vivek V. Ranade, Vinay M. Bhandari, and Aniruddha B. Pandit									
4.	Introduction to Multiphase Flow by Christophe Morel									
5.	Hydrodynamics of Multiphase Flow by Ashutosh Kumar Dubey and S.K. Gupta									

Syllabus of Courses

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering			Academic Year			2025-26			
		B. E. (Mechanical Engineering): Regular Programme									
Year	IV	Core / Elective/ Foundation MEC1814DECS: Advance Heat and Mass Transfer		Credits / Hours per week				Lectures: 04 Practical:- 00			
Semester	II	Year of Introduction: 2025-2026		Maximum Marks / Grade				Theory: 100 PR/TW/VIVA: 00			
Mode of Transaction: Lectures and Practical											
		Course Outcome (CO) MEC XXXX CO1 Understanding of compressible flow and shock waves CO2 Understanding of 1D isentropic flow and flow with friction CO3 Understanding of flow with heating and cooling CO4 Understanding of energy transfer and fluid flow mechanism in turbomachine CO5 Apply cascade theory to radial and axial turbomachines									
Unit No.	Topic		Contact Hours	Weightage (%)	BT Level	CO	PSO	PO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/ Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)
1	The Equation of Continuity: Overall Mass Balance, Momentum Balance, Energy Balance, Special Mass Balance, Equation of fluxes		10	15	2,3	CO1	PSO1	PO1, PO2, PO3	All	All	ES, PE
2	Diffusive Heat and Mass Transfer: Steady and Unsteady, One and Multiple dimensions, Perturbation Techniques, Moving Boundary Problems, Simultaneous Heat and Mass Transfer		15	15	2,3	CO2	PSO1	PO1, PO2, PO3			
3	Convective Heat and Mass Transfer:		10	10	4	CO3	PSO1	PO1, PO2,			

	Flow inside Ducts, Dispersion, Laminar Boundary Layer, Asymptotic Methods, Simultaneous Momentum, Natural Convection						PO3			
4	Multicomponent Transport: Binary Systems, Multi Component Flux Equations, Thermal diffusion, Dimensional Analysis	10	10	4	CO3	PSO1	PO1, PO2, PO3, PO4			
5	Mass Transfer in Turbulent Flow: Time averaging and eddy viscosity, universal velocity, mass transfer in turbulent pipe flow	10	10	2,3	CO4	PSO1	PO1, PO2, PO3, PO4			
		55								
Reference Books										
1.	Heat and Mass Transfer – Fundamentals and Applications, Yunus A Cengel, Afshin J Ghajar, McGraw Hill									
2.	Heat and Mass Transfer – P K Nag, McGraw Hill									
3.	A Textbook of Heat and Mass Transfer – R K Rajput, S Chand									

Syllabus of Courses

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Mechanical Engineering			Academic Year			2025-26			
		B. E. (Mechanical Engineering): Regular Programme									
Year	IV	Core/ Elective/Foundation MEC1813DECS: Jet Propulsion Systems			Credits / Hours per week			Lectures: 04 Practical:- 00			
Semester	II	Year of Introduction: 2025-2026			Maximum Marks / Grade			Theory: 100 PR/TW/VIVA: 00			
Mode of Transaction: Lectures											
		Course Outcome (CO) MEC XXXX CO1 Understand the Gas turbine cycle with its application CO2 Analyze the thermodynamics and performance parameters of jet propulsion systems CO3 Illustrate ideal and actual air breathing gas turbine cycles with performance curves. CO4 Apply the concepts of jet propulsion and solve the problems CO5 Explore rocket propulsion theory and discuss types of chemical rockets.									
Unit No.	Topic		Contact Hours	Weightage (%)	BT Level	CO	PSO	PO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	Basic concept: Introduction to jet propulsion, basic principles, and historical development. Newton's laws of motion and their application to jet propulsion. Thermodynamics review, including concepts of enthalpy, entropy, and perfect gas laws.		10	20	2,3	CO1	PSO1	PO1, PO2, PO3	All	All	ES, PE
2	Jet Engine Cycles: Ideal Brayton cycle analysis for turbojet engines. Real cycle analysis considering losses in		10	20	2	CO2	PSO1	PO1, PO2, PO3			

	components like compressors, combustors, and turbines. Turbofan, turboprop, and turbo-shaft engines. Ramjet & Scramjet Engine									
3	Performance parameters: Performance parameters for air breathing engine (Thrust, Specific impulse, Efficiency, Specific Fuel Consumption). Parametric Cycle Analysis of Ideal Turbo Jet Engine, Real Turbojet Cycle.	10	20	3,4	CO3 CO4	PSO1	PO1, PO2, PO3, PO4			
4	Jet Engine Components: Inlets: Subsonic and supersonic inlet design Compressors: Axial flow compressors. Combustion Chambers: Combustion process, flame stability Turbines: Axial flow turbine design, blade cooling techniques Nozzles: Convergent-divergent nozzle design.	15	25	3	CO4	PSO1	PO1, PO2, PO3, PO4			
5	Introduction To Rocket Propulsion: Introduction, Rocket propulsion theory, Chemical Rockets (Solid Rockets, Liquid Rockets, Solid & Liquid Propellants, Propellant feed system.	07	15	2,3	CO5	PSO1	PO1, PO2, PO3, PO4, PO5			
		52								
Reference Books										
1.	V. Ganeshan, “Gas Turbines”, Tata McGraw Hill Education Pvt. Ltd, 2010									
2.	S.M.Yahya , “Fundamental of compressible flow with aircraft and rocket propulsion”, New Age International publication									
3.	G. P. Sutton and O. Biblarz, “Rocket Propulsion Elements”, John Wiley & Sons, Inc.									
4.	Cohen. Rogers, C.F.G., Sarvanamuttoo “Gas Turbine Theory”, H.I.H., Pearson Edu.									
5.	S.M.Yahya., “Turbines, Compressors and Fans”, McGraw Hill									