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

Programme Name: B.E.-I (Civil, IWM, Mech.,Elect.,Electro.,Comp.,Chem.,Met.,TE/TT, TP)

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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Applied Mathematics**		**Academic Year**	**2024-25**
BE-I (C,M,E, Chem, Electro., Comp. Sc i., Met, IWM, TE, TT,TP)				
Year	**I**	**Core / ~~Elective / Foundation~~** **AMT 1101: APPLIED MATHEMATICS-I**	**Credits / Hours per week**	**04**
Semester	**I**	Year of Introduction: 2010 Year of Syllabus Revision: 2016	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lecture		

Course Outcome (CO) (AMT1101)

CO1 Evaluate successive differentiation of given function and solve identities involving higher order derivatives, evaluate radius of curvature, obtain Taylor & Maclaurin series expansion of function of single variable. Evaluate limits of indeterminate forms.

CO2 Test for convergence sequences and positive term series using various tests like comparison test, ratio test. Also find the convergence, absolute and conditional convergence for alternating series.

CO3 Understand the requirement of complex numbers their various representations, Demovier's theorem and its applications. Logarithm of complex numbers. Evaluate and use circular functions, hyperbolic functions.

CO4	Classify the differential equations with respect to their order and linearity, explain the meaning of different types of solutions of a differential equation.
CO5	Identify and solve the 1st order differential equations.
CO6	Apply the method of undetermined coefficients to solve the non-homogeneous linear differential equations with constant coefficients.
CO7	Apply the method "variations of parameters" to find to solution of higher-order linear differential equations with variable coefficients.
CO8	Solve the Cauchy-Euler equations and systems of linear differential equations .
CO9	Analyze real-world problems in field of Engineering like problems related to bending of beams, mixtures, growth and decay, heating and cooling, electric circuits, Spring-mass system etc.
CO10	Find series solutions of Bessel differential equation and Legendre's differential equations and make use of the properties of Bessel's functions and Legendre polynomials to study and analyze the solution.

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	**Calculus:** Reorientation, Functions of one variable Application of derivatives, Curvature, Successive differentiation, Partial derivatives, Leibnitz rule for the nth order derivative of a function, Techniques of partial derivatives.	8	16.67	1,2,3,5	CO1	1,3	SD	G	ES
2	**Infinite Series:** Sequence and their convergence , 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, Maclauarin's & Taylor's expansion with reminder form, Indeterminate forms L'Hospital's rule	8	16.67	1,2,3,4	CO2	2,3,4			

3	**Complex Numbers:** Complex numbers & their geometrical representation, Complex numbers in polar form, Demoivre's theorem and its applications, Exponential, logarithmic, trigonometric & hyperbolic functions.	8	16.67	1,2,3,4	CO3	1,5,6			
4	**Differential Equations** Reorientation, Modeling of engineering systems pertaining to first order differential equations, Exact differential equations, integrating factors, Unified approach to first order ordinary differential equations, Equations of first order and higher degree.	8	16.67	1,2,3,5	CO4 CO5 CO9	1,2,3			
5	Linear differential equations of higher order with constant coefficients and with variable coefficients Models of higher order differential equations, Method of variation of parameters, Simultaneous linear differential equations Method of solution in series	10	20.83	1,2,3,5	CO6 CO7 CO8 CO9	3,4,7			
6	Bessel and Legendre's equations, Properties of Bessel functions Introduction to Legendre polynomials	6	12.5	1,4,5	CO10	1,3			
	TOTAL	**48 Hours**	**100%**						

Reference Books

1.	Erwin Kreyszing :	Advanced Engineering Mathematics, (6th edition) Johnwilley&Sons.,1988
2.	Donald Greenspan :	Introduction to Partial Differential Equations, Mc. Graw – Hill Inc., 2012
3.	C. R. Wylie :	Advanced Engineering Mathematics,Mc. Graw – Hill Inc., 1986
4.	G. B. Thomas, R. L. Finney :	Calculus and Analytic Geometry, Addison-Wesley Publishing Co., 2010
5.	J. W. Brown, R.V. Churchill :	Complex variables and Applications, McGraw-Hill Higher Education, 2013.
6.	P. V. O'Neil :	Advanced Engineering Mathematics, Cengage Learning (India edition), 1991.
7.	B. V. Ramana :	Higher Engineering Mathematics, Tata Mc. Graw – Hill. (Core Engineering Series), 2006.
8.	David V. Widder :	Advanced Calculus, Prentice Hall of India Pvt. Ltd., 1986.

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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Applied Physics**		**Academic Year**	**2024-25**
B.E. (Civil, Mechanical, Electrical, Chemical, Metallurgy, Electronics, Irrigation and Water Management, Computer Science, Textile Technology and Engineering, Textile Processing): Regular Programme				
Year	**I**	**~~Core / Elective /~~ Foundation** **APH1101** **Applied Physics I**	**Credits / Hours per week**	**04**
Semester	**I**	Year of Introduction: 2007 Year of Syllabus Revision: 2012	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO) APH1101
CO1 Understand the basics of laws governing physical world.
CO2 Application of physical laws in various engineering applications

Unit No.	Topic/Unit	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/	Relevance to Local (L)/ National	Relation to Gender (G), Environment

							Entrepreneurship (Ent)/ Skill Development (SD)	(N)/ Regional(R)/ Global (G) developmental needs	and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	**Interference:** • Types of interference. Fresnel's biprism, White light fringes, Determination of the thickness of a thin sheet of transparent material. • Interference in thin films, Wedge-shaped film, Necessity of an extended source. • Newton's rings, Determination of wave-length of sodium light using Newton's rings, Determination of refractive index of a liquid, Newton s rings with white light. • Non-reflecting films, Michelson interferometer, Types of fringes, Uses of Michelson's interferometer, Standardization of the meter. • Fabry-Perot interferometer, Interference filters.	05	9.6	1,2	CO1 CO2	PSO1	EMP, ENT, SD	N,R,G	ES, PE
2	**Diffraction:** • Introduction, Two kinds of diffraction, Difference between interference and diffraction. • Fraunhofer diffraction at a circular aperture, Plane diffraction grating, Formation of multiple spectra with grating, Maximum number of orders available with a grating. • Absent spectra with a diffraction grating, Effect of increase in the width of niled surface. • Determination of wavelength,	05	9.6	1,2	CO1 CO2	PSO1			

	dispersive power of grating.								
3	**Resolving Power of Optical Instruments:** • Meaning of resolving power, Rayleighs criterion of resolution. • Resolving power of grating, prism, telescope and microscope.	05	9.6	1,2	CO1 CO2	PSO1			
4	**Polarization:** • Geometry of calcite crystal, double refraction, Nicol's prism, Huygen's theory of double refraction. • Quarter-wave plate, polarization by selective absorption. Half-wave plate. • Elliptically and circularly polarized light, production of circularly and elhptically polarized light, conversion of elliptically polarized light into circularly polarized light, analysis of polarized light of different kinds. • Ken effect. Optical activity, specific rotation, Laurent's half shade polarimeter. Photo elasticity.	04	7.7	1,2	CO1 CO2	PSO1			
5	**LASER:** • Lasers, spontaneous and stimulated emission, population inversion, pumping and active system. • The Ruby laser. Gas laser. Semiconductor laser. • CO2 laser, design of CO2 laser, mechanism of CO2 laser. • Uses of lasers.	05	9.6	1,2,3,4	CO1 CO2	PSO1			
6	**Semiconductor Diode Applications and Solar Cells:** • Rectifier, ripple factor, capacitor filter. • Types of Solar Cells, p-n junction	03	5.8	1,2,3,4	CO1 CO2	PSO1			

	Solar Cells Characteristics, Efficiency.								
7	**Ultrasonics:** • Ultrasonic waves, production of ultrasonic waves. • Detection of ultrasonic, properties of ultrasonic, wavelength of ultrasonic waves. • Applications of ultrasonic waves.	5	9.6	2,3,4,5	CO1 CO2	PSO1			
8	**Maxwell's equations and electromagnetic waves:** • Vector field, Irrotational vector field, rotational vector fields (curl), source and sinks of vector fields - divergence theorem. • Basic laws of electricity and magnetism- different forms. • Lumped and distributed elements - oscillations, electromagnetic cavity oscillator. • Charge conservation law — continuity equation, displacement current. • Maxwell's equations, electromagnetic waves in free space.	06	11.5		CO1 CO2	PSO1			
9	**Waves and Particles:** • Equation of motion of matter waves, physical interpretation of wave function • Operators. Eigen functions and Eigen values, momentum and energy operators, properties of wave functions • Solution of Schrodinger equation. Stationary state solutions. • The free particle, particle in a box, energy levels of a particle enclosed in one-dimensional potential box of infinite height. • The hydrogen atom (qualitative).	08	15.4		CO1 CO2	PSO1			

	Barrier Tunneling, STM, electron microscope.								
10	**Temperature and its measurement:** • Liquid thermometers, mercury thermometers, errors in mercury thermometers. • Bimetallic thermometers. Platinum resistance thermometers, thermoelectric thermometers, Pyrometers, Fery's total radiation pyrometer. Disappearing filament optical pyrometer. • Factors for the selection of a thermometer for a particular use, temperature range of various thermometers.	03	5.8		CO1 CO2	PSO1			
11	**Vacuum technology:** • Introduction, exhaust pump and their characteristics, different types of pumps. • Rotary oil pumps. Diffusion pump. • Measurement of low pressure, Pirani gauge.	03	5.8		CO1 CO2	PSO1			
	TOTAL	**52 Hours**	**100%**						

Reference Books

1.	Engineering Physics: by R. K. Gaur and S. L. Gupta, DhanpatRai Publications (P) Ltd. 8th Edition.
2.	Fundamentals of Physics: by D. Halliday, R Resnick and J. Walker, Asian Books Pvt. Ltd. 6th Edition
3.	Modem Engineering Physics: by A. S. Vasudeva, S. Chand and Company Ltd.
4.	A Textbook of Engineering Physics by MN Avadhanulu& PG Kshirsagar, S Chand Publishers

Year	**I**	**Core / ~~Elective / Foundation~~** **APH1101L** **Applied Physics Laboratory Practical**	**Credits / Hours per week**	**03**
Semester	**I**	Year of Introduction: ~~2007~~ Year of Syllabus Revision: ~~2016~~	**Maximum Marks / Grade**	**50**
Mode of Transaction		Laboratory Experiments, discussion and viva		

Course Outcome (CO) APH1101L

CO1 Understanding the optics
CO2 Understanding the physical properties through experiments
CO3 Methods to determine physical properties
CO4 Understanding of advances in instrumentation
CO5 Understanding the spectroscopy

Sr. No.	**Experiment**	**Hours**	**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	**Newton's Rings:** To Study the interference patterns from single monochromatic source and find out the Radius of Curvature of given Plano-Convex lens from the obtain interference pattern.	06	1,2	CO1, CO2	PSO1	SD	G	PE
2	**Diffraction Grating:** To study the diffraction pattern from sodium vapor lamp and find out the wavelength of this source by using diffraction pattern that obtain with the help of Transmission Grating.	06	2	CO1 CO2	PSO1			
3	**Frequency of AC Mains:** To determine the frequency of A. C. Mains.	06	2,3	CO3 CO4	PSO1			
4	**Ultrasonic Waves:** To determine the frequency of Ultrasonic waves and find out the velocity of Ultrasonic wave in air medium by using the interference theory of longitudinal wave.	06	3,4		PSO1			
5	**Resolving Power of Telescope:**-Comparative study between resolving power of Travelling Microscope and Telescope.	06	2,3	CO1 CO2	PSO1			

6	**Solar Cell:** Study of various parameters of solar cell	3	2,3		PSO1			
7	**Dispersion of Light:** Calculate the refractive index of different wavelength associated with white light using the prism.	3	3,4		PSO1			
8	**Laser Parameters:** (1) To determine the full angular divergence of the given gas laser. (2) To determine the wavelength of the given laser source using diffraction by grating.	**03**	3,4	CO5	PSO1			
9	**Polarimeter:** To determine the specific rotation of the given optically active substance.	**03**	2,3,4	CO1 CO2	PSO1			
10	**Rectifier Circuits:** To study the process of rectification through half wave, full wave and bridge rectifiers.	**06**	2,3,4	CO3 CO4	PSO1			

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

Programme Name: **F.S. B.E. I** (C, M, E, Ch., Met & Mats., IWM, Comp. Sci., Text. Engg.)**] – All Branches**

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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Textile Chemistry**		**Academic Year**	**2024-25**
Common Subject for All Branch [F.S. B.E. I(C, M, E, Ch., Met &Mats., IWM, Comp. Sci., Text. Engg.)**]**				
Year	**I**	~~**Core**~~ **/** ~~**Elective**~~ **/ Foundation** **MEC 1101: Engineering Drawing I**	**Credits / Hours per week**	**Lectures: 04** **Practical-: 04**
Semester	**I**	Year of Introduction: 2016 Year of Syllabus Revision: ----	**Maximum Marks / Grade**	**Theory: 100** **PR/TW/VIVA: 50**
Mode of Transaction		Lectures		

Course Outcome (CO) MEC 1101
CO 1 Use the drawing instruments effectively and how to use the dimensioning methods.
CO 2 Observe, analyze and correlate two-dimensional (Orthographic view) and three dimensional (Isometric view)
CO 3 Construct and application of various engineering curves in engineering practice
CO 4 Apply the knowledge of Projection of points, Lines and Planes in engineering
CO 5 Create freehand sketches of basic machine components

Unit No.	**Topic/Unit**	**Contact Hours**	**Weightage (%)**	**BT Level**	**CO**	**PSO**	**Elements of** Employability	**Relevance to** Local (L)/	**Relation to** Gender (G), Environment

							(Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	National (N)/ Regional(R)/ Global (G) developmental needs	and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1.	Introduction to Engineering Curves: Introduction to conic sections, types of conic sections, eccentricity, construction of conic sections(parabola, ellipse , hyperbola) by different methods, Construction of involutes, construction of cycloid, epicycloid and hypocycloid, construction of spiral, construction of normal and tangent to all curves.	08	20	1,2,6	CO3	2, 3, 6, 7	Emp, Ent, SD	L,N,R,G	G, ES, HV, PE
2.	Free hand sketches: Parts of screw thread and its types, conventional representation of threads, screwed fastening- types of nuts, bolts, set screws, locking arrangement of nuts, foundation bolts, riveted and welded joints, forms and proportions of rivet heads, representation of welded joints, shaft keys and couplings- types of keys, cotter joint, knuckle joint, double cotter/sleeve joint, types of couplings.	08	10	1,2,6	CO5	2, 3, 6, 7			
3.	Projection of Point and Line Introduction to principal planes of projections, projections of points located with respect to reference planes (in different quadrants), Projection of Lines, Line parallel to reference planes, Line parallel to one reference plane and inclined to other reference plane, Line inclined to both the reference planes, Application of all variants	08	20	3,4,6	CO4	2, 3, 6, 7			
4.	Projection of Planes Projection of Planes (Polygons, circle, semi-circle, ellipse etc.). Plane parallel to one reference plane and inclined to other, Plane inclined to both the reference plane, Concept of auxiliary plane method for projection of plane.	08	10	1,2,4	CO4	2, 3, 6, 7			
5.	Orthographic projection Fundamental of projection along with classification, Projections from the pictorial view of the object on the principal planes for view from front, top and sides using first angle projection method and third angle projection method, full sectional view	10	20	2,3,5	CO2	2, 3, 6, 7			
6	Isometric Projections and Isometric View or Drawing: Isometric Scale, Conversion of orthographic views into	10	20	2,4,5	CO2	2, 3, 6, 7			

	isometric projection, isometric view or drawing of objects								
	TOTAL	**52 Hours**	**100%**						
1.	Different types of Engineering Curves:	08	20	1,2,6	CO3	2, 3, 6, 7	Emp, Ent, SD	L,N,R,G	G, ES, HV, PE
2.	Free hand sketches:	08	10	1,2,6	CO5	2, 3, 6, 7			
3.	Projection of Point and Line	08	20	3,4,6	CO4	2, 3, 6, 7			
4.	Projection of Planes	08	10	1,2,4	CO4	2, 3, 6, 7			
5.	Orthographic projection	10	20	2,3,5	CO2	2, 3, 6, 7			
6	Isometric Projections and Isometric View or Drawing:	10	20	2,4,5	CO2	2, 3, 6, 7			
	TOTAL	**52 Hours**	**100%**						

Reference book

1.	Bhatt, N.D., ‘Engineering Drawing’,
2.	Shah, P. J., ‘Engineering Drawing’,
3.	Bhatt, N.D., ‘Machine Drawing’,
4.	Dhawan, R.K., ‘A Textbook of Engineering Drawing’,
5.	Venugopal, K., ‘Engineering Drawing and Graphics’
6.	M. Raja Roy, B.V.R. Gupta, ‘Engineering Drawing with AutoCAD’,

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

Program Name: Bachelor of Metallurgical & Materials Engineering

Programme Specific Outcome (PSO)

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.

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Civil Engineering**		**Academic Year**	**2024-25**
B. E. (Metallurgical & Materials Engineering) : Regular Program				
Year	**I**	**Core / ~~Elective / Foundation~~** **CVL 1104 : FUNDAMENTALS OF CIVIL AND ENVIRONMENTAL ENGINEERING (NEW COURSE)**	**Credits / Hours per week**	**04**
Semester	**I**	Year of Introduction**: 2019** Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures		
Course Outcome (CO) CVL 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 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	**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.	14 hrs	27	2,3	CO1	PSO5	(Emp), (Ent), (SD)	(L), (N), (R), (G)	(ES), (PE)
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	23	2,3	CO2	PSO5			
3	**Surveying and Leveling** Surveying - Introduction – Principle – Object of survey –	14 hrs	27	2, 3, 4	CO3	PSO5			

	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.								
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.	12 hrs	23	1, 2, 3	CO4	PSO5			
	TOTAL	**52 Hours**	**100%**						

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.

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Civil Engineering**	**Academic Year**	**2019-20**

B. E. (Metallurgical & Materials Engineering) : Regular Program

Year	**I**	**Core / ~~Elective / Foundation~~** **CVL 1104L : FUNDAMENTALS OF CIVIL AND ENVIRONMENTAL ENGINEERING (NEW COURSE) : Field Practical**	**Credits / Hours per week**	**02**
Semester	**I**	Year of Introduction: **2019** Year of Syllabus Revision:	**Maximum Marks / Grade**	**50**

Course Outcome (CO) CVL1104L

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	CVL1104L	1,2,3	CO3	PSO5
2	Linear measurements: tape, ranging, offsets	4	CVL1104L	2,3	CO3	PSO5
3	Compass: Introduction, Bearings	2	CVL1104L	2,3,4	CO3	PSO5
4	Auto level: Introduction, HI, Rise and fall	6	CVL1104L	2,3,4,5	CO3	PSO5
5	GPS : Introduction, and demonstration	2	CVL1104L	2,3,4	CO3	PSO5
6	Theodolite and Total Station demonstration	6	CVL1104L	2,3,4,5	CO3	PSO5
7	Any other term-work based on syllabus	4	CVL1104L	1,2	CO1 CO4	PSO5

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

Program Name: Bachelor of Metallurgical & Materials Engineering

Program Specific Outcome (PSO)

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.

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Civil Engineering**		**Academic Year**	**2024-25**
B. E. (Metallurgical & Materials Engineering) : Regular Program				
Year	**I**	**Core / ~~Elective / Foundation~~** **CVL 1101 : FUNDAMENTALS OF CIVIL ENGINEERING (OLD COURSE)**	**Credits / Hours per week**	**04**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures		

Course Outcome (CO) CVL

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	Topic	Contact	Weightage	BT	CO	PSO	Element	Relevan	Relation

No.		Hours	(%)	Level			s of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	ce to Local (L)/ National (N)/ Regional (R)/Global (G)	to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	**Building Material** Stone - Introduction to stone, Uses of stone, Classification of rock Characteristics of good building stone, Availability ,suitability and property of different stone. **Bricks -** Comparison between stone work & brick work, Advantages of bricks, Chemical composition of brick & harmful elements of brick, Characteristics of good brick, Classification of bricks, Standard test for brick along with field test for brick, Special types of brick.	8 hrs	15	2,3	CO1	PSO5	(Emp), (Ent), (SD)	(L), (N), (R), (G)	(ES), (PE)
2	**Lime -** classification of Lime – characteristics of good lime – slaking process of lime – I.S. Specification of lime**.** **Cement** - Basic ingredient of ordinary cement, Basic ingredient of ordinary cement – Physical properties of cement – Field examinations of cement – Storing of cement, Varieties of cement and its uses – I.S. Specification of ordinary cement.	8 hrs	15	2,3	CO1	PSO5			
3	**Mortar and concrete** specifications of ingredients for mortar and concrete – classification of mortar and concrete – selection of mortar and its uses – precaution in using mortar Production and quality control of concrete – physical properties of concrete. Plastic-Properties of plastics, Types and uses of plastic.	5 hrs	10	2,3	CO1	PSO5			
4	**Timber -** Introduction to timber, Characteristics of good timber, Importance of seasoning, Wood base product, Requirements of good preservatives for timber.	5 hrs	10	2,3	CO1	PSO5			

	Steel - Introduction, Properties of mild steel, Use of different form of steel, Marketable forms of steel **Glass –** Introduction, Composition of glass, Classification, Properties of glass, Use of glass								
5	**Surveying -** Introduction – Principle – Roll of survey – classification, Basic instruments of linear and angular measurements – chain, tape, compass – uses – field work and notes – survey drawings – conventional symbols – scale.	8 hrs	15	2,3,4	CO3	PSO5 PSO5 PSO5			
6	**Levelling –** Temporary adjustments – field work – computation of levels – Arithmetic checks, Profiles and contours – area measurements by field measurements from drawings.	8 hrs	15	2, 3, 4	CO3	PSO5 PSO5 PSO5			
7	**Building Construction :** Types of constructions – Typical details of load bearing & framed structures – Brief discussion and illustrations sketches of typical important building components, light and medium type foundations – functions, spread footing, slope footing, isolated column footing. Lintels – function, types, lintel with weathershed flooring, roofing Different types of doors & windows	5 hrs	10	1, 2, 3	CO4	PSO5 PSO5			
8	**Introductory Environmental Engineering** Terminology— Introduction to various types of pollution, water and land pollution and remedial for control, water and wastewater quality criteria – Disposal of wastes. Air pollution and remedial for control – Ecology, Environmental Protection and legislation –	5 hrs	10	1, 2, 3	CO2	PSO5 PSO5			
	TOTAL	**52 Hours**	**100%**						

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.

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Civil Engineering**	**Academic Year**	**2019-20**
B. E. (: Metallurgical & Materials Engineering) : Regular Program			
Year	**I**	**Core / ~~Elective / Foundation~~** **CVL 1101L : FUNDAMENTALS OF CIVIL ENGINEERING (OLD COURSE) : Field Practical**	**Credits / Hours per week**	**02**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**50**

Course Outcome (CO) CVL

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	6	CVL1101L	1,2,3	CO3	PSO5
2	Linear measurements: tape, ranging, offsets	6	CVL1101L	2,3	CO3	PSO5
3	Compass: Introduction, Bearings	6	CVL1101L	2,3,4	CO3	PSO5
4	Auto level: Introduction, HI, Rise and fall	4	CVL1101L	2,3,4,5	CO3	PSO5
5	Minor instruments : Introduction, and demonstration	2	CVL1101L	2,3,4	CO3	PSO5
6	Theodolite and Total Station demonstration	2	CVL1101L	2,3,4,5	CO3	PSO5

Syllabus of Course: Materials Science

	The Maharaja Sayajirao University of Baroda **Faculty of Technology and Engineering** **Department of Metallurgical and Materials Engineering**	**Academic Year**	**2024-2025**

Common Subject for All Branch [F.S. B.E. I(C, M, E, Ch., Met &Mats., IWM, Comp. Sci., Text. Engg.)**]**

Year	I	**~~Core~~ / ~~Elective~~ / Foundation : Materials for Engineering**	**Credits / Hours per Week**	**04** (Theory)
Semester	I	Year of Introduction :	**Maximum Marks / Grade**	**100** (Theory)
Mode of Transactions		Lectures and Tutorials		

Course Outcome (CO) / <u>MET 1101</u>

CO-1:Understanding of materials and their classification
CO-2:Study about crystals and lattices parameters
CO-3:Understanding mechanical properties and behavior of these properties on engineering materials
CO-4: Studies of phase importantwith their diagrams and materials defects
CO-5:Learning about ceramics and glasses materials
CO-6: Understanding briefly causes and types of corrosions and their protection methods
CO-7: Study about electronics and electrical materials
CO-8:Learn about some advanced materials and their uses

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		SD	G	ES
2	**Crystal Structure** Crystallography, Atomic structure and; Structure of crystalline solids; Lattices, unit cells; Crystal systems, Bravaislattices; Indexing of directions and planes,	**06**	**15%**	1/2/3/5	CO2		SD	G	ES

	notations, Inter-planar spacings and angles, co-ordination number, packing factors stacking sequence in BCC, FCC and HCP.								
3	**Mechanical Properties of Materials** Concepts of stress and strain, Stress-Strain diagrams; Properties obtained from the tensile test; Elastic deformation, Plastic deformation. Impact Testing & toughness behavior. Hardness of materials.	**08**	**15%**	1/2/3	CO3		SD	G	ES
4	**Phase diagram** Gibbs phase rule, Binary phase diagram its types, solid solution – Hume Rothery Rules. Imperfections: Point defects, Line defects and surface defects – grain boundary, tilt boundary and twin boundary, Grain, Grain size number. Burgers vector and its representation.	**08**	**15%**	1/2/3	CO4		SD	G	ES
5	**Ceramic Materials** Introduction, ceramic structures, silicate structures, Processing of ceramics; Properties, glasses; Composite Materials-Introduction, classification, metal-matrix, ceramic–matrix and polymer matrix composites.	**05**	**10%**	1/2	CO5		SD	G	ES
6	**Corrosion** Types of corrosion – Dry and Wet corrosion, Electro chemical and oxidation (Chemical) corrosion. Corrosion prevention – anodic and cathodic protection & coatings	**06**	**15%**	1/2/3	CO6		SD	G	ES
7	**Electrical & Electronic Materials** Intrinsic and Extrinsic Semi conductivity, Dielectric material, Piezo-electric materials. Magnetic Materials: Introduction, classification of magnetic materials, soft & hard magnetic materials.	**05**	**10%**	1/2	CO7		SD	G	ES

8	**Advanced Materials** Nano Materials & its application, Metallic glasses, Super conducting material, optic fibers, smart materials.	**05**	**10%**	1/2	CO8		SD	G	ES
		45	**100%**						

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
4.	Raghavan V (2007), Materials Science and Engineering - A First Course, Prentice Hall, India
5.	James F. Shackelford (1996), Introduction to Materials Science for Engineers, Prentice Hall, India

Note:

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

[2] Elements of Employability **(EMP)** / Entrepreneurship **(ENT)** / Skill Development **(SD)**

[3] Relevance to Local **(L)** / Reginal **(R)** / National **(N)** / Global **(G)** development needs

[4] Relation to Gender **(GN)** / Environment and Sustainability **(ES)** / Human Values **(HV)** / Professional Ethics **(PE)**

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

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 **Workshop Practice I**			
Year	**I**	**Core** **MEC 1102**	**Credits / Hours per week**	**Lectures: 00** **Practical-: 02**
Semester	**I**	Year of Introduction: Year of Syllabus Revision: 2018	**Maximum Marks / Grade**	**Theory: NILL** **PR/TW/VIVA: 50**
Mode of Transaction: Lectures and Practical				

Course Outcome (CO) MEC 1102
CO1 Understand carpentry shop work ,different tools ,use of tools and hand on practices of subject.
CO2 Understand Smithy workshop related tools and learning forging operation in workshop .

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	Carpentry: Name, use and setting of hand tools, Construction of halved single mortise and tenon joints, dovetail joint, bridle joint, oblique mortise and tenon joint and rafter joint.	20	50	1,2,3, 4,5,6	Co1	3,4	All	All	All
2	Smithy: Tools used for preparing simple jobs in hand forging.	19	50	1,2,3, 4,5,6	Co2	3,4			
		39	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

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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Applied Chemistry**		**Academic Year**	**2020-21**
BE-I (Metallurgy): Regular Programme				
Year	**I**	**Core / ~~Elective / Foundation~~** **ACH1201: Applied Chemistry**	**Credits / Hours per week**	**04**
Semester	**II**	Year of Syllabus Revision: 2009	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO) ACH1201

CO1 To learn about basics of phase rule and to construct and analysis of phase diagrams with respect to one and two component systems.
CO2 To learn about various physical properties of molecules.
CO3 To understand the common themes running through metallic descriptions of chemical bonding, imperfections in solids and lattice defects.
CO4 To learn about various types of alloys and their uses.
CO5 To explore the basics of various metallurgical processes/extractions of metals to solve metallurgical and materials engineering issues.

CO6	To learn about various types of corrosion, their prevention together with types of coating techniques.
CO7	To learn about the chemistry of various aliphatic compounds with respect to their preparation, properties and uses.

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.	**Phase rule**: Phase rule and its applications to one and two component systems	06	12.5	1,2,3	CO1	PSO1	Emp	G	ES
2.	**Physical properties of molecules**: Surface tension, viscosity, refractive index, optical rotation.	06	12.5	1,2	CO2	PSO1			
3.	**Metals**: Chemical bonding, types, metallic bonds and structure, metallic properties, Imperfections in solids, lattice defects, application of X-ray to metallic structure.	07	14.6	1,2	CO3	PSO1			
4.	**Alloys**: Alloys, types and their structure	04	8.3	2,3	CO4	PSO1			
5.	**Chemistry of metallurgical processes**: Froth flotation process, chemical and electric reduction, Goldsmith thermite process, specialized techniques (electro refining, zone refining, Van Arkel's process).	07	14.6	1,2,4	CO5	PSO1			
6.	**Typical extractions**: Extraction of beryllium, uranium, platinum group metals; isolation of noble gases from atmosphere.	05	10.4	1,2,4	CO5	PSO1			
7.	**Corrosion and passivity**: Types of corrosion, its prevention;	06	12.5	1,2	CO6	PSO1			

	protective coatings: metallic coatings, paints (types of paints), miscellaneous coatings; passivity.								
8.	**Organic Chemistry**: Introduction to different functional groups, nomenclature. Preparation, properties and uses of alkanes, alkenes, alkynes and alkyl halides.	07	14.6	1,2,3	CO7	PSO1			
	TOTAL	**48 Hours**	**100%**						

Reference Books:

1.	Engineering Chemistry: Jain and Jain, Dhanpatrai Publishing House
2.	Industrial Chemistry: B. K. Sharma, Goel Publishing House
3.	Essentials of Physical Chemistry: B. S. Bahl, A. Bahl and G. D. Tuli; S Chand & Co.
4.	Organic Chemistry: Morrison and Boyd, Prentice-Hall of India Ltd. New Delhi.
5.	Text book of Organic Chemistry for B.Sc. Students: P. L. Soni.

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Applied Chemistry**	**Academic Year**	**2020-21**

BE-I (Metallurgy): Regular Programme

Year	**I**	**Core / ~~Elective / Foundation~~** **ACH1201L:** Applied Chemistry-TW/Practical/Viva	**Credits / Hours per week**	**02**
Semester	**II**	Year of Syllabus Revision: 2009	**Maximum Marks / Grade**	**50**
Mode of Transaction		Term work, Practical and Viva		

Course Outcome (CO) ACH1201L

CO1 To determine the strength and normality of an unknown analyte by performing a redox titration.

Unit No.	Topic/Unit	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of	Relevance to	Relation to

							Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Local (L)/ National (N)/ Regional (R)/Global (G) developmental needs	Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1.	To determine the strengths and normalities of $KMnO_4$ and $FeSO_4.7H_2O$ solutions using a standard solution of Oxalic acid.	03	13	1,2,4	CO1	PSO1	Emp	G	HV
2.	To determine the strengths and normalities of $KMnO_4$ and $FeSO_4(NH_4)_2SO_4.6H_2O$ solutions using a standard solution of Oxalic acid.	03	13	1,2,4	CO1	PSO1			
3.	To determine the strengths and normalities of $KMnO_4$ and H_2O_2 solutions using a standard solution of Oxalic acid.	03	12	1,2,4	CO1	PSO1			
4.	To determine the strengths and normalities of $KMnO_4$ and $NaNO_2$ solutions using a standard solution of Oxalic acid.	03	13	1,2,4	CO1	PSO1			
5.	To determine the strength and normality of I_2 solution against a standard solution of $Na_2S_2O_3$.	03	12	1,2,4	CO1	PSO1			
6.	To determine the strengths and normalities of I_2 and $CuSO_4.5H_2O$ solutions using a standard solution of $Na_2S_2O_3$.	03	13	1,2,4	CO1	PSO1			
7.	To determine the strengths and normalities of I_2 and Na_3AsO_3 solutions using a standard solution of $Na_2S_2O_3$.	03	12	1,2,4	CO1	PSO1			
8.	To determine the strength and normality of $CaOCl_2$ solution against a standard solution of $Na_2S_2O_3$.	03	12	1,2,4	CO1	PSO1			

Reference Books:

1. Vogel's Textbook of Quantitative Chemical Analysis -J. Mendham, R. C. Denney, J. D. Barnes and M. J. K. Thomas, (6th edition, Prentice Hall) 2000.

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

Programme Name: B.E.-I (Civil, IWM, Mech.,Elect.,Electro.,Comp.,Chem.,Met.,TP)

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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Applied Physics**		**Academic Year**	**2020-21**
B.E.-I (Civil, IWM, Mech.,Elect.,Electro.,Comp.,Chem.,Met.,TP): Regular Programme				
Year	**I**	**Core / ~~Elective / Foundation~~** **AMT1201: Applied Mathematics - II**	**Credits / Hours per week**	**04**
Semester	**II**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures		

Course Outcome (CO)

CO1 Understand and apply the concept of multivariable functions , its differentiability concept and applications of partial derivatives in various engineering problems.
CO2 Able to focus on understanding and applications of gradient, curl and divergence in engineering problems.
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 Implement various concepts of matrices in engineering problems and able to solve system of linear equations using matrices.
CO6 Apply the idea of Laplace transforms to solve Boundary Value Problems which occur in almost every problem of engineering.

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	**Partial Differentiation:** Function of two variables – Definition, limit, continuity and partialderivatives Chain rule Euler's theorem, implicit functions differentials Applications of partial derivatives (Tangent plane and normal line,approximation, maxima and minima, Lagrange's multiplier's method), Jacobians and transformations	12	24	1,2,3	CO1	1,2,3	Emp / Ent	N / G	PE
2	**Vector Calculus:** Reorientation, scalar and vector fields gradient of a scalar function, Directional derivative divergence and curl of a vector field and their applications	05	11	1,2,3	CO2	3,4,7			
3	**Analytical Geometry:** Reorientation, curvilinear coordinates (polar, cylindrical andspherical), cone, cylinder Conicoids, Surfaces and solids of revolutions	10	20	2, 3, 4,5	CO3, CO4	1,3			
4	Tangent planes and normal lines to above surfaces (by calculusmethod	07	15	2, 3, 4,5		2,4			

	Tracing of curves: Cardiod, cycloid, lemniscates, spiral, four leaved rose								
5	**Rank of a matrix** solution of homogeneous and non – homogeneous systems of linear equations Eigen values and eigen vectors of a matrix Cayley – Hamilton theorem	07	15	1, 2, 3,5	CO5	6,7,8			
6	**Laplace Transforms** Laplace transforms of elementary functions inverse Laplace transforms, linearity property, first and secondshifting theorem. Laplace transforms of derivatives and integrals, applications of Laplace transform in solving ordinary differential equations.	07	15	1,2,3,4,5	CO6	4,6,8			
	TOTAL	**48 Hours**	**100%**						

Reference Books

1.	Erwin Kreyszig: Advanced Engineering Mathematics, (6th edition) John-Wiley & Sons.
2.	Srivastava, Dhavan **:** Text Book of Engineering Mathematics, Dhanpat Rai & Sons.
3.	Shantinarayan **:** Differential Calculus, S. Chand & Co. New Delhi.
4.	Willfred Kaplan **:** Advanced Calculus, Addison Weseley Publ. Company, Inc.
5.	C. R. Wylie **:** Advanced Engineering Mathematics, Mc. Graw – Hill, Inc.

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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Applied Mechanics**		**Academic Year**	**2019-20**
B.E. (Metallurgy) : Regular Programme				
Year	**I**	~~**Core / Elective**~~ **/ Foundation** **Code: APM1201** **Subject**: **APPLIED MECHANICS**	**Credits / Hours per week**	**04**
Semester	**II**	Year of Introduction: 2010 Year of Syllabus Revision: -----	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures		

Course Outcome (CO) APM1201
CO1: Student will learn different various types of forces and force system. Effect of Force system and Equilibrium condition the factor affecting the Equilibrium.
CO2: Understanding of the axial forces in Plane and Space truss. Analysis of problems by analytical and Graphical Method.
CO3: Student will be able to learn of the Center of Gravity and Moment of Inertia of any type of the section of the body.
CO4: Refreshes the basics of theory of machine.

CO5: Analysis and evaluation of number of Teeth on the wheel and its rotation in the body.
CO6: Refreshes the effects on body when kinetics and kinematics forces acting on the body. Analysis of D'Alembert's principle, work, power and energy. Impulse and momentum, Equations of motion, Translation, Fixed axis rotation and Problems involving friction.
CO7: student will understand basic stress system and elastic constants in brittle and ductile materials.
CO8: Application of frictional force on inclined planes etc. by applying static conditions of equilibrium.

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	**Statics: Introduction, Forces and Force system** 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. Vectors. Operations on forces using vectors. Moment of force, Varignon's theorem, Couple and its properties, Resultant of a coplanar force system. Concentrated and uniform loads. Resultant of a spatial force system. Wrench resultant, Equilibrium of a particle. External	15	25	1,2,3,4,5,	CO1 CO2	PSO1	SD,EMP	G	ES

	& 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 joints. Method of sections. Determinateness of truss. Rigid and non-rigid frames. Simple mechanisms. Space frames.								
2	**StaticsCenter of Gravity, Moment of Inertia and Friction**: Centre of gravity. Centroids of lines and of basic and composite areas, Built-up sections, Product of inertias. Mass moment of inertia, Types of friction. Characteristics of dry friction. Equilibrium on rough inclined plane. The wedge-The screw-The screw Jack-general bearing, Axle friction, Thrust bearing-Disc friction-Clutches.	15	25	1,2,4	CO3,CO 8	PS O1			
3	**Statics: Transmission of power** Lifting Machine, Basic machines, The differential principle, Linearlaw, Belt drive, Velocity ratio. Compound belt drive-length of belt. Transmission of power, Gearings, Trains of wheels. Epicyclic gearing. Speed reduction gear. Differential types of gear.	15	25	2,3,4,5	CO5	PS O1			
4	**Dynamics: Strength and Elasticity 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. Fixed axis rotation. Problems Involving friction, Simple stresses and strains. Hook's law. Elastic limit. Ultimate stress. Factor of safety, Lateral strain.	15	25	1,2,3,4,5	CO6, CO7	PS O1			

	Poisson's ratio. Stress concentration idea. Temperature stress. Simple shear, Elastic moduli relations.								
	TOTAL	**60 Hours**	**100%**						

Reference Books

1.	Applied Mechanics by S. B. Junnarkar and H. J. Shah, Charotar Pub.
2.	Engineering Mechanics byMerium 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 **Faculty Technology and Engineering** **Department of Applied Mechanics**	**Academic Year**	**2019-20**
B.E. (Metallurgy): Regular Programme			
Year **I**	~~**Core / Elective**~~ **/ Foundation** **APM1201L: Laboratory Practical & Graphics**	**Credits / Hours per week**	**03**
Semester **II**	Year of Introduction: 2010 Year of Syllabus Revision: ----	**Maximum Marks / Grade**	**50**
Mode of Transaction	Laboratory Experiments, Graphics, discussion and viva	**is common for all experiments**	

No.	**EXPERIMENT**	**Contact hours**	**%weightage**	**BT Level**	**CO**	**PSO**
1	LAW OF PARALLELOGRAM OF FORCES	3	6.66	2,3	CO1	PSO1
2	LAW OF POLYGON	2	4.44	2,3	CO1	PSO1
3	SIMPLE BEAM	2	4.44	2,3	CO2	PSO1
4	JIB CRANE	2	4.44	2,3	CO2	PSO1
5	THEORY OF LIFTING MACHINE	3	6.66	2	CO4	PSO1
6	ROPE AND PULLEY BLOCK	2	4.44	2,3	CO4	PSO1
7	SCREW JACK	2	4.44	2,3	CO4	PSO1
8	DIFFERINTIAL AXLE	2	4.44	2,3	CO4	PSO1

9	WORM AND WORM WHEEL	2	4.44	2,3	CO5	PSO1
10	MOMENT OF INERTIA OF FLY WHEEL	2	4.44	2,3	CO3	PSO1
11	RADIUS OF GYRATION OF COMPOUND PENDULUM	2	4.44	2,3	CO3	PSO1
GRAPHICS						
12	COPLANAR CONCURRENT FORCE SYSTEM-1	3	6.66	2	CO1	PSO1
13	COPLANAR CONCURRENT FORCE SYSTEM-2	2	4.44	2	CO1	PSO1
14	COPLANAR NON-CONCURRENT FORCE SYSTEM-1	2	4.44	2	CO1	PSO1
15	COPLANAR NON-CONCURRENT FORCE SYSTEM-2	2	4.44	2	CO1	PSO1
16	REACTION OF BEAMS-1	2	4.44	2	CO2	PSO1
17	REACTION OF BEAMS-2	2	4.44	2	CO2	PSO1
18	ANALYSIS OF ROOF TRUSS FOR SIMPLY SUPPORTED	2	4.44	2	CO1	PSO1
19	ANALYSIS OF ROOF TRUSS FOR CANTILEVER	2	4.44	2	CO1	PSO1
20	WEDGE BLOCK FRICTION	2	4.44	2	CO8	PSO1
21	CENTROID OF PLANE LAMINA	2	4.44	2	CO3	PSO1

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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2024-25**
BE (Metallurgical & Materials) Regular Programme				
Year	**I**	**Core / ~~Elective / Foundation~~** **Code: MME1201** **Subject**: Basic Metallurgy	**Credits / Hours per week**	**03**
Semester	**II**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures		

Course Outcome (CO)

CO1 Scope of metallurgy &Its application in future.
CO2Knowledge about minerals of metal & production of metal.
CO3Introduction to furnace.
CO4Understand about microscope & sample preparation for microscope.
CO5Study of phase diagram & basic introduction of heat treatment of metal.
CO6Introduction to foundry, welding,wire drawing powder metallurgy.
CO7 Testing of metal & alloy.

Unit No.	Topic/Unit	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human

							Development (SD)	developmental needs	Values (HV)and Professional Ethics (PE)
1	Scope of Metallurgy: Various fields of metallurgical engineering, metallurgical industries in India and their future.	4	7.7	1,2	CO1	1,2	SD,Ent	G	HV,PE
2	Occurance of important areas, minerals: Sources of metals Basic outline of the principle of production of iron and steel, copper, aluminium, zinc, lead.	8	15.4	2,6	CO2	2,3,4			
3	Metallurgical Fuels and furnaces, common refractories and their classification, Pyrometry-various methods used for measurement, recording and control of temperature.	6	11.5	3,2	CO3	1,2,6,7			
4	Metlalurgical microscope, optical systems, resolution & magnification. Polishing & etching macro & micro examination.	6	11.5	1,2,3,6	CO4	6,7			
5	Phase Rule Study of simple binary diagrams, different types, Iron-carbon phase diagram, Use of phase diagram as a basis for introduction to the heat treatment of metals & alloys.	8	15.4	2,5,3,6	CO5	3,4,5			
6	Introduction to foundry metallurgy, moulding, melting and casting methods.	6	11.5	2,3	CO6	4,5,6			
7	Methods of metal forming-Rolling, forging, extrusion, wire drawing, tube drawing and powder metallurgy.	8	15.4	2,3	CO6	7,8			
8	Metal joining - welding, soldering, brazing	6	11.5	2,3	CO6	5,7,8			
9	Testing of metals and alloys, hardness, tensile strength, ductility measurements. Introduction to NDT techniques.	6	7.7	5,4	CO7	7,8			
	TOTAL	**52 Hours**	**100%**						

Reference Books

1	Elements of Metallurgy by D. Swarup.
2	Principles of metallographic laboratory practice by G.L. Kehl.
3	Elements of physical metallurgy by A.G. Gu.
4	Introduction to Metallurgy by A.R. Bailey
5	Materials Science and Processes : S.K. Hajra Choudhury, Indian Book Distributing CO., Calcutta.

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

Programme Name: <u>BE (Metallurgical & Materials) Regular Programme</u>

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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2019-20**
B.E. (Metallurgy): Regular Programme				
Year	**I**	**Core**	**Credits / Hours per week**	**02**
Semester	**I**	Year of Introduction: 1994 Year of Syllabus Revision:	**Maximum Marks / Grade**	**50**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO)

At the end of this course, learners will
CO1 Get exposure to and nurture their proficiency/skill in discipline/subject/domain other than their core discipline
CO2 Develop life-skills through both theory and hands-on training
CO3 Understand and analyze effective communication skills as pre-requisite for general employability
CO4 Enhance employability through creative application of communication skills

CO5 Evaluate situations and make important work-related decisions
CO6 Review and critically use social interaction skills and interpersonal skills effectively
CO7 Develop oral and written communication skills in the work place

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	Reading Comprehension – based on Text Book	10	20%	1,2,3,	CO1, CO2 , CO3, CO7	PSO1	Emp, Ent, SD	L,N,R,G	HV, PE
2	Writing skills – based on Text book.	10	20%	1,2,3,	CO1, CO2 , CO5, CO7	PSO1			
3	Grammar Exercises	10	20%	1,2,3	CO4, CO5 , CO6, CO7	PSO1			
4	Essay Writing on topics related to Architecture.	10	20%	1,2,3	CO4, CO5,	PSO1			

					CO6, CO7				
5	Letter Writing on topics related to Architecture	10	20%	1,2,3,	CO1, CO2 , CO3, CO7	PSO1			
	TOTAL	**50 Hours**	**100%**						

Reference Books

1. Sara Freeman. *Study strategies in English (Student's Book).*Orient Longmans

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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Textile Chemistry**		**Academic Year**	**2020-21**
B.E. Mechanical, Chemical, Metallurgical : Regular Programme				
Year	**I**	**~~Core~~ / ~~Elective~~ / Foundation** **MEC 1201: Engineering Drawing II**	**Credits / Hours per week**	**Lectures: 03** **Practical-: 04**
Semester	**II**	Year of Introduction: 2016 Year of Syllabus Revision: ----	**Maximum Marks / Grade**	**Theory: 100** **PR/TW/VIVA: 50**
Mode of Transaction		Lectures		

Course Outcome (CO) MEC 1201

CO 1 Understand different kind of machine drawing and their components.
CO 2 Observe, analyze and correlate two-dimensional (Orthographic view) and three dimensional (Isometric view)
CO 3 Construct and application of various Solid Geometry ,also study geometry in autocad software with multiple drawing view.
CO 4 Apply the knowledge ofSection of solids by different planes and their conventions, partial and revolved sections.
CO 5 Create freehand sketches of basic machine components.

Unit	Topic/Unit	Contact	Weightage	BT	CO	PSO	Elements of	Relevance to	Relation to Gender

No.		Hours	(%)	Level			Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Local (L)/ National (N)/ Regional(R)/ Global (G) developmental needs	(G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1.	Solid Geometry – Projection of simple solids such as prism, pyramid, cylinders, cones and regular of oblique.	02	10	1,2,6	CO3	2, 3, 6, 7	Emp, Ent, SD	L,N,R,G	G, ES, HV, PE
2.	Section of solids by different planes and their conventions, partial and revolved sections.	03	10	1,2,6	CO5	2, 3, 6, 7			
3.	Interpretation of simple solids such as prism, pyramid, cylinders, cones, spheres.	05	10	3,4,6	CO4	2, 3, 6, 7			
4.	Development of surfaces of solids and combined solids.	05	10	1,2,4	CO4	2, 3, 6, 7			
5.	Missing views and interpretation of views with sections, oblique projections, details of assembly drawings, surface finish and tolerances, approach to production drawing.	05	10	2,3,5	CO2	2, 3, 6, 7			
6	Introduction to Nomograph.	05	10	2,4,5	CO2	2, 3, 6, 7			
7.	AutoCAD upto 2D drawing.	05	20	1,2,6	CO3	2, 3, 6, 7			
8.	Machine drawing and sketches of: a) Bearings, pipe fittings and pipe joints, b) Power transmission systems like belt drives c) Flat belt, V-belt, rope and variable speed belts, and pulleys d) Positive drive, gear drive like spur, helical, worm wheel, bevel with their basic terms of definition e) Chain drive with basic terms of definition f) Variable speed drive g) I.C. engine parts like piston, connecting rod, bearing, valves, etc.	09	20	2,4,6	CO5	2, 3, 6, 7			
	TOTAL	**39 Hours**	**100%**						
	Experiments								
1.	Solid Geometry – Projection of simple solids s	02	10	1,2,6	CO3	2, 3, 6, 7	Emp, Ent, SD	L,N,R,G	G, ES, HV, PE
2.	Section of solids by different planes and their conventions.	03	10	1,2,6	CO5	2, 3, 6, 7			
3.	Interpretation of simple solids such as prism, pyramid, cylinders, cones, spheres.	05	10	3,4,6	CO4	2, 3, 6, 7			
4.	Development of surfaces of solids.	05	10	1,2,4	CO4	2, 3, 6, 7			

5.	Oblique projections and details of assembly drawings.	05	10	2,3,5	CO2	2, 3, 6, 7			
6	Introduction to Nomograph.	05	10	2,4,5	CO2	2, 3, 6, 7			
7.	AutoCAD upto 2D drawing.	05	20	1,2,6	CO3	2, 3, 6, 7			
8.	Machine drawing and free handsketches .	10	20	2,4,6	CO5	2, 3, 6, 7			
	TOTAL	**52 Hours**	**100%**						

Reference book

1.	Bhatt, N.D., ‘Engineering Drawing’,
2.	Shah, P. J., ‘Engineering Drawing’,
3.	Bhatt, N.D., ‘Machine Drawing’,
4.	Dhawan, R.K., ‘A Textbook of Engineering Drawing’,
5.	Venugopal, K., ‘Engineering Drawing and Graphics’
6.	M. Raja Roy, B.V.R. Gupta, ‘Engineering Drawing with AutoCAD’,

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

Programme Name: B.E.-I (Civil, IWM, Mech.,Elect.,Electro.,Comp.,Chem.,Met.,TP)

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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Applied Mathematics**		**Academic Year**	**2020-21**
B.E.-II (Metallurgical and Mateials Engineering): Regular Programme				
Year	**II**	**Core / ~~Elective / Foundation~~** **AMT 1308: (APPLIED MATHEMATICS III)**	**Credits / Hours per week**	**04**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lecture		

Course Outcome (CO) (AMT1308)

CO 1: Make use of Fourier series to analyze wave form of periodic functions and use it for solving / modeling systems in Metallurgical Engineering.
CO 2: Introduce classification of 2nd order PDE's, separable variable techniques to solve PDE's and analyze the behavior of solutions.
CO 3: Demonstrate the ability to analyze data by appropriately fitting, assessing, and interpreting a variety of statistical models.
CO 4: Understand the concept of the sampling distribution of a statistic, and in particular describe the behavior of the sample mean.
CO 5: Able to compute probabilities using discrete and continuous distributions.
CO 6: Evaluation of multiple integrals to integrate functions of several in Cartesian system, polar, cylindrical and spherical coordinates.

CO 7: Understand the statement of change of order, change of variables theorem for integrals from Cartesian to any other coordinate systems.
CO 8: Evaluate improper integrals.
CO 9: Apply Green's Theorem, Stokes's Theorem and the Divergence Theorem to evaluate line integrals, surface integrals and flux integrals.
CO 10: Understand, evaluate and apply the various technique related to Tensors.

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	Multiple Integrals: Reorientation of concept of integrals, line 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	7	14.58%	2,3,4,5	CO 6, CO 7, CO 8	PSO1, PSO8	Emp	G	ES
2	Vector Calculus: Surface integrals, Green's theorem, Stoke's theorem. Gauss divergence theorem and application of integral theorem.	5	10.41%	2,3,4,5	CO 9	PSO1, PSO8			
3	Improper Integrals: Convergence of improper integrals, Error functions	6	12.50%	2,3,4,5	CO 8	PSO1, PSO8			
4	Fourier Series: Fourier expansion of periodic functions with period 2 π, Fourier series of even and odd functions, half range series, Fourier series of functions with arbitrary	5	10.41%	2,3,4,5	CO 1	PSO1, PSO8			

	period, conditions of convergence of Fourier series.								
5	Tensors: Space of N – dimensions, transformation of co-ordinates, summation convention, contravariant and covariant vectors (tensors of first order). Tensors of second order (Kroneker delta), tensors of higher rank, invariant or scalar. Algebraic operations with tensors, addition and subtraction of tensors, contraction, product of tensors, inner product, symmetric tensor, skew – symmetric tensor, quotient law.	6	12.50%	2,3,4,5	CO 10	PSO1, PSO8			
6	Second order partial differential equations: Classification in to elliptic, Parabolic and hyperbolic equations; models leading to 2nd order PDEs. Boundary value problems involving 2nd order PDEs and their solution by methods of separation of Variables Heat, wave and Laplace equations and their solution by method of separation of variables and using Fourier series.	8	16.67%	2,3,4,5	CO 2	PSO1, PSO8			
7	Introductory Statistics, Regression and Correlation : Reorientation, measures of central tendency, measures of dispersion, Correlation, rank correlation, regression, Curve fitting, method of least squares.	6	12.50%	2,3,4,5	CO 3	PSO1, PSO8			
8	Sampling Techniques and Testing of Hypothesis Population and samples, different methods of sampling, probability distributions (discrete and continuous), binomial, Poisson, normal distribution and their properties, Estimation of parameters, Confidence intervals, testing of hypotheses, decisions.	5	10.41%	2,3,4,5	CO 4, CO 5	PSO1, PSO8			
	TOTAL	**48 Hours**	**100%**						

Reference Books

1. Erwin Kreyszing : Advanced Engineering Mathematics
2. Donald Greenspan : Introduction to Partial Differential Equations
3. C. R. Wylie : Advanced Engineering Mathematics

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

Programme Name: BE (Metallurgical and Materials Engineering)

Programme Specific Outcome(PSO)

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.
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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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Electrical Engineering**		**Academic Year**	**2024-25**
B E (Metallurgical and Materials Engineering): Regular Programme				
Year	**II**	**Foundation** **ELE1313: Electrical Engineering Fundamentals**	**Credits / Hours per week**	**03**
Semester	**I**	Year of Introduction: 2007 Year of Syllabus Revision: 2012	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO) ELE1313
Student will be able to
CO1 **Determine** the parameters of simple DC and AC circuits. BT 5
CO2 **Evaluate** the performance of AC circuits. BT 5
CO3 **Explain** performance characteristics of DC Rotating Machines , AC Rotating machines and Transformers. BT 5
CO4 **Determine** the parameters of DC Rotating Machines. BT 5
CO5 **Explain** fundamentals concepts of Semiconductor Theory. BT 2

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	D.C. Circuits : Review of Ohm's law. Kirchoff's law. Series parallel connections. Solution of simple d.c. circuits.	09	18.8	5	CO1	PSO6	SD	G	PE
2	A.C. Circuits : Sinusoidal e.m.f. and currents. R.M.S. and average value. Phaser representation. Voltage current relations in purely resistive, inductive and capacitive circuits and their combination. Power and power factor. Poly phase system : Voltage and current relation and power in balanced 3 phase system.	15	31.3	5,5	CO1 CO2	PSO6			
3	D.C. Generators : Principle of working. Types of generators. Their characteristics and applications. D.C. Motors : Principle of working. Types of generators. Their characteristics and applications.	10	20.8	5,5	CO3 CO4	PSO6			
4	Transformers : Review of Faraday's law and Lenz's law. Self and mutual induction. Principle of working of transformer. e.m.f. equation. Uses of transformer. Induction motor : Principles of working and applications.	05	10.4	5	CO3	PSO6			
5	Alternators : Principle of working and applications. Syn. Motor : Principle of working. Special features and its applications	05	10.4	5	CO3	PSO6			
6	Qualitative Semiconductor Theory : Conductors. Semiconductors and Insulators. Intrinsic and extriosic semiconductors. Conduction in p-n, p-n-p and n-p-n junctions. Their characteristics. Zener diode. Photo-diode and display devices.	04	8.3	2	CO5	PSO6			
	TOTAL	**48 Hours**	**100%**						

1.	Applied Electricity by H. Cotton.
2.	Electrical Technology by B.L. Theraia.
3.	Advance Electrical Technology by H. Cotton.

4.	Problems in Electrical Engg. by Parker Smith.

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Electrical Engineering**	**Academic Year**	**2020-21**

B E (Metallurgical and Materials Engineering): Regular Programme

Year	**II**	**Foundation** **ELE1313L: Electrical Engineering Fundamentals Laboratory**	**Credits / Hours per week**	**03**
Semester	**I**	Year of Introduction: 2007 Year of Syllabus Revision: 2012	**Maximum Marks / Grade**	**50**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO) ELE1313L

Student will be able to

CO1**Examine** the Laboratory Apparatus and Constructional Features of DC machine.
CO2**Justify** the Kirchhoff's Laws
CO3 **Determine** the parameters of Single Phase and Three Phase Circuit and Single Phase Transformer.
CO4**Evaluate** the performance characteristics of DC Machines
CO5 **Develop** technical report based on performed experiment.

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	Study of Laboratory apparatus -Examine the laboratory apparatus	03	100	4,3	CO1 CO5	PSO6	SD	G	PE
2	Verification of Kirchhoff's Laws -Justify the Kirchhoff's laws	03	100	5,3	CO2 CO5	PSO6			
3	R-L Series Circuit -Determine the parameters of R-L series circuit supplied by 1-phase supply	03	100	5,3	CO3 CO5	PSO6			
4	R-L-C Series Circuit -Determine the parameters of R-L-C series circuit supplied by 1-phase supply	03	100	5,3	CO3 CO5	PSO6			

5	Power measurement of single phase circuit using 3 voltmeter method -Determine the parameters of Single phase circuit by 3 voltmeter method	03	100	5,3	CO3 CO5	PSO6			
6	OC and SC test of Single Phase Transformer -Determine the parameters of singe phase transformer using OC and SC test	03	100	5,3	CO3 CO5	PSO6			
7	Study of DC machine -Examine the constructional features of DC Machines	03	100	4,3	CO1 CO5	PSO6			
8	Plot the characteristics of DC Series Generator -Evaluate the performance characteristics of DC series generator	03	100	5,3	CO4 CO5	PSO6			
9	Plot the characteristics of DC Shunt Generator -Evaluate the performance characteristics of DC shunt generator	03	100	5,3	CO4 CO5	PSO6			
10	Plot the characteristics of DC Compound Generator -Evaluate the performance characteristics of DC compound generator	03	100	5,3	CO4 CO5	PSO6			
11	Plot the characteristics of DC Separately Excited Generator -Evaluate the performance characteristics of DC Separately excited generator	03	100	5,3	CO4 CO5	PSO6			
12	Speed Control of DC Shunt Motor -Evaluate the performance characteristics of Speed Control of DC Shunt Motor	03	100	5,3	CO4 CO5	PSO6			
13	Power measurement in 3 phase circuit by two wattmeter method -Determine the parameters of Three phase circuit by two wattmeter method	03	100	5,3	CO3 CO5	PSO6			

1.	Applied Electricity by H. Cotton.
2.	Electrical Technology by B.L. Theraia.
3.	Advance Electrical Technology by H. Cotton.
4.	Problems in Electrical Engg. by Parker Smith.

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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2024-25**
BE (Metallurgical & Materials) Regular Programme				
Year	**II**	**Core / ~~Elective~~ / ~~Foundation~~** **Code: MME1502** **Subject: Industrial Ceramic Materials**	**Credits / Hours per week**	03 (Theory)
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	100 (Theory)
Mode of Transaction		Lecture		

Course Outcome (CO)
CO-1: Understanding of ceramic materials
CO-2: Study about white ware manufacturing and their application scopes
CO-3: Knowledge- different types of fluxes and their uses
CO-4: Understanding about traditional ceramic powder manufacturing and their uses
CO-5: Learning about synthetic ceramic powder production and their uses
CO-6: Studying various ceramic powder preparation techniques
CO-7: Knowledge about different applications of ceramic refractories
CO-8: Learning of various advanced industrial ceramics applications
CO-9: Study and understand ceramic evaluation methods

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	Fundamental aspects of ceramics. Their difference from metallic and organic materials. Traditional and modern ceramics, classification od modern ceramics as oxide and non-oxide ceramics as well as classification based on their application.	03	5%	1/2	CO1	1,2	Emp/Ent/SD	G	ES
2	Ceramic raw materials, Methods of Ceramic Powder processing, Pressing, Casting and plastic forming processes and brief review of other forming processes. Sintering / Firing of ceramics. Other modified classification processes.	06	10%	1/2/3	CO2	1,2,3			
3	Structural Ceramics : Properties and uses of Oxides and non-Oxide structural ceramics such as alumina, aluminium nitride, boron nitride, tungsten carbide, titanium carbide, silicon carbide, Sialon.	04	10%	1/2/3	CO3	2,4,5			
4	Electronic Ceramics: Properties and applications as Piezoelectric materials,ferrites,electroptical materials as pressure, gas and moisture detectors,etc. Ceramic dielectrics.	04	15%	1/2/3	CO4	1,2,6			
5	Ceramic cutting tools : Properties and applications of ceramic cutting tools such as alumina tools, boron nitride tools, Si3N4, Sialon etc.	04	15%	1/2/3	CO5	1,2,3,			
6	Glasses and optical Fibres: Basic and application of various types of glasses namely Silica glass, Vycor glass,Opal-Glass. Application of glass fibres in composite materials and telecommunications, some aspects of crystallized glasses.	06	15%	1/2/3	CO6	2,3,5,			
7	Ceramic Coatings :Techniques,parameters and applications of plasma / spray coatings for	06	10%	1/2/3	CO7	5,6,7, 8			

	coating materials like WC, Cr3C, Al2O3, Stabilized Zirconia, etc. Similar studies on flame spray coatings**.**								
8	Refractories : Classifications, properties such as PCE, RUL, Spalling, thermal properties, Chemical properties,Testing of refractories, Phase diagrams of Al2O3 -SiO2, etc	06	10%	1/2/3	CO8	5,6			
9	Applications of refractories in Iron making and Steel making, foundries, Special refractories	**04**	**10%**	1/2/4/5	CO9	7,8			
		43	100%						

Reference Books	
1	Modern Ceramic Engineering: - David W Richerson Marcel Dekker,Inc., New Yoek [1982]
2	Introduction to fine Ceramics: - Applications in Engineering. Noborn Ichinose by John Wiley & sons Ltd, Newyork [1987]
3	Advanced Ceramics P.Ramkrishnan, Oxoford& IBHPubl.Co. P. Ltd., New Delhi.

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

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Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Applied Mechanics**		**Academic Year**	**2024-25**
B.E. (Metallurgy): Regular Programme				
Year	**II**	**~~Core / Elective~~ / Foundation** **Mechanics of Materials**	**Credits / Hours per week**	**04**
Semester	**I**	Year of Introduction: 1949 Year of Syllabus Revision: 2004	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures		

Course Outcome (CO) APM 1303
CO1: Understanding of shear force and bending moment in beams for different types of loading and support by graphical and analytical method.
CO2: Learning theory of simple bending in beam and its application in the bending stress analysis for simply supported, cantilever beams and flitched beams.
CO3: Student will learn basic theory of shear stress in beam and apply it to calculate shear stresses and its distribution.
CO4: Analysis of beam for calculating curvature, slope and deflection and application of this theory in the analysis of carriage springs.
CO5: Understanding compound stresses and calculation of principal stresses, strains and shear stress by analytical method and Mohr's circle.
CO6: Learning concept of resilience due to normal stresses and its application to find stresses due to of gradual, sudden and impact loading.

CO7: Learning stress analysis of thin cylinders and spheres subjected to internal pressure and its application in design of shells.
CO8: Understanding load transfer and failure in bolted joints and applying them in the analysis and design of bolted connections subjected to axial force.
CO9: Learning concept of combined direct and bending stresses in columns and applying it for analysis of retaining walls, chimney and dam for horizontal load.
CO10: Student will learn Buckling Analysis of column and strut by Euler's and Rankine's Formula and apply it in design.
CO11: Learning the theory of torsion of circular shafts and applying it in design of shaft used for power transmission and helical spring used for absorbing shock energy.

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	**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 as well as graphically-with varying and distributed loads, Effect of couples, 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. Distribution of shear stress: Principal stresses in beam, Curvature, slope and deflection of cantilever and simply supported beams including overhang beams, Carriage springs.	18	30	1,2,3,4,5	CO1, CO2, CO3, CO4	PSO1,3,4	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, Resilience of sudden, impact and shock loading, Stresses in thin cylinders subjected to internal pressure, Cylindrical shell with hemispherical ends, Spherical shell, Bolted joints, types of failure and load transfer	18	30	2,3,4,5	CO5, CO6, CO7, CO8	PSO1,3,4			

	in bolted joint, Design of bolted connections.								
3	**Columns and struts and Direct and bending stress** Eccentric loading: Tension or compression combined with bending, 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	CO9, CO10	PSO1,3,4			
4	**Torsion of Circular Shafts** 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, Helical spring under axial force.	12	20	2,3,4,5	CO11	PSO1,3,4			
	TOTAL	**60 Hours**	**100%**						

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**	**2019-20**

B.E. (Metallurgy): Regular Programme

Year	**II**	~~**Core / Elective**~~ **/ Foundation** **APM 1303 L: Laboratory Practical and Graphics statics drawing**	**Credits / Hours per week**	**04**
Semester	**I**	Year of Introduction: 1949 Year of Syllabus Revision: 2010	**Maximum Marks / Grade**	**50**
Mode of Transaction		Laboratory Experiments, Graphics,Discussion and Viva	**is common for all experiments**	

No.	**EXPERIMENTS**	**Contact Hours**	**% weightage**	**BT Level**	**CO**	**PSO**
1	COPMLETE TENSILE TEST ON MILD STEEL(MS)	3	5	2,3	CO5,6,7	PSO3,4
2	MODULUS OF ELASTICITY FOR MS	3	5	2,3	CO5,6,7	PSO3,4
3	DIRECT SHEAR TEST ON MS	3	5	2,3	CO3,5,7,8	PSO3,4
4	COPMRESSION TEST ON MS AND CAST IRON (CI)	3	5	2,3	CO3,5,10	PSO3,4

5	COMPRESSION TEST ON TIMBER	3	5	2,3	CO3,5,10	PSO3,4
6	IZOD IMPACT TEST ON CI, MS AND BRASS	3	5	2,3	CO6	PSO3,4
7	HARDNESS TEST ON MS, CI AND BRASS	3	5	2,3	CO1	PSO3,4
8	TORSION TEST ON MS AND CI	3	5	2,3	CO5,11	PSO3,4
9	MODULUS OF RUPTURE OF TIMBER	3	5	2,3	CO1,2	PSO3,4
10	MODULUS OF ELSTICITY OF TIMBER	3	5	2,3	CO4	PSO3,4
GRAPHICS						
11	ANALYSIS OF FINK ROOF TRUSS	3	5	2,3,4	--	PSO3,4
12	ANALYSIS OF ROOF TRUSS FOR WIND LOAD	3	5	2,3,4	--	PSO3,4
13	SF AND BM DIAGRAM FOR SIMPLY SUPPORTED BEAM	3	5	2,3,4	CO1	PSO3,4
14	SF AND BM AND AF DIAGRAM FOR SIMPLY SUPPORTED BEAM	3	5	2,3,4	CO1	PSO3,4
15	SF AND BM DIAGRAMS FOR SIMPLE BEAMS WITH OVERHANG	3	5	2,3,4	CO1	PSO3,4
16	MOHR’S STRESS CIRCLE METHOD-1	3	5	2,3,4	CO5	PSO3,4
17	MOHR’S STRESS CIRCLE METHOD-2	3	5	2,3,4	CO5	PSO3,4
18	MOHR’S STRESS CIRCLE METHOD-3	3	5	2,3,4	CO5	PSO3,4
19	MOHR’S STRESS CIRCLE METHOD-4	3	5	2,3,4	CO5	PSO3,4
20	MOHR’S STRESS CIRCLE METHOD-5	3	5	2,3,4	CO5	PSO3,4

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

Programme Name: BE (Metallurgical & Materials) Regular Programme

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Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year:**	**2024-25**
BE (Metallurgical & Materials) Regular Programme				
Year	**II**	**Core / ~~Elective / Foundation~~** **Code: MME1301** **Subject: Metallurgical Thermodynamics**	**Credits / Hours per week**	**04**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO)

CO1 Introduction to thermodynamics.
CO2 Learn concept of thermodynamic equilibrium & 1st law of thermodynamics.
CO3 learn Terms hat capacity,specificheat,enthalpy,heat balance.
CO4 Understand and calculate heat reaction.
CO5 Study of 2nd law of thermo dynamics.
CO6 Understand concept of free energy and 3rd law of thermodynamics.
CO7 Learn term fugacity, activity standard state for activity, equilibrium constant.
CO8 Gibb's Helmholtz,von'thoff equation &clausius-clapeyronequation.
CO9 Learn criterion to assess the feasibility of reaction & Gibb's phase rule.

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	Definition, Applications, Advantages, Limitations Law of thermodynamics, Basic terms used, kind of systems, The stgate of a system, Equation of state, Properties of a system.	04	7.7	1,2,3	CO1	1,3	Emp, Ent, SD	G	ES,PE,HV
2	Reversible and irreversible changes, Equilibrium, Isothermal and Adiabatic change, energy and first law, Energy : a state property, Energy change in terms of partial derivatives. The concept of thermodynamic equilibrium	08	15.4	2,3,5, 6	CO2	2,3,4			
3	Heat capacity, Specific heat, Heat capacities at constant volume/pressure in terms of energy and relation between them. Dependence of heat capacity on heat capacity on temperature, Enthalpy and enthalpy change for a substance, Heat balance.	08	15.4	3,4,5	CO3	4,5			
4	Heat of reaction, Exothermic and endothermic reaction, Calculation of heat of reaction, Enthalpy change in different types of reactions Hess' Law, Kirchoff 's law equation.	06	11.5	2,3,56	CO4	4,5,6			
5	Second law of thermodynamics and the concept of entropy, Entropy change for reversible and irreversible process. Entropy changes with change of state and for a chemical reaction. Combine expressions of 1st and 2nd laws, Maxwell's relations.	06	11.5	1,2,3, 4,5	CO5	5,6			
6	Free energy : Helmholtz's, Free energy of reaction, free energy as a criterion of equilibrium. The partial derivatives. The third law of thermodynamics and Nernst heat theorem.	04	7.7	2,3,4	CO6	2,5,7			
7	Fugacity, Activity, Standard states for activity, Equilibrium constant, Equations for predictions of feasibility of reactions and for calculation of the equilibrium condition, Le chatelier principle.	04	7.7	1,2,5	CO7	4,5			
8	Gibb's-Helmholtz equation, Van't Hoff equation, The clausius-Clapeyroneuation and its applications, solutions : Atom fraction, mole fraction, Partial molal quantity, General interrelations.	04	7.7	1,2,3, 4,5	CO8	6,7			

9	Ideal and non-ideal solutions, Raoult's law and Henry's law, positive and negative deviation, Sievert's law, Chemical potential, criterion to assess the feasibility of reaction, Gibbs phase rule.	04	7.7	2,5	CO9	3,4			
10	Free energy – composition and temperature-composition diagrams and their corlation, metastable phase. Ellingham diagrams: its important features for metal-oxide system- in tutorial numerical based on all above imp. Topics to be covered.	04	7.7	1,2,3	CO6	5,6			
	TOTAL	**52 Hours**	**100%**						

Reference Books	
1	Physical Chemistry of Metals- L.S. Darken and R.W. Gurry, McGraw Hill Pub.
2	Problems in Metallurgical Thermodynamics and Kubetics – G.S Upadhyay and R.K Dube, Pergamon Press, 1977.
3	Text book of Materials and Metallurgical Thermodynamics – A. Ghosh.
4	An Intro. Chemical Metallurgy – R.H. Parkar

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

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Syllabus of Course

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year:**	**2024-25**
BE (Metallurgical & Materials) Regular Programme				
Year	**II**	**Core/ ~~Elective~~ / ~~Foundation~~** **Code: MME1302** **Subject: Mineral Dressing**	**Credits / Hours per week**	**03 (Theory)**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Laboratory		

Course Outcome (CO)

CO1 Introduction to basic concepts of Minerals around us & terms used
CO2 Study about the laws for differentiating sizes of minerals
CO3 Understanding different crushing & Grinding mechanisms
CO4 Analyze the use of different laws for classification & settling
CO5 Discuss the use of different classifiers & separators

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, Occurrence of metallic minerals in nature, Role of beneficiation in extractive metallurgy, Mineral dressing as physical separation. Important properties of minerals as criteria for separation. Terms used in mineral beneficiation.	04	08	1,2	CO1	1,2,3	Ent,SD	N,G	ES
2	Liberation and its significance, comminution, crushing, type of crushers. The laws of comminution. Grinding, dry and wet grinding.	05	12	2,3,5, 6	CO2, CO3	2,3			
3	Grinding media, theory of tumbling grinding mills, grinding circuits.	05	10	2,3,4	CO3	4,5			
4	Sizing, screens, industrial screening, size analysis representation. Size distribution.	04	10	1,2,6	CO4	3,4,6			
5	Motion of solid in fluid. Stokes and Newton's law. , Free setting and hindered settling, equal settling particles, classifiers. Sizing and sorting classifiers. Hydrocyclone.	05	12	2,3,4, 5,6	CO4	6,7			
6	Gravity separation, concentration criteria. Tabling, wilflly table. Jigging, jigs, heavy media separation. Sedimentation. Dewatering techniques. Thickener. Filtration and drying.	05	14	2,5,6	CO5	1,2,3			
7	Flotation. Physico chemical principles. Surface properties, contact angle. Adsorption. Flotation chemicals. Differential flotation. Machines.	04	14	2,5,6	CO5	2,3,4			
8	Process variables in flotation. Roughing, concentration. Scavenging. Study of flow sheet for important minerals.	04	10	1,2,5, 6	CO5	7,8			
9	Magnetic and electrostatic separation. Application of computer in mineral dressing.	04	10	1,2,3, 6	CO5	7,8			
		40	100%						

Reference Books

1	Mineral Processing Technology-B.A.Willis.Pergamon AILLSS
2	Introduction to mineral processing- EG Kelly and D. J. Spotiswood.Wiley,1990.
3	Principle of mineral dressing-A.H.Gaudin, Mc-Grow Hill.
4	Mineral processing- E.J.Pryor, Pergamon Press.

5	Chemical Engineering – J M Coulron JF Richardron,Mc-Grow Hill.
6	Experiments in Mineral Processing, S. Venkatachalam.

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engg**	**Academic Year**	**2020-21**

BE (Metallurgical & Materials) Regular Programme

Year	**II**	**Core / Elective / Foundation** **Code:MME1302L** **Subject: Mineral Dressing Laboratory**	**Credits / Hours per week**	**02**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**50**
Mode of Transaction		Laboratory Experiments, discussion and viva		

No.	**Experiment**	**Contact hours**	**% Weightage**	**BT Level**	**CO**	**PSO**
1	Basics & Terms used in Mineral beneficiation	2	8.33	1,2	CO1	1,2,3
2	Study about Sieve Analysis & particle size distribution	2	8.33	1,2,3,4	CO1	2,3
3	Study about principle & working of Jaw & Roll crusher	2	8.33	2,3,4,5	CO2	4,5
4	Understanding about principle & working of Tumbling mill	2	8.33	2,3,4,5	CO2	3,4,6
5	Study the use of Magnetic separator	2	8.33	1,2,3	CO3	6,7
6	Understanding the Jigging process for coarser particles	2	8.33	3,4,5,6	CO3	1,2,6,7
7	Study about principle & working of Wilfley table	2	8.33	2,3,4,5	CO4	1,2,3
8	Study about principle & working of Centrifugal classifier	2	8.33	2,3,4,5	CO4,5	2,3,4
9	Understand the Froth floatation process	2	8.33	3,4,5,6	CO4,5	7,8
10	Study about principle & working of Air classifier	2	8.33	3,4,5,6	CO4,5	6,7

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Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2020-21**
BE (Metallurgical & Materials) Regular Programme				
Year	**II**	Core / Elective / Foundation **Code: AMT1402** **Subject:Computational Techniques**	**Credits / Hours per week**	**04 Hrs/ week**
Semester	**II**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100 Marks**
Mode of Transaction		Lectures, PPT, Tutorials, Factory Visit, Videos etc		

Course Outcome (CO)
CO1

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.	**Computational Techniques**								

Reference									

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

Programme Name: B E ((Metallurgical and Materials Engineering))

PROGRAMME OUTCOME:

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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Mechanical Engineering**		**Academic Year**	**2020-21**
B. E. (Metallurgical and Materials Engineering): Regular Programme				
Year	**II**	**Core / ~~Elective~~ / ~~Foundation~~** **Subject:** MACHINE DESIGN & DRAWING **Code:** MEC 1401L	**Credits / Hours per week**	**Lectures: 04** **Practical-: 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 Practical				

Course Outcome (CO) MEC 1401

CO 1 Understand design procedure in detail with stress component.
CO 2 Study types of mechanical joints and its application.
CO 3 Study design of machine parts subjected to eccentric load & columns with load calculation.
CO 4 Study of design of shaft, different key using in mechanical joints and understand coupling joint with machine design.
CO 5 Understand the design procedure of various levers and spring using in machine component.
CO 6 Understand cad moldling of different component of machine design with part and assembly drawing

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	1. Designing: Design procedure. Need for designing synthesis. Material selection. Engineering materials. Important mechanical – properties of materials. Stress concentration. Factor of safety. Types of loads and Stresses. Basic design calculations. Contact stresses. Fatigue loading & calculation based on various criteria. Theory of failure.	8	10	1	Co1	PSO2	All	All	All
2	2. Operational & Permanent joints: Design of operational joints like – cotter, knuckle, Turn back etc. Design of riveted and welded joint for Structure and pressure vessel.	8	10	1,3	Co2	PSO 4			
3	. Machine parts subjected to eccentric load & columns: Eccentric loading on rivets of bolts. Columns & starts. Buckling – load End fixing conditions. Column subjected to eccentric load.	8	10	3	Co3	PSO 6			
4	Shafts, Keys and Couplings: Shaft : Design consideration. Materials for shafts, Loading, various factors affecting design of shafts. Keys: Types of keys and design criteria. Couplings: Design of various types of couplings like Muff coupling. Flange coupling. Flexible coupling. Elastomer type coupling. Metallic Grid (Steel Flex) coupling. Oldhlam coupling et	8	20	5	Co4	PSO 1 ,4			
5	Springs: Materials & manufacturing, Pre-stressing. Design of helical compression & Tensile springs, composite spring, contial spring. Torsion spring. Flat spiral spring & Leaf spring.	8	20	1,6,3	Co5	PSO 3			

6	Levers: Design procedure. Design various levers like – Bell crank, rocker arm etc. Design of various types of Handless & Foot levers.	4	10	3	Co5	PSO 2			
7	Computer aided drafting & design: Importance of CAD. Design process. The application of computers for design. Product cycle of CAD. Introduction of software and Hardware.	8	20	5,6	Co6	PSO 5			
	TOTAL	**52 Hours**	**100%**						

Reference Books

1.	Machine Design Vol.1 – Patel, Sikh, Rajput & Pandya, C. Jamnadas& Co.
2.	Mahcine Design Vol.2 – Patel, Sikh, Rajput & Pandya, C. Jamnadas& Co.
3.	Elements of Machine Desing – Spott., Prentice Hall.

The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Mechanical Engineering**	**Academic Year**	**2020-21**

B. E. (Metallurgical and Materials Engineering): Regular Programme

Year	**II**	**Core / ~~Elective~~ / ~~Foundation~~** **Subject:** MACHINE DESIGN & DRAWING **Code:** MEC 1401L	**Credits / Hours per week**	**02** (Practical)
Semester	**II**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**50** (TW/VIVA)
Mode of Transaction		Experiment		

Sr. No.	**Experiment**		**Course Code**	**BT Level**	**CO**	**PSO**
1.	Detail and assembly drawing of a toolpost			2,3,4	CO4, CO3, CO6	PSO3
2.	Design, detail and assembly drawing of spigot and socket type cotter joint			2,3,4,5	CO3, CO4, CO5	PSO5
3.	Design, detail and assembly drawing of knuckle joint			2,3,4,5	CO3, CO4	PSO2

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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year:**	**2024-25**
BE (Metallurgical & Materials) Regular Programme				
Year	**II**	**Core / Elective / Foundation** **Code:MME1403** **Subject:Principles of Extractive Metallurgy**	**Credits / Hours per week**	**03**
Semester	**II**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures		

Course Outcome (CO)

CO1 Definition of ore,mineral,metals & Scope of extractive metallurgy.
CO2 Study of hydrometallurgy and its application.
CO3 Study of Ellingham diagram in detail for metal oxide.
CO4 Study of Reaction Kinetics and factors affecting on homogeneous & heterogeneous reaction.
CO5 Study of effect of temperature on rate of reaction.
CO6 Understand extraction of metals from oxide &sulphide ores.
CO7 Study of Refining of impure metals.

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	Definitions: Ore, Minerals, Metals, etc. Scope of extractive metallurgy, Drying, Calcining, Sintering, Roasting, Smelting, Distillation, Fire refining.	06	11.5	1,2	CO1	2,3,4	Ent,SD,Emp	G	HV,PE,ES
2	Hydrometallurgy, Steps involved, Importance. Merits of pyro and hydrometallurgy. Electrometallurgy, Electro winning. Electro refining. Applications. Fundamentals of unit Process, Unit operations.	06	11.5	2,3,4	CO2	1,2,6,7			
3	Review of chemical equilibrium. The basic concept of free energy change. Requirements for prediction and calculation of a chemical reaction. Ellingham diagram in detail for metal oxides. Activities in concentrated solution and in industrial liquid metallic solution 1wt/std. State. Henrian solution activity and activity coeff. (Problems based on few above selected topics are solved in tutorial classes.).	08	15.4	1,2,3,5	CO3	6,7			
4	Reaction kinetics. Factors affecting Homogeneous and heterogeneous reactions. Effect of conc. Of reacting substances on rate of a reaction. Order and molecularity of a reaction, reaction and concentration of reactant of 1st, 2nd, and nth order. Determination of order and velocity constant of a reaction. Reversible reactions.	08	15.4	1,2,3,4	CO4	3,4,5			
5	The effect of temperature on rates of reactions. Arrhenius equation, Role of activation energy. Theory of absolute reactions. Rates, Applicability of reaction kinetics to metallurgical systems.	06	11.5	3,4,5	CO5	4,5,6			
6	Extraction of metals from oxide and sulphide ores. Reduction of oxide ores by Carbon Hydrogen metallothermic reduction (Al, Si, Mg, Ca. etc). Electrolysis at low pressure and high pressure. Conversion into halides and subsequent extraction.	08	15.4	2,3,4,5	CO6	7,8			
7	Reduction of sulphide ores by reduction, smelting and matte smelting. (Discussion of all above topics with at least specific examples in each case.).	04	7.7	2,5	CO6	5,6,7			

8	Refining of impure metals. Introduction chemical, electrochemical and physical methods i.e. fire refining. Refining via volatile comp. Electrolysis, Distillation. Zone refining, Materials and heat bala1nce. Flow diagram. Techniques and procedure of material balance. Techniques and methods of heat balance.	06	11.5	2,4,5,6	CO7	7,8			
	TOTAL	**52 Hours**	**100%**						

Reference Books

1	Principles of Extractive Metallurgy – A. Ghosh and H. S. Ray, Pub.-New Age International (P) Ltd. Publishers, New Delhi, 1991
2	Extractive Metallurgy – J. Newton, Pub.- John Wiley & Sons, 19
3	Principles of Extractive Metallurgy – T. Rosenqvist , Pub.- McGraw-Hill, 1974
4	An Introduction to Chemical Metallurgy – R. H. Parker, Pub.- Pergamon Press, 1967
5	Physical Chemistry of Metals – L. S. Darken, R. W. Gurry, Pub.- McGraw-Hill, New York, 1953
6	Engineering Chemistry – P. C. Jain &M. Jain., DhanpatRai Publishing Company, 2004

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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2024-25**
BE (Metallurgical & Materials) Regular Programme				
Year	**II**	**Core / ~~Elective / Foundation~~** **Code:MME1402** **Subject: Transport Phenomena**	**Credits / Hours per week**	**04**
Semester	**II**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lecture and Tutorials		

Course Outcome (CO)

CO1 Modes of heat transfer and conduction of heat through solid steady and unsteady state.
CO2 Study of heat conduction through hollow composite cylinder and sphere & convective heat transfer.
CO3 Study of laws of diffusion.
CO4 Study of radiative heat transfer.
CO5 Study of heat transfer between two bodies by radiation.
CO6 Basic knowledge of fluid flow, viscosity.
CO7 Study of Rotameter fiction factor.

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	Modes of heat transfer. Conduction of heat through solid. Steady and unsteady state.Temperature profile. Fourier law of heat conduction. General equation of heat conduction inCartesian co-ordinate. Spherical co-ordinate & Cylindrical. One dimensional steady state heat flow through composite walls.	08	15.4	1,2,3,4	CO1	1,3	SD,Ent,Emp	N,G	HV,PE,ES
2	Radial heat conduction through hollow composite cylinders and spheres. Convectiveheat transfer. Free and forced convection. Application of dimensional analysis to Effectiveboundary layer. Convective mass transfer coefficient.	08	15.4	2,3,5	CO2	2,3,4			
3	Laws of diffusion. Diffusivity. Steady state one dimensional mass diffusion throughstationary media. Counter current diffusion. Unidirectional diffusion. Solid state diffusion.	08	15.4	2,3,4,5	CO3	1,5,6			
4	Radiative heat transfer. Reflection adsorption and transmission of radiation. Definitionof black body Plank's Law. Wien's distribution law.	06	11.5	2,4,5	CO4	1,2,3			
5	Heat transfer between two bodies by radiation Labert's law. View factor.	06	11.5	4,5	CO5	3,4,7			
6	General features of fluid flow. Viscosity. Classification of fluids. Newtonian. Non-Newtonion. Viscous-non viscous. Laminar turbulent. Compressible incompressible. Steadyunsteady fluid flow. Macroscopic energy balance. Verturimeter. Oritices, capilary flowmeter. Pilot tube. Nozzle Buckimghamtheorem	08	15.4	2,4,5,6	CO6	1,3			
7	Rotameter. Friction factor. Dimensional analysis supplied to fluid flow. Flow throughpipes bends. Flow around spherical particle-bed of solids. Equation of continuity Naijerstokes equation. Bed and particle fluidization	08	15.4	2,4,5	CO7	7,8			

	TOTAL	**52 Hours**	**100%**						

Reference Books

1	Elements of Heat and Mass Transfer – Prof. R.C. Parel, Acharya Book..
2	Fundamentals of Momentum. Heat and Mass Transfer : J.R. Welty, C.E. Wicks and R.E. Wilson Wiley.
3	Principles of Extractive Metallurgy – A. Ghosh and H.S. Ray.
4	Chemical Engineering – J.M. Coulson and J.F. Richardson. Mc.Hill ELDS.
5	Engineering in Process Metallurgy – RLL Guthrie Oxford.
6	Rate Phenomena in Process Metallurgy – J.Z. Szekely and N.J. Themelis, Wiley Inter-Science.

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical and Materials Engineering**	**Academic Year**	**2024-25**

B.E. (ALL BRANCHES) : Regular Programme

Year	**I**	**Core / Elective / Foundation** **FTE XXXX: Universal Human Values – I**	**Hours per week (L-T-P) & Credit** **02-00-00, No Credit**
Semester	**I**	Year of Introduction: 2024 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, 2nd Edition (2019).								
2.	Universal Human Values and Professional Ethics by Dr. Saroj Kumar, Prof. SheenuNayyer, Thakur Publication Pvt Ltd, (2020)								
3.	Online Universal Human Values material of AICTE.								

FS of BE – III	Major	I

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,

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PSO7 Get platform to design and create prototypes with changing demands of the metallurgical and materials engineering fields through various research and development.
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Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2024-25**
(Metallurgical & Materials) Regular Programme				
Year	**III**	**Core / Elective / Foundation- Major** **Code: _____** **Subject:Iron Making**	**Credits / Hours per week**	**03**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO)

CO1 Classify ferrous metals and alloys.
CO2 Describe the different methods of processing of iron ores.
CO3 Enumerate modern trends in iron making blast furnace.
CO4 Explain brief principles of alternative methods and their advantages and limitations.

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	Iron Making historical, Occurrence and distribution of raw materials,Valuation of Iron ores. Flux, coal/coke and their evaluation.	05	10	1,2,3	CO1	1,3	Emp,Ent	G	HV,PE
2	Burden preparation-I for Iron making, Burden Qualities, Methods of beneficiation, agglomeration, sintering process & its mechanism. Palletization process, Theory of bonding, testing of agglomerates.	07	20	2,3,4	CO2	2,3,4			
3	Blast furnace and Mini blast furnace, Constructional features of blast furnace, Fuel Injection, oxygen injection, high-top pressure, high temperature blast, their effect, operational troubles and minimization, Blast furnace gas, gas cleaning and utilization.	07	15	2,3	CO3	1,2,3, 7,8			
4	Physiochemical principles of blast furnace, Blast furnace reactions, Thermodynamics of Iron oxide reductions, Slag metal reactions.	07	15	1.2,3	CO3	1,2,3			
5	Burden preparation-II for Alternative Iron Making, Characteristics of raw materials - Sponge iron. Present and future of Sponge iron.	07	20	1,2,3	CO4	3,4,7,8			
6	Sponge Iron Processes: Fastmet, ITmk3, Midrex, HyL, Finmet, and uses of sponge iron in Blast Furnace, Cupola, BOF, Electric Furnaces Smelting Reduction Processes: Corex, Romelt, FASTMET, FINEX, Plasmamelt	07	20	1,2,3	CO4	3,4,7,8			
	Total	**40 Hours**	**100%**						

Reference Books	
1	Introduction to Modern Iron making -R.H.Tupkary,KhannaPub.,Delhi.
2	Introduction to Physical chemistry of iron and steel making -R.G.Ward,ELBS
3	Alternative methods of Iron Making – Prof.S.K.Dutta & Prof.Rameshwar Sha. Pub-SChand. Delhi.
4	Principles of blast furnace Iron Making- A.K.Biswas,SBA Pub,Calcutta
5	Alternative roots of Iron Making – Arbinda sarangi & Bidyapati Sarangi PHI Pub.New Delhi
6	Sponge Iron production by Direct Reduction Iron oxide – Amit Chatterjee PHI Pub.New Delhi

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**	**Academic Year**	**2024-25**

BE (Metallurgical & Materials) Regular Programme

Year	**III**	**Core / Elective / Foundation - Major** **Code** **Subject:Iron Making Laboratory**	**Credits / Hours per week**	**01**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**50**
Mode of Transaction		Laboratory Experiments, discussion and viva		

No.	**Experiment**		**Course Code**	**BT Level**	**CO**	**PSO**
1	Tutorial – 1 : Status of Iron and Steel industries in India			1,2	CO3	1,2,3
2	Tutorial – 2 : New developments in iron making manufacturing			2,3		3,47
3	Tutorial – 3: Numericals on Blast Furnace Charge calculation.			1,4		1,3
4	Experiment - 1: Agglomeration of Iron ore – Pelletization of Iron ore			2,5		2,4
5	Experiment - 2: Sintering of Iron ore			6		3,7
6	Experiment - 3: Testing of Agglomerated Materials			2,3		7,8

FS BE-III Major II

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.
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Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2024-25**
BE (Metallurgical & Materials) Regular Programme				
Year	**III**	**Core / ~~Elective~~ / ~~Foundation~~** **Code: MME** **Subject: Furnace Technology**	**Credits / Hours per week**	**03 Hrs/ week**
Semester	**I**	Year of Introduction: Year of Syllabus Revision: 2024	**Maximum Marks / Grade**	**100 Marks**
Mode of Transaction		Lecture and Laboratory		

Course Outcome (CO)

CO1 Classification of various furnaces, component parts and uses of furnaces.
CO2 Overview of basic laws of heat transfer.
CO3 Study of gas dynamics and its importance in design of furnace body.
CO4 Design of furnace component to improve efficiency and yield of furnaces
CO5 Detail study of all electrical energy based industrial furnaces in details
CO6 Knowledge of advance furnaces and its utility -different sources of energy
CO7 Importance to control the furnace temperatures by recording of temperature

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	Classification and uses of furnaces, fundamentals of heat engineering of furnaces, heat transfer laws (conduction, convection and radiation)	7	14	1-6	CO1, CO2	1,2,3	Emp,Ent, SD	G	ES, HV ,PV
2	Gas dynamics, waste heat recovery (regenerators and recuperators) and blast furnace stove.	6	16	1,2	CO3	2,3,4			
3	Elements of furnace design: refractories, fuel burning devices for solid/liquid/gaseous fuel, other materials for furnace constructions, design of roof and hearth.	8	20	1,2	CO4	2,3			
4	Electric heating furnaces: resistance heating furnace, induction furnace and arc furnace.	6	15	1,2,3, 4,5,6	CO5	5,6,			
5	Special furnaces: plasma heating furnace, optical heating furnace, LASER furnace and advance furnaces	8	15	1,2,3, 4,5,6	CO6	6,7,8			
6	Various devices for temperature measurement and control in the furnaces.	7	20	1,2,3, 4,5,6	CO7	7,8			
	TOTAL	**42 Hours**	**100%**						

Reference Books:

1	Combustion Engineering, A.K.Shaha,Oxford and IBH Publ. Co. Calcutta,1974 and Fuel Technology
2	Metallurgical Furnaces, V.KKrivanchiv and B.Markov,MIR Publ. Moscow,1977.
3	Metallurgical Engineering, Schuman Principles Vol 1
4	The General Theory of M.A.Glinkov and G.M. Glinkov, MIR Publ.Moscow,1978

The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials**		**Academic Year**	**2024-25**
BE (Metallurgical & Materials) Regular Programme			
Year	**III**	**Core / ~~Elective / Foundation~~** **Code: MME** **Subject: Furnace Technology Laboratory**	**Credits / Hours per week**	**02**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**50**
Mode of Transaction		Tutorials and Laboratory		

No.	Experiment	BT Level	CO	PSO
1	Introduction and classification of the furnaces	1,2	CO2	4,5,6
2	Problems of conduction	2,4,5	CO1	2,3,4
3	Problems of convections	2,4,5	CO1	6,7,8
4	Problems of radiations	2,4,5	CO1	4.7.8
5	Design of the furnace	1,2,3	CO3,CO4	1,2
6	Waste heat recovery	1,2,6	CO4,CO6	5,6
7	Different furnaces available to the department	1,2,3	CO1, CO3, CO6	7,8

FS of BE – III | **Major** | **III**

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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2024-25**
BE (Metallurgical & Materials) Regular Programme				
Year	**III**	**Core / ~~Elective / Foundation~~** **Code: MME 1501** **Subject:Non Ferrous Extractive Metallurgy**	**Credits / Hours per week**	**03 + 01 =04**
Semester	**I**	**Year of Introduction:** **Year of Syllabus Revision: 2024**	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO)

CO1 Learn about ores and mineral deposits and Production of non-ferrous metals such as Cu, Zn, Ni, Pb, Al, Sn, Mg.
CO2 Study of Copper ore and minerals & Extraction of copper and study of electrowinning&electrorefining.
CO3 Understand extraction of Ni, Al& Mg.
CO4 Explore extraction of Zn, Pb& Sn.
CO5 Analyze extraction of precious metals from secondary resources.

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	Indian scenario of ores and mineral deposits and production facility for non-ferrous metals such as Cu, Zn, Pb, Al, Sn, Ni, Mg, Ti.	04	10	1,2,3	CO1	1,2,3	Emp,Ent,SD	G	HV,PE, ES
2	Copper:Ores & Minerals,Pyrometallurgical extraction, concentration, roasting and smelting, converting refining, Hydrometallurgy of Copper, Comparative study of electrowinning and electrorefining of copper &behavior of impurities.Parallel and Series systems	06	15	2,3,4	CO2	2,3,4			
3	Nickel: Ores & Minerals, Pyrometallurgical extraction, Refining, And Aluminum: Ores and minerals. Pyro and hydro Metallurgical processes of extraction. Preparation of alumina from bauxite.Preparation of electrode. Manufacture of carbon electrode, Hall & Harout's process, Anode effect, Hoop's process.	06	15	2,3,4,5, 6	CO2	2,3			
4	Magnesium: Ores and minerals, method s of production of MgO and $MgCl_2$, Pyrometallurgical extraction of magnesium. Electrolytic extraction, Refining of electrolyte.	06	15	2,3,4	CO3	5,6,			
5	Extraction methods for low melting point metals. Zinc: ores &minerals, Pyrometallurgical extraction of zinc, methods of distillation, Hydrometallurgical extraction of zinc.	06	15	1,2,3,4, 6	CO3	6,7,8			
6	Lead: Ores &Minerals, Pyrometallurgical extraction of lead, Pyrometallurgical refining of lead bullion, Continuous lead refining, Separation and extraction of Ti-metal. Process, mini- blast furnace, electrothermal process. Tin:Ores& Minerals and extraction of tin from its ores	06	15	2,3,4,5, 6	CO4	5,6,			
7	Properties uses of important nonferrous metals Recovery of precious metals from secondary resources such as anode mud, zinc dross, red mud and zinc electrolyte.	06	15	2,3,4,5, 6	CO5	2,5,6			
	Total	**40 Hours**	**100%**						

Reference Books	
1	Extractive Metallurgy:J.Newton.Willey
2	Metallurgy of Non Ferrous metals -W.H.Dennis,Ditman.
3	Extraction of Non Ferrous metals -H.S.Ray, R.Shridhar and K.P.Abraham
4	General Metallurgy-B.Kuznetov,Peacepubs.Moscow
5	Hydrometallurgy-S.Venkatachalam,NorsaPub,Bombay.

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**	**Academic Year**	**2023-24**

BE (Metallurgical & Materials) Regular Programme

Year	**III**	**Core / ~~Elective~~ / ~~Foundation~~** **Code: MME 1501L** **Subject:Non Ferrous Extractive MetallurgyLaboratory**	**Credits / Hours per week**	**01/2Hours per week**(Practical)
Semester	**I**	**Year of Introduction:** **Year of Syllabus Revision:2024**	**Maximum Marks / Grade**	**50** (TW/VIVA)
Mode of Transaction		Laboratory Experiments, discussion and viva		

No.	**Experiment**		**Course Code**	**BT Level**	**CO**	**PSO**
1	Tutorial – Ores and Minerals of various non ferrous metals			1,2,3,4,6	CO1	1,2,3
2	Tutorial- Various non ferrous industries in india			2,3,4,5,6	CO2	2,3,4
3	Tutorial – Roasting process and roasting furnaces			2,3,4,5,6	CO2	2,3
4	Tutorial- Smelting furnaces			2,3,6,4,5	CO3	5,6,
5	Tutorial – Continuous Copper production			1,2,3,4,6	CO3	6,7,8
6	Tutorial – Problems based on Cu smelting and Roasting			2,3,4,5,6	CO1	5,6,
7	Tutorial – Problems based on converting process			2,3,4,5,6	CO2	2,5,6
8	Tutorial – Problems based on heat and mass transfer			2,3,6,4,5	CO2	7,8
9	Assignment –Comparison of non ferrous industries at worldwide level			1,2,3,4,6	CO4	1,2,3
10	Assignment – Properties and Applications of non ferrous metals and alloys			2,3,4,5,6	CO5	2,3,4

SS BE –III Minor Elective-III 4.5

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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2024-25**
BE (Metallurgical & Materials) Regular Programme				
Year	**III**	**Elective - III** **Code:** **Subject:** Smart Materials	**Credits / Hours per week**	**03 (Credit)**
Semester	**II**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO)

CO1 Learn about the basics of smart materials.
CO2 Study various types of smart materials
CO3 Understand applications of various smart materials.

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	Definition of smart materials, Introduction to smart materials and classification of smart materials, need for smart materials	06	20	1,2,3,5, 6	CO1	1,2,3,4	Emp, Ent, SD	G	G,ES
2	Piezoelectric Materials,magneto strictive materials, magnetorheological fluids,electrorheological materials	06	20	2,3,4	CO2	2,3			
3	Electro strictive materials,Electronic Materials, Electro-active Polymers, Ionic Polymer Matrix Composites (IPMC)	06	15	3,4,5	CO2	5,6,			
4	Chromogenic materials. classification of chromogenic materials, Thermochromic, Photochromic & electrochromic materials	06	15	1,2,3,4, 5	CO2	6,7,8			
5	Shape memory Materials: Shape Memory Effect, Shape Memory Alloys,	08	15	1,2,4,5	CO2	5,6,			
6	Applications of smart materials in various fields	08	15	2,4,5,6	CO3	2,5,6			
	TOTAL	**40 Hours**	**100%**						

Reference Books

1	B. Culshaw, Smart Structures and Materials, Artech House, 2000
2	P. Gauenzi, Smart Structures: Physical Behaviour, Mathematical Modelling and Applications, Wiley Publishers, 2009
3	M. Addington, Schodek, L. Daniel.: Smart materials and new technologies, Architectural Press, 2005
4	M. Schwartz, Encyclopedia of Smart Materials, Volumes 1-2 ,Willey, 2002
5	W. G. Cady, Piezoelectricity, Dover Publication, 1964
6	Smart Material Systems and MEMS: Design and Development Methodologies, V. K. Varadan, K. J. Vinoy, S. Gopalakrishnan, John Wiley and Sons, England, 2006.

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**	**Academic Year**	**2024-25**

BE (Metallurgical & Materials) Regular Programme

Year	**III**	**Elective-III** **Code:** **Subject**: Smart Materials	**Credits / Hours per week**	**01 (Credit)**
Semester	**II**	Year of Introduction: NA Year of Syllabus Revision: NA	**Maximum Marks / Grade**	**50** (TW/VIVA)
Mode of Transaction		Laboratory Experiments, discussion and viva		

No.	**Experiment**	**Contact Hr**	**Weightage (%)**	**BT Level**	**CO**	**PSO**
1	Exp;1	2	15	1,2,3	CO1	1,2,3
2	Exp:2	2	15	2,3	CO2	2,3,4
3	Exp:3	2	15	4	CO3	3,4
4	Exp:4	2	15	4,5	CO1	5,6
5	Exp:5	2	10	4,6	**CO2**	7,8
6	Exp:6	2	10	5,6,	CO3	3,4
7	Exp:7	2	10	,4,5,6	CO1	4,5
8	Tutorial : 1	2	5	2,3,4	CO2	5,6,7
9	Tutorial :2	2	5	3,4,5	**CO3**	6,7

FS of BE – III | **Major** | **IV**

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)

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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering**		**Academic Year**	**2024-2025**
BE (Metallurgical & Materials) Regular Programme				
Year	**III**	**Core / ~~Elective / Foundation~~** **Code: MME 1506** **Subject:Engineering Economics**	**Credits / Hours per week**	**04 Hrs / week**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO)

CO1 Understanding the meaning and scope of economics
CO2 Learn about the application of demand and supply to real life problems
CO3 Learn about application of production and cost concepts and how they are applied
CO4 Understand the General market structure
CO5 Understand basics of Investment analysis

CO6 Applications of macro economics to real life situations									
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 Economics	2	05	1,2	CO1	8	EMP	G	ES and HV
2	Demand and Supply Analysis	6	15	2,3,4	CO2	3,4			
3	Production Analysis	5	15	2,3,4	CO3	2,3			
4	Cost Analysis	6	15	2,3,4	CO3	2,3,4			
5	Break Even Analysis	3	15	2,3,4	CO3	2,3,4			
6	Market Structure	3	05	2,5	CO4	2,3			
7	Investment Analysis	4	10	2,3,4	CO5	7			
8	National Income	4	05	2,3,5	CO6	5,6	SD		
9	Inflation	3	10	2,4	CO6	5,6			
10	Monetary and Fiscal Policy	4	05	2,4	CO6	6,7			
	Total	**40 Hours**	**100**						

Reference Books	
1	Economics by Paul. A Samuelson
2	Advanced Economic Theory by H.L Ahuja
3	Micro Economics for Management Students by Ravindra Dholakia and Ajay Oza

FS of BE – III	Elective I 5.1 Minor

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.
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PSO3 Build successful career in design, development, manufacturing and process control of metallurgical and materials engineering industries.
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PSO5 Manage proficiency and necessary skills to take up entrepreneurial Venture.
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Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2024-25**
BE (Metallurgical & Materials) Regular Programme				
Year	**III**	**Core / Elective / Foundation** **Code: MME1303** **Subject: Fuels and Energy Sources in Metallurgy**	**Credits / Hours per week**	**03**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures		

Course Outcome (CO)

CO-1: Understanding of different sources of fuels and energies with their characteristics
CO-2: Study of Indian coal and testing of coking coal properties
CO-3: Learning about artificial gas manufacturing processes and their applications
CO-4: Knowledge of non-conventional energy sources for manufacturing and metallurgical uses
CO-5: Learning about energy management in metallurgy
CO-6: Understanding the importance of energy conservation and environmental protection for sustainable developments

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 Fuels and Energy Sources** Types of Fuel, Classification of energy sources (Conventional and Non-conventional sources), Classification of fuels Solids, Liquids and Gases, Characterization of fuels	06	10%	1/2	CO1	4,5,6	Emp/Ent/SD	L/N/R/G	ES/PE
2	**Solid Fuels -I Coal** Classification of Indian coal, coal cleaning and storage **Solid Fuels -II Coke** Coke making and testing of coke	05	15%	1/2/3	CO2	1,4,6			
3	**Gases Fuels** Classification and composition of gases, Natural gas, liquefied petroleum gas (LPG) and refinery gases, reformed natural gas in HyL-III, Midrex, Corex gas, LD steel gas, blast furnace gas, uses of fuel gases in different metallurgical applications	07	20%	1/2	CO3	2,7,8			
4	**Non-conventional Energy Source** Non-conventional energy source like solar, wind, bio, tidal etc. in metallurgical applications. Biofuels (Bio-coke) for steel making, Concentrated solar energy applications in metallurgy	07	20%	1/2	CO4	3,5,6			
5	**Energy Management in Metallurgical Industries** Energy need and its role, energy need for steel, aluminum, and other major metallurgical industries, Hydrogen and Biomass as a renewable energy source for iron and steel industry	08	20%	1/2/3/4	CO5	3,5,6			
6	**Energy conversation and low of environment protection** Energy / economy conservation and recovery, Energy generation from wastes, Gas cleaning and purification, reduction of greenhouse gas emissions (GHG's) from various metallurgical	07	15%	1/2/3/4/5	CO6	7,8			

	processes (mostly iron, steel and aluminum manufacturing process and other metallurgical operations)								
	Total	**40 Hours**	**100%**						

Reference Books

1	*R.C. Gupta*, **"Fuels, Furnaces and Refractories"**, PHI Learning Private Limited, New Delhi (2016)
2	*Barbara Elvers*, **"Handbook of Fuels: Energy Sources for Transportation"**, Wiley (2007)
3	*Balasubramanian Viswanathan*, **"Energy Sources: Fundamentals of Chemical Conversion Processes and Applications"**, Elsevier (2016)
4	*Sunggyu Lee*, **"Alternative Fuels"** , CRC Press, Taylar and Francis Group (1996)
5	*R.C. Gupta*, **"Energy and Environmental Management in Metallurgical Industries",** PHI Learning Private Limited, New Delhi (2012)

FS of BE – III

5.2 Minor Elective-I

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.
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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
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PSO7 Get platform to design and create prototypes with changing demands of the metallurgical and materials engineering fields through various research and development.
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Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2024-25**
BE (Metallurgical & Materials) Regular Programme				
Year	**III**	~~**Core**~~ **/ Elective** ~~**/ Foundation**~~ **Code:** **Subject :**Energy Economy and Waste Management	**Credits / Hours per week**	**03**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO)

CO1 Learn about energy sources for industrial applications & Requirement of energy in metallurgy processes.
CO2 Methods use in energy analysis and routes of extraction metallurgy energy.
CO3 Case studies in energy conservative in metallurgy industry.
CO4 Classification of industrial waste& effect on environment due to pollution and method to prevent pollution.
CO5 Understand Generation of solid waste in metallurgy and powder industry.

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	Energy sources for industrial applications. Economic value of energy conservation. Economics of alternative sources of energy for industrial applications.	03	7.5	1,2,3,4, 5	CO1	1,2	Ent,SD	G	ES,HV,PE
2	Requirement of energy in Metallurgical processes. Areas of intensive use and scope for efficient utilization. Energy spent in extraction / processing of metals and materials.	05	12.5	2,3,5	CO1	1,2,3			
3	Energy analysis – Review, methodology and conventions. Methods use in energy analysis. Effect of energy saving measures. Application of thermodynamic principles and energy balance.	04	10	1,2,3,4, 5,6	CO2	3,4			
4	Perspectives in energy conservations – Alternative routes of extraction of metals for energy saving. Direct reduction v/s Conventional route for steel making. Role of optimal selection of metal processing route. Conservation through protection of materials against decay. Waste heat recovery methods	04	10	2,3,4,5, 6	CO2	4,6			
5	Case studies in energy conservation in metallurgical industry. Use of energy efficient equipments.	04	10	2,3,4,5	CO3	4,6,7			
6	Classification of industrial waste. Effect of waste on environment and resources. Economic value of industrial waste. Waste disposal v/s recycling and secondary uses (value added products).	04	10	2,4,5,6	CO4	3,7,8			
7	Effect on environment due to excessive use of gaseous, liquid and solid resources from earth. Environmental degradation due to minimizing, disposal of lean ores, pollution due to water used. Extraction from leaner ores, recycling of spent metal for energy saving and use of water in industrial processes. Generation of waste during primary processing of ores and beneficiation.	04	10	2,3,4,6	CO4	2,4			
8	Air pollution and control due to toxic and non-toxic gases, fumes, dust etc. during combustion, heating and roasting processes and industrial production, control methods, cleaning of gaseous effluents, recovery of	04	10	1,2,3,4	CO4	3,7			

	economic value from gases.								
9	Generation of solid waste in metallurgical and powder industry. Economic uses of solid waste such of B.F. slag and fly ash & wastes from non-ferrous industry.	04	10	2,3,5,6	CO5	7,8			
10	Water pollution. Methods of treatment of waste water, recovery and recycling of effluents water. Case studies related to waste management in metal related industries. Knowledge of Environmental system, ISo-14000.	04	10	1,3,4,5	CO5	1,2,7			

Reference

1.	R.C Gupta , ENERGY AND ENVIRONMENTAL MANAGEMENT IN METALLURGICAL INDUSTRIE, PHI Learing Pvt Ltd 6 dec 2012	
2.	Waste to resources A waste management handbook published by TERI press ,The energy and resource institute new delhi, india.	
3.	TOTAL ENERGY MANAGEMENT HANDBOOK ,New Approach to Energy Conservation in Thailand (Final Version) NOVEMBER 2005	

FS BE-III **Minor** **5.3** **Elective-II**

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.
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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

Syllabus of Courses

The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2024-25**
BE (Metallurgical & Materials) Regular Programme			
Year	**III**	~~**Core**~~ **/ Elective-II /** ~~**Foundation**~~ **Code:** **Subject:** Nuclear Metallurgy	**Credits / Hours per week**	**03**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO)

CO1 Understand atomic structure &Fission, fusion and other nuclear reactions.
CO2 Learn about essential parts of a nuclear reactor.
CO3 Understand Indian atomic power plant& Purity requirements of nuclear metal.
CO4 Method of production of Ultra high purity metal and important in nuclear metallurgy

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	Atomic structure. Fundamental properties. Atomic nucleus. Radio activity. Half life period and isotopes.	05	15	1,2,3,5, 6	CO1	1,2,3,4	Emp, Ent, SD	G	G,ES
2	Fission, fusion and othernuclear reactions. Essential parts of a nuclear reactor. Reactor types. Reactor fuel cycle Critical mass. in India and future trends.	05	15	2,3,4	CO1	2,3			
3	Indian atomic power plants. Nuclear power programme in india & future trends	07	20	3,4,5	CO2	5,6,			
4	Difference in separation methods as compared to conventional methods. Purity requirements of nuclear metal. Separation processes – Ion and solvent extraction techniques	06	10	1,2,3,4, 5	CO3	6,7,8			
5	Occurance, extraction, mechanical & physical properties and use of uranium and thorium	08	20	1,2,4,5	CO3	5,6,			
6	Methods of production of ultrahigh purity metals and their importance in nuclear metallurgy. Influence of radiation damage on mechanical properties. Scope of beryllium in nuclear plants.	07	20	2,4,5,6	CO4	2,5,6			
	TOTAL	**40 Hours**	**100%**						

Reference Books

1	Nuclear Reactor Fuel Elements – Metallurgy and Fabrications – Kaufmann.
2	Proceedings of Seminar on Nuclear Metallurgy, March 1978, IIM, Bombay Chapter and IE, Maharashtra State.
3	Extraction of Non-ferrous Metals – H.S. Ray, R. Sridhar, K.P. Abraham, Affiliated East-West Press Pvt. Ltd.
4	Zone Mellign – William G. Pfann, John Wiley & Sons Inc., New York.

FS BE-III **Minor** **5.4** **Elective-II**

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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2024-25**
ME (Metallurgical & Materials) (Materials Technology) Regular Programme				
Part	**I**	**Core / ~~Elective / Foundation~~** **Code:** **Subject:** Nano materials	**Credits / Hours per week**	**03**
Semester	**I**	Year of Introduction: Year of Syllabus Revision: 2024	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures		

Course Outcome (CO)

CO1 To understanding the basics of nanomaterials and nanotechnology
CO2 To learn basics of various phenomena at nano scale and various building blocks of nano materials
CO3 To learn the functional properties of nanomaterials
CO4 To understand the Synthesis & fabrication techniques &
CO5 To study consolidation methods for nano powders
CO6 To learn Characterization of nanomaterials
CO7 To know various applications of nanomaterials

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 nanomaterials and nanotechnology, history, scope & applications of nanotechnology. Classifications and types of nanomaterials.	3	12	1,2	CO1	1,3	Emp, Ent, SD	G	PE,HV,ES
2	Size confinement and interfacial surface phenomena. Basic building blocks namely carbon nanotubes, fullerenes, quantum dots, etc.	5	16	1,2	CO2	2,3, 4			
3	Functional properties of nanomaterials such as physical, mechanical, electrical, magnetic, chemical and optical properties.	7	15	1,2,3	CO3	4,5			
4	Synthesis & fabrication techniques: 'Top down' vs 'Bottom-up' approach of synthesis. Sol-gel method, chemical vapour deposition, physical vapour deposition, sputtering, plasma deposition process, mechanical milling, etc.	8	15	1,2,3	CO4	4,5			
5	Consolidation methods for nanopowders such as cold isostatic pressing (CIP), hot isostatic pressing (HIP), and sintering.	4	16	2,3	CO5	3,4			
6	Characterization of nanomaterials. An introduction to characterization techniques like transmission electron microscopy (TEM), scanning tunneling microscopy (STM), scanning probe microscopy (SPM), atomic force microscopy (AFM) etc.	8	16	1,2,3	CO6	2,5			
7	Applications of nanomaterials namely nano-composites, nanomagnetic materials, chemical applications etc.	5	10	1,2,3	CO7	4,5			
	TOTAL	**40 Hours**	**100%**						

Reference Books

1	Nanomaterials: Synthesis, Properties & Applications, ed. by A.S. Edelstein and R.C. Cammarata, published by Institute of Physics, UK, 1996.
2	Nanostructured Materials: Professing, Properties and Applications, ed. by C.C. Koch, William Andrew Publishing, New York, 2002.
3	Nanotechnology by George Timp, Springer-Verlag, New York, 1999.
4	Nanoparticles and Nanostructured Films: Preparation, characterization & Applications, ed. by J.H. Fendler, John Willey & Sons, 1998.
5	Handbook of Nanophase and Nanostructured Materials, ed. by Z.L. Wang, Z. Zhang and Y. Lim, Kluwer Academic Publisher, 2002
7	Carbon Nanotubes: Science and Applications ed. by M. Meyyappan, CRC Press, Boca Raton Florida, 2004.

FS of BE – III

5.5 Minor - Elective I

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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2024-25**
B.E (Metallurgical & Materials) Regular Programme				
Year	**III**	**Elective I** **Code:** **Subject: Strengthening Mechanism**	**Credits / Hours per week**	**03**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lecture and Tutorials		
Course Outcome (CO) CO1:To understand the basic Fundamentals of strengthening mechanism of materials CO2: To learn the presence of different kinds of defects in metal or crystal that has significant effect on material properties. CO3: To learn science and technological aspects for designing high temperature materials or materials for adverse environments				

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: Elemental Plastic flow in metals and alloys and dislocation theory: Mechanism and micro mechanism of strengthening in engineering materials.	06	15%	1,2,3,4	CO1	1,5,8	SD,Ent,Emp	N,G	HV,PE,ES
2	Mechanism of Strengthening: Dislocation theory , solid solution strengthening, Strengthening due to sub and grain boundaries, precipitation strengthening, dispersion strengthening, martensitic strengthening, , Order strengthening.	08	20%	2,3,5	CO2	3,5,6,8			
3	Factors affecting on Strengthening Mechanism: Physical phenomena that contribute towards high temperature mechanical strength in engineering materials,	07	15%	2,3,5	CO2	3,5,6,8			
4	Strengths at High Temperature, Strengthening against diffusion flow, Strengthening against dislocation creep, Strengthening against high rate of deformation.	07	20%	2,3,5	CO3	3,5,6,8			
5	Strengthening in Product Manufacturing: Strength improvement in forge, cast, weld, draw, rolling, extrusion products	06	15%	2,3,5	CO1, CO2	3,5,6,8			
6	Testing of Strengthen Materials: Chemical and Mechanical testing, Metallography etc.	06	15%	2,3,4,5	CO2, CO3	2,5,7,8			
	Total	**40 Hours**	**100%**						

References	
1	Dislocation and Mechanical Behaviour of Materials, M. N. Shetty, PHI Learning Pvt. Ltd.
2	Mechanical Behaviour and Testing of Materials, A. K. Bhargava and C. P. Sharma, PHI Learning Pvt. Ltd.
3	George Dieter, Mechanical Metallurgy, McGraw-Hill, 3rd Edition
4	Structural Properties of Engineering Alloys, William F.Smith, Tata Mc-Graw-Hill, Inc., 1993.
5	William D. Callister, Jr., Materials Science and Engineering an Introduction, 6th Edition , John Wiley & Sons, Inc., 2004.
6	G. L. Kehl, Principles of metallographic laboratory practice ,3rd Edition

FS of BE – III	6.1 Minor - Elective II

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

Programme Name: B.E. (All Branch) Open elective/ Institute elective from (Metallurgical & Materials) Regular Programme

Programme Specific Outcome (PSO)

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 s 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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engg**		**Academic Year**	**2024-2025**	
BE (Metallurgical & Materials) Regular Programme					
Year	**III**	**Code:_____** **Subject: Composite Materials**	**Credits / Hours per week**	**03 [03]**	
Semester	**I**	Year of Introduction: NA Year of Syllabus Revision: NA	**Maximum Marks / Grade**	**70 UA**	**30 IA**
Mode of Transaction		Lectures, PPT, Tutorials, Factory Visit, Videos etc			

Course Outcome (CO)

CO1 Overview ofBasic of Composite Material
CO2 Importance and Preparation of reinforcement materials Fibbers and Whiskers, Oxides and Non oxides base
CO3 Structure and properties of various Fibers and Particulates as reinforcement.Test to check the properties of it
CO4 Classification of Composites on the basis of Matrix Material
CO5 Interface and its importance in composites in details
CO6 Polymer Matrix Composites – Various methods to prepare it, structure and applications
CO7 Metal Matrix Composites- Various methods to prepare it, structure and applications
CO8 Ceramic Matrix Composites- Various methods to prepare it, structure and applications
CO9 Study Mechanical Probertites of composites, test required to check its mechanical properties, fatigue test, types of various fracture modes
CO10 Critical Application of Composites

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)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and

								developmental needs	Professional Ethics (PE)
1	Introduction, relevance as modern materials, comparison of composites classification & basic characteristics of composites.	3	5	1-6	CO1	1	SD	G	ES
2	Classification on the basis of matrix. Types and properties of matrix, Selection of Matrix	3	5	1,2,3, 4,5,6	CO4	1	ENT	G	ES
3	Production and properties of various types of fiber reinforcing materials such as glass, carbon Boron, Aramid etc.in terms of structure and properties	7	10	1,2	CO2	3	EMP	G	ES
4	Interfaces – Interaction and types of bonding at the interface. Tests for measuring interfacial strength.	9	20	1,2,3, 4,5,6	CO5	5	EMP	G	ES
5	Metal matrix composites – scope, properties and applications. Methods of fabrication.	6	15	1,2,3, 4,5,6	CO5	7	ENT	G	ES
6	Polymer matrix composites and Ceramic matrix composite– scope, properties and applications. Methods of fabrication.	6	10	1,2,3, 4,5,6	CO7	6	EMP	N and G	ES
7	Mechanical testing of composite Mechanical properties of composites – tensile elastic and fatigue properties. Fracture modes in composites.	4	15	2,3	CO9	9	SD	G	ES
8	Examples of some critical applications of composite materials.	2	5	2,3,4	CO10	10	EMP	G	ES
	Total	**40 Hours**	**100%**						

Text Books:

1	Composite Materials –Science and Engineering Krishan K Chawla, Third Edition, Springer Publication
2	Modern Composite Materials – Lawrence J., Broutman and Richard H. Krock, Addison-Wesley Publishing Company, California.
3	Advances in Materials & their Applications – edited by P. Ramarao, Wiley Eastern Ltd., New Delhi.s

Reference Books:

1	Composite Materials – Lensile – Holliday, Elsevie Publishing Company, Amsterdam.
2	Modern Composite Materials – Lawrence J., Broutman and Richard H. Krock, Addison-Wesley Publishing Company, California.
3	Composite Materials Science and Application, Deborah D.L. Chung, Springer Publication
4	Hand Book of composite Edited by S T Peters- Chapman and hall publication
5	Composite materials: Testing and design ASTM 13 th Ed Editor By Steven J Hopper

FS BE-III **Minor** **6.2** **Elective-II**

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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2024-25**
BE (Metallurgical & Materials) Regular Programme				
Year	**III**	**Elective II** **Code:** **Subject: Fundamental and practical Application of phase diagrams**	**Credits / Hours per week**	**03**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100 Marks**
Mode of Transaction		Lectures, PPT, Tutorials, Factory Visit, Videos etc		

Course Outcome (CO)

CO1 To understand the concept of phase diagram
CO2 To study various phase diagrams.
CO3 To learn features of phase diagram.
CO4 To Practical applications and errors in phase diagram.

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 : introduction to alloy phase diagram, Common terms	6	10	1,2	CO1	1,2	Emp, Ent, SD	G	G, ES, HV, PE
2	Unary diagram, invariant equilibrium ,univarient equilibrium, Bivarient equilibrium, Binary phase diagram, Ternary phase diagram	6	15	1,2,3	CO2	1,2,3			
3	Thermodynamic principles : internal energy,closed system, first law, enthalpy, heat capacity, second law, entropy, third law, Gibbs energy	6	15	1,2,3, 4	CO2	1,5,8			
4	Features of phase diagram: phase field rule,theorem of La-chatelier,clausius-claperyon equation, Mixtures, curves& intersections, congruent transformation	6	15	2,3,4	CO3	2,4,8			
5	Crystal structure & determination of phase diagram, Reading phase diagrams	4	15	1,2,3	CO3	6,7			
6	Examples of phase diagram, types of binary phase diagram	4	10	1,2,3	CO3	3,4,6			
7	Practical applications of phase diagram: Alloy design, processing	4	10	1,2,3	CO4	4,6,8			
8	Errors in phase diagram	4	10	3,4	CO4	6,7,8			
Total		40	100						

Text Books

1	ASM Metals handbook Vol.3
2	Engineering physical metallurgy by Y.Lakhtin
3	Physical Metallurgy by Vijendra singh
4	Physical metallurgy for engineers by Donald clark &Wilbur varney

FS BE-III **Minor** **6.3** **Elective-II**

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)

PSO1 Learn basics of classical, quantum and statistical mechanics and develop methodology to understand and solve various problems
PSO2 Basic understanding and application of the electromagnetic theory, modern optics, laser, fiber optics and their applications in imaging, holography, and optical instrumentation
PSO3 Learn mathematical methods and computational techniques used in physical sciences including simulations
PSO4 Semiconductor devices, electronics and their applications
PSO5 Learn about various properties of materials, instrumentation, nuclear reactor physics
PSO6 Advanced understanding and application of physical techniques used in industries at various levels including nondestructive evaluation and device fabrication
PSO7 Hands-on practice of basics and advanced experiments intended for industrial and research applications
PSO8 Training and exposure to research problems through project dissertation

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials**		**Academic Year**	**2024-25**
BE (Metallurgical & Materials) Regular Programme				
Year	**III**	**Elective-II** **Code: Subject**: Materials for petrochemical industry	**Credits / Hours per week**	**03**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO)

CO1 to understand Basics of the petrochemical industry
CO2 To study the processing of various products
CO3 Learn the selection criteria for various materials used in petrochemical industry
CO4 Study materials Behavior, failure and safety norms

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 petrochemical industries, Petrochemical Materials: Raw material and final products. Properties of the raw material and final products.	06	15	1,2,3	1	2	(Emp/Ent/SD)	L/R/G	G/ES/HV/PE
2	Processing of crude oil, hydrocarbons, non-hydrocarbons, monomers, polymers, and plastics.	06	15	1,2,3,4	1,2	5			
3	Selection criteria for materials in the petrochemical industries, General idea of the design, and material selection with respect to the pressure, temperature, and atmosphere in service.	06	15	1,2,3	3	5,6,7			
4	Special alloys for petroleum industries, carbon steel, stainless steel, Ni and alloys, Ti and alloys, Cu and alloys and overall metallurgy of them. Their properties and application.	06	15	1,2,3	2,3	5,6,7			
5	Corrosion behavior of various metals and alloys and its preventive methods implemented in the petrochemical industries.	06	15	1,2,3	3,4	5,6,7			
6	Failure Mechanism in the Petrochemical Industries, High temperature Failure mechanisms, Creep, thermal fatigue, etc.	05	15	1,2,3,4, 5	2,4	5,6,7			
7	Environment of the petrochemical industries, Environmental control in the petroleum industries, Environmental Audits, and safety norms.	05	10	2,3,4,5	4	5,6,7			
Total		40	100						

Reference Books	
1	Handbook of petrochemical processes, James G. Speight, CRC press
2	Handbook of petrochemical processes, James G. Speight, CRC press
3	Understanding how components fail, Donald J Wulpi, ASM International
4	Physical Metallurgy, William F. Hosford, CRC Press, ASM Handbook Volume 2: Non-ferrous alloys and special-purpose materials.
5	Handbook of Corrosion Data, Bruce D. Craig, David A. Anderson, ASM International., Corrosion Engineering, Mars G Fontana
6	Understanding how componenets fail, Donald J Wulpi, ASM International
7	Environmental Control in Petroleum Engineering, John C. Ries, Gulf publishing company Tokyo

FS BE-III **Minor** **6.4** **Elective-II**

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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2024-25**
BE (Metallurgical & Materials) Regular Programme				
Year	**III**	**Elective II** **Code:** **Subject: Materials for Aerospace applications**	**Credits /** Hours per week	**03**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lecture and Tutorials		

Course Outcome (CO)
CO1: Know about the components used in Aircraft, Rocket and Helicopter
CO2: Understand different type of testing methods for aerospace components
CO3 Choose a suitable base material and coating material for gas turbine applications
CO4 Describe the properties and applications of aluminium, magnesium, titanium and stainless steel in aircrafts.
CO5 Demonstrate the utilization of polymer and ceramic matrix composites in aerospace applications.

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	Classification and different components in Aircraft, Helicopter and Rocket – Properties of Materials- Airworthiness-Aerospace material design drivers-	05	10	1,2,3,4	CO1	1,2, 3,4,	SD,Ent,Emp	N,G	HV,PE,ES
2	Quality Standards for aerospace industry-Materials requirements for aerospace structures, Engines and Rockets	05	09	1,2,3,4	CO1	1,2, 3,4,			
3	Mechanical and durability testing of aerospace materials – Aerospace materials certification- Structural health monitoring and non-destructive testing of aircraft components-Corrosion and corrosion testing of aerospace materials	05	10	2,3,5	CO2	1,2, 3,4			
4	Materials selection for aerospace, space environments and its effect on materials – stealth technology, Yield strength anomaly(Kerf-Wilsdorf Mechanism)	05	08	2,3,5	CO2	1,2, 3,4			
5	Materials for Gas turbine-Ni-based super alloys- Intermetallics-Ti-Al alloy – Bond coat-Thermal barrier coating(plasma spraying)-Materials for Rocket combustion chambers and Nozzles-Copper alloys-Cobalt base alloy- Stellite-Columbium alloy	06	19	2,3,4,5	CO3, 4	3,4, 5			
6	Superalloys, aluminum alloys, magnesium alloys and titanium alloys, materials for plasma engines, intermetallic aluminides, ceramics and polymeric materials	07	16	2,4,5	CO1,2	13, 6,			
7	Carbon-carbon composites, production, properties and applications, intermetallic matrix composites, ablative composites based on polymers, ceramic matrix, metal matrix	07	14	4,5	CO1,2, 5	1,2, 3,			
		40	100						
Reference Books									
1	H. Buhl								

2	Balram Gupta et.al
3	Willam D. Callister
4	Adrian P Mouritz, Introduction to Aerospace Materials, Wood head publishing,2012
5	Cantor,B.,Assender.H., and Grant.P(Ed),Aerospace Materials, CRC press,2007
6	Reed.R.C., The Superalloys – Fundamentals and Applications, Cambridge Univ. Press,2009
7	Campell.F.C., Manufacturing Technology for Aerospace Structural Materials,Elsevier,2010
8	KrishnadasNair,C.G. Handbook of Aircraft Materials, Interline Publishing,1993
9	BalramGuptha, Aerospace Materials, Vol. I, II, III, S. Chand publications,1993
10	Horst Buhl, Advanced Aerospace Materials,Springer,2006
11	Harvey M Flower, High Performance materials in Aerospace, Springer, 2006.

FS BE-III **Minor** **6.5** **Elective-II**

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)

PSO1 Learn basics of classical, quantum and statistical mechanics and develop methodology to understand and solve various problems
PSO2 Basic understanding and application of the electromagnetic theory, modern optics, laser, fiber optics and their applications in imaging, holography and optical instrumentation
PSO3 Learn mathematical methods and computational techniques used in physical sciences including simulations
PSO4 Semiconductor devices, electronics and their applications
PSO5 Learn about various properties of materials, instrumentation, nuclear reactor physics
PSO6 Advanced understanding and application of physical techniques used in industries at various levels including nondestructive evaluation and device fabrication
PSO7 Hands-on practice of basics and advanced experiments intended for industrial and research applications
PSO8 Training and exposure to research problems through project dissertation

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Applied Physics**		**Academic Year**	**2024-25**
BE (Metallurgical & Materials) Regular Programme				
Year	**III**	**Elective II** **Code: Subject**: Biomedical Materials	**Credits / Hours per week**	**03 (Credit)**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		
Course Outcome (CO) CO1 To understand the biomaterials CO2 Application and study of various materials for implant CO3 To learn about the degradation of materials CO4 To learn selection and design of material				

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**: Historical background, construction materials, impact ofbiomaterials, strength of biological tissues, performance of implants,tissue response to implants, interfacial phenomena, safety, and efficacytesting	04	10	1,2,3	1	2	Emp/Ent/SD	L/R/N/G	G/ES/HV/PE
2	**Metallic and Ceramic materials**: Stainless steels, Co-Cr alloys, Tibased alloys, Nitinol, biological tolerance of implant metals, ceramic implant materials, alumina, yittria stabilized zirconia, hydroxyapatite glass ceramics carbons, restorable ceramics, composites	06	15	1,2,3,4	1,2	5			
3	**Polymeric implant materials**: Polymers in biomedical use, polyethylene, polypropylene, acrylic polymer, hydrogels, polyurethans, polyamides, biogradable synthetic polymers, silicon rubber, microorganisms in polymeric implants, polymer sterilization	06	20	1,2,3	1,2	5,6,7			
4	**Dental Materials**: Tooth composition and mechanical properties, impression materials, bones, liners, and varnishes for cavities, filling and restorative materials, oral implants, use of collagen in dentistry	04	10	1,2,3	1,2	5,6,7			
5	**Cardiovascular and Orthopedic implants**: Artificial heart, aorta and valves, geometry of circulation, vascular implants, cardiac pacemakers, bone composition and properties, fracture healing, joint replacement, knee joint repair, bone regeneration with restorable materials	06	15	1,2,3	1,2	5,6,7			
6	**Degradation of Materials in the biological environment**: Chemical and biochemical degradation of polymers, degradation effects on metals and ceramics, pathological classification of biomaterials	04	10	1,2,3,4	2,3	5,6,7			
7	**Case studies:** Selection and design of biomaterials, implant, and device failures	06	20	1,2,3,4, 5	1,2,3, 4	5,8			

		36 Contact Hours	**100%**						

Reference Books	
1	Park J.B. and Bronzino J.D., Biomaterials: Principals and Applications, CRC Press
2	Park J.B., Biomaterials Science and Engineering, Springer Press
3	Rattner B.D., Hoffman A.S, Schoen F.J., Lemons J.E., Biomaterials Science: An Introduction to Materials in Medicine, Academic Press
4	Park J.B. and Lakes R.S., Biomaterials: An Introduction, 3rd edition, Springer press
5	Bhat, S.V., Biomaterials, 2nd edition, Narosa Publishing

FS BE-III **Minor** **6.5** **Elective-II**

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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2024-25**
BE (Metallurgical & Materials) Regular Programme				
Year	**III**	**Elective II** **Code:** **Subject: Materials for Advance Energy Devices**	**Credits** / Hours per week	**03**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lecture and Tutorials		

Course Outcome (CO)
CO1 To study to various sorces.
CO2 To learn about solar and hydro energy
CO3 Application of nano materials for energy storage.
CO4 To understand thermo electric materials and energy harvesting.

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 – Energy demand in India and sources – Renewable energy sources – Wind energy (Principles & types) – Solar energy (PV cells & Solar cells), Electrochemical energy storage and conversion (Batteries, Fuel cells & Supercapacitors)	06	10%	1,2,3,4	CO1	1,2,5,6	SD,Ent,Emp	N,G	HV,PE,ES
2	Solar energy & materials – Nanomaterials for Photovoltaic solar energy conversion systems Principles of photovoltaic energy conversion (PV) – Types of photovoltics Cells – Physics of photovoltaic cells	04	10%	1,2,3,4	CO2	2,3,4,5			
3	Organic photovoltaic cell cells – Thin film Dye Sensitized Solar Cells – Quntum dot (QD) Sensitized Solar Cells (QD-SSC) – Organic-Inorganic Hybrid Bulk Hetero Junction (BHJ-SC) Solar cells – Current status & future trends.	06	15%	2,3,5	CO2	5,6,7,8			
4	Hydrogen energy & harvesting (Production, Storage & Energy Conversion Hydrogen storage methods & Materials – Metal hydrides –Carbon based materials, etc. Processing and performance	04	10%	2,3,4,5	CO3	1,2,3,			
5	Nanomaterials for energy conversion (Fuel cell) systems: Issues & challenges of functional nanostructured materials for electrochemical energy conversion systems – Fuel Cells: Principles & materials for different fuel cells	04	10%	2,3,4,5	CO3	5,6,8			

6	Nanomaterials for Energy Storage (Batteries & Supercapaitors): Systems Issues and Challenges of functional Nanostructured Materials for electrochemical	04	10	2,4,5	CO3	1,2,3			
7	Energy Storage systems – Primary and Secondary Batteries (Lithium ion, Sodium ion, Redox flow, Ni-MH & Metal-Air Batteries) – Cathode & anode materials – Nanostructured Carbon based materials & Nano-Oxides materials (Batteries & Redox capacitors)	05	15	2,4,5	CO1	3,4,5, 6,8			
8	Thermoelectric materials & energy harvesting Thermoelectric (TE): Principles & effects (Seebeck, Peltier effect & Thomson Effect) – Electronic & thermal transport of TE materials – Inter-relation of thermoelectric properties (Seebeck coefficient, ZT, Electrical conductivity, Thermal conductivity & Power factor) – Classification of Thermoelectric materials Types of materials (Low, Medium & High Temperature) – Processing of thermoelectric materials – Applications – Fabrication & assembly of Thermoelectric devices – Current status and future trends	07	20	2,4,5	CO4	1,4,5, 8			
		40	**100**						

References

1	J. Twidell and T. Weir, Renewable Energy Resources, E & F N Spon Ltd, London, 1986
2	Electrochemical methods: Fundamentals and Applications, Allen J.Bard and Larry R. Faulkner, 2ndEdition John Wiley & Sons. Inc (2004)
3	Fuel cell technology handbook. Hoogers. CRC Press, 2003
4	Handbook of Nanomaterials for Hydrogen Storage - Mieczyslaw Jurczyk

SS BE-III Minor Elective-III 4.1

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

Syllabus of Course:

The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year:**	**2024-25**
BE (Metallurgical & Materials) Regular Programme			
Year	**III**	**Core / Elective / Foundation- Minor** **Code:** **Subject: FOUNDRY TECHNOLOGY**	**Credits / Hours per week**	**03 (Theory)**
Semester	**II**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Laboratory		

Course Outcome (CO)

CO1 Introduction to basic concepts of foundry &Classify various foundry industries and its applicationsaround us
CO2 Understanding about different processes of moulding & testing them
CO3 Understanding gating & risering design & defects
CO4 Discuss the use of different processes in foundry & casting

Unit No.	Topic/Unit	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability	Relevance to Local (L)/ National (N)/	Relation to Gender (G), Environment and

							(Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Regional(R)/Global (G) developmental needs	Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	Introduction: Importance of Foundary Industry in Modern Industrial scenario, Advantages and limitations of casting method. Classification of Foundries, Different sections in Foundary and their functions.	06	15	1,2	CO1	1,2	Emp, Ent,SD	N,G	ES
2	Patterns: Types, Brief discussion on pattern making materials, consideration in selection of pattern materials, colour code, Pattern allowances, core-boxes, types of core boxes.	06	20	2,3,5,6	CO2	2,3,4			
3	Moulding and core making materials, Ingrediants of common type of moulding and core making sands, their properties and behavior. Testing of sands & clay.	07	15	2,3,4	CO3	1,2,6, 7			
4	Shell Moulding, CO2 Silicate process, Investment Casting process, Permanent moulding process Gravity and Pressure die casting, centrifugal casting process.	07	20	2,3,4,5, 6	CO3	3,4,5			
5	Elements of gating system: Classification, Basic considerations in gatting design, Gating ratio, Gating practice for ferrous and non-ferrous alloys, Pouring equipments.	07	15	2,5,6	CO4	7,8			
6	Risering practice, Functions of riser, Directional and progressive solidification, Centreline feeding resistance , Riser efficiency, Riser design considerations, Risering curves, Cain's, N.R.L. and Modulus method, Feeding distance, Feeding aids, blind and atmospheric risers, Defects in castings, causes and remedies.	07	15	1,2,5,6	CO4	5,7,8			
		40 Contact Hours	**100%**						

Reference Books

1	Principles of metal casting –Heine &Rosenthall
2	Foundry technology – Peter Beelay
3	Foundry Technology - M.Lal
3	Foundry technology – P.L.Jain

4	Foundry technology –Goel and Sinha

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engg**	**Academic Year**	**2024-25**

BE (Metallurgical & Materials) Regular Programme

Year	**III**	**Core / Elective / Foundation – Minor** **Code:** **Subject: Foundry technology Laboratory**	**Credits / Hours per week**	**01**
Semester	**II**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**50**
Mode of Transaction		Lectures and Laboratory		

No.	**Experiment**	**Contact hours**	**% Weightage**	**BT Level**	**CO**	**PSO**
1	Sieve analysis	2	8.33	1,2	CO1	1,2
2	Sand testing : Clay content	2	8.33	1,2,3,4	CO1	2,3,4
3	Sand testing : moisture content	2	8.33	2,3,4,5	CO2	1,2,6,7
4	Preparation of moulding sand &std sample	2	8.33	2,3,4,5	CO2	6,7
5	Mould strength test	2	8.33	1,2,3	CO2	3,4,5
6	Mould sand permeability test	2	8.33	3,4,5,6	CO3	4,5,6
7	Effect of variation in moisture content on properties	2	8.33	2,3,4,5	CO3	7,8
8	Effect of variation in clay content on properties	2	8.33	2,3,4,5	CO3	1,2,3
9	Defects in casting processes	2	8.33	3,4,5,6	CO4	2,3,4.5
10	Study about principle & working of Centrifugal casting process	2	8.33	3,4,5,6	CO4	1,2,6,7

SS BE –III Minor Elective-III 4.2

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)

PSO1 Learn basics of classical, quantum and statistical mechanics and develop methodology to understand and solve various problems
PSO2 Basic understanding and application of the electromagnetic theory, modern optics, laser, fiber optics and their applications in imaging, holography and optical instrumentation
PSO3 Learn mathematical methods and computational techniques used in physical sciences including simulations
PSO4 Semiconductor devices, electronics and their applications
PSO5 Learn about various properties of materials, instrumentation, nuclear reactor physics
PSO6 Advanced understanding and application of physical techniques used in industries at various levels including nondestructive evaluation and device fabrication
PSO7 Hands-on practice of basics and advanced experiments intended for industrial and research applications
PSO8 Training and exposure to research problems through project dissertation

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Applied Physics**		**Academic Year**	**2024-25**
BE (Metallurgical & Materials) Regular Programme				
Year	**III**	**Elective - III** **Code: Subject**: Materiolography	**Credits / Hours per week**	**03**
Semester	**II**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO)

CO1To learn the basics of Materiolography.
CO2 To study the structure and steps of Metallography.
CO3 To understand and study ceramography.
CO4 To study Metallography for various metals and materials.

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:introduction to Materiolography, microstructure, importance of microstructure phases.	4	10	1,2,3,5	CO1	1,2	SD,Ent,Emp	N,G	HV,PE,ES
2	Metallurgy & Microstructure: solidification structure of pure metals, solidification structure of steels and cast iron,	6	20	1,2,3,4	CO1	1,6,7			
3	Solidification structure of Al and its alloys, solidification structure of titanium and its alloys, recovery -recrystallization and growth structure.	6	20	1,2,3,4	CO1	1,6,7,8			
4	Metallographic technique: Sample preparation steps, Microscopy and its types,quantitative and qualitative metallography	6	15	2,3,4	CO2	2,3,6			
5	Metallography and microstructure of Ferrous alloys: Cast iron,low carbon and coated steels,low alloy steels,case hardened steels, tool steels,stainless steels, maraging steels,austenitic-Mn steel casting	6	15	2,3,4,5	CO4	1,3,6,8			
6	Metallography and microstructure ofnon-Ferrous alloys: Al & its alloys, Cu & its alloys, Ti and its alloy, Tin& its alloys, precious metal & its alloys	6	10	2,3,4,5	CO4	1,3,6,8			
7	Ceramography: introduction, ceramographic sample preparation, Qualitativeceramography& quantitative ceramograpgy	6	10	2,3,4,5	CO3	1,2,3			
		40 Contact Hours	**100**						

References

1	Ceramography:Preparation and Analysis of Ceramic Microstructures,Richard E. Chinn · 2002
2	ASM Metals handbook Vol.9

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**	**Academic Year**	**2024-25**

BE (Metallurgical & Materials) Regular Programme

Year	**III**	**Elective-II** **Code:** **Subject**: Materiology	**Credits / Hours per week**	**01 (Credit)**
Semester	**II**	Year of Introduction: NA Year of Syllabus Revision: NA	**Maximum Marks / Grade**	**50** (TW/VIVA)
Mode of Transaction		Laboratory Experiments, discussion and viva		

No.	**Experiment**	**Contact Hr**	**Weightage (%)**	**BT Level**	**CO**	**PSO**
1	Exp;1	2	15	1,2,3	CO1	1,2,3
2	Exp:2	2	15	2,3	CO2	2,3,4
3	Exp:3	2	15	4	CO3	3,4
4	Exp:4	2	15	4,5	CO4	5,6
5	Exp:5	2	10	4,6	**CO1**	7,8
6	Exp:6	2	10	5,6,	CO2	3,4
7	Exp:7	2	10	,4,5,6	CO3	4,5
8	Tutorial : 1	2	5	2,3,4	CO4	5,6,7
9	Tutorial :2	2	5	3,4,5	**CO2**	6,7

SS BE –III Minor Elective-III 4.3

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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2024-25**
BE (Metallurgical & Materials) Regular Programme				
Year	**III**	**Elective-III** **Code:** **Subject: Material Testing and Standard**	**Credits / Hours per week**	**03(Credit)**
Semester	**II**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lecture and Tutorials		

Course Outcome (CO)
CO1: Analyze the various metallurgical factors affecting mechanical properties of different metals and alloys
CO2: Explain the tensile test and calculate various mechanical properties from test data
CO3: Describe basic mechanisms of fatigue and creep behavior of engineering materials and their importance in materials design
CO4: Explain impact test, toughness and types of fracture of metals
CO5: Explain how to select and conduct a hardness test to determine the hardness of a given material

CO6: Differentiate various defect types and describe the main criteria to select the appropriate NDT methods for the product

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	Tension test:Introduction. Stress strain diagram and its salient features. Tensile Properties and their calculation from test data, solving numerical problems, effect of temperature on tensile properties	06	15%	2,3,4	CO1,2,6	2,4,5	SD,Ent,Emp	N,G	HV,PE,ES
2	Creep test Duration: Mechanism, stages of creep, testing of creep strength	06	25%	1,4,5	CO6	6,8			
3	Impact test and Fracture:Impact test – Test specimens, principles and procedures of conducting the tests. Notch sensitivity, Notch toughness, transition temperature. Definition, ductile and brittle fracture, cohesive strength Equation, Griffith theory of brittle fracture	06	20%	2,3,4	CO1,6	1,2,3,5			
4	Fatigue test:Importance, different cycles, S-N Curve, endurance limit, Fatigue failures, effect of various factors on fatigue	06	20%	1,3,4	CO2,5	3,4 7,8			
5	Hardness test : Introduction,specimen preparation,types of hardness testing machines	06	20%	2,4,5	CO3	2,6,8			
6	Non – Destructive testing:Importance of Nondestructive testing, various non-Destructive tests, – Visual, Dye penetrant, Magnetic particle, Radiography and Ultrasonic test	06	20%	2,3,4	CO4,5	3,6,7,8			

Reference Books

1	Mechanical metallurgy by G.E. Dieter
2	Non-destructive testing by Barry Hull and Vernon John, ELBS.
3	Principles of metallographic Laboratory Practice by Kehl
4	Practical Non – Destructive Testing by Baldevraj, Jayakumar T, Thavasimuthu. M

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**	**Academic Year**	**2022-23**

BE (Metallurgical & Materials) Regular Programme

Year	**III**	**Elective-III** **Code:** **Subject**: **Material Testing and Standard**	**Credits / Hours per week**	**01 (Credit)**
Semester	**II**	Year of Introduction: NA Year of Syllabus Revision: NA	**Maximum Marks / Grade**	**50** (TW/VIVA)
Mode of Transaction		Laboratory Experiments, discussion and viva		

No.	**Experiment**	**Contact Hr**	**Weightage (%)**	**BT Level**	**CO**	**PSO**
1	Exp;1	2	15	1,2,3	CO1	1,2,3
2	Exp:2	2	15	2,3	CO2	2,3,4
3	Exp:3	2	15	4	CO3	3,4
4	Exp:4	2	15	4,5	CO4	5,6
5	Exp:5	2	10	4,6	**CO5**	7,8
6	Exp:6	2	10	5,6,	CO6	3,4
7	Exp:7	2	10	,4,5,6	CO6	4,5
8	Tutorial : 1	2	5	2,3,4	CO6	5,6,7
9	Tutorial :2	2	5	3,4,5	**CO6**	6,7

SS BE –III Minor Elective-III 4.4

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

Programme Name: ME (Metallurgical & Materials) (Material Technology)RegularProgramme

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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2024-25**
BE (Metallurgical & Materials Engineering) proramme				
Year	**III**	~~**Core**~~ **/ ElectiveIII** ~~**/ Foundation**~~ **Code:** **Subject: Advance Characterization Techniques**	**Credits / Hours per week**	**03 Hrs/ week**
Semester	**II**	Year of Introduction: NA Year of Syllabus Revision: NA	**Maximum Marks / Grade**	**100 Marks**
Mode of Transaction		Lectures, PPT, Tutorials, Factory Visit, Videos etc		

Course Outcome (CO)

CO1 Importance of the subject
CO2 Classification of various material characterization techniques based on raw material, impurity etc
CO3 Chemical characterization techniques
CO4 Physical characterization techniques
CO5 Mechanical characterization techniques
CO6 Microstructural characterization techniques

Unit No.	**Topic/Unit**	**Contact Hours**	**Weightage (%)**	**BT Level**	**CO**	**PSO**	**Elements of** Employability (Emp)/ Entrepreneurship	**Relevance to** Local (L)/ National (N)/	**Relation to** Gender (G), Environment and Sustainability (ES),

							(Ent)/ Skill Development (SD)	Regional(R)/Global (G) developmental needs	Human Values (HV)and Professional Ethics (PE)
1	Importance of characterization in metallurgy.	2	10	1-6	CO1	1	SD	G	ES
2	Thermal analysis techniques: Principle, working and application of DTA, TGA, TMA and DSC.	6	10	1,2	CO2	2	EMP	G	ES
3	Optical microscopy, characteristic of microscope, different conditions of viewing such as bright field, dark field, oblique illumination, macroscopy, basic principles of quantitative metallography and image analysis.	8	20	1,2	CO3, 6	1	EMP	G	ES
4	Electron microscopy: TEM, SEM, STEM, merits and demerits, applications, techniques of replica preparation.	8	20	1,2,3, 4,5,6	CO4	2	ENT	G	ES
5	Techniques for chemical analysis: XRF, EDS & WDS, Atomic absorption spectrometer, Emission spectroscopy & direct reading spectrometer, mass spectrometer.	8	20	1,2,3, 4,5,6	CO5	1	EMP	G	ES
6	Diffraction method, X-ray diffraction, determination of crystal structure, lattice parameter, crystallite size by diffraction techniques / low angle X-ray scattering technique.	8	20	1,2,3, 4,5,6	CO5	3	ENT	G	ES
		40	**100**						

Text Books

1	F. Weinberg, Editor, Tools & Techniques in Physical Metallurgy, Vol. I & Vol. II, Marcel Dekker, 1970.
2	John P. Sibilia, A guide to Material Characterization & Chemical Analysis, VCH Publishers, 1988.
3	J.M. Walls, Editor, Methods of Surface Analysis: Techniques & Applications, Cambridge University Press, 1990
4	ASTM handbook for Mechanical test
5	IDavid Brandon Wayne D Kaplan ISBN 978-0-470-02785-1, microstructural characterization pf Materials 2nd edition
6	B.D. Cullity, Elements of X-ray diffraction, Addison-Wesley Publishing Company, INC, 1978.
7	Bernhard Wounderlich, Thermal Analysis, Academic Press, INC, 1990
8	B.L. Gabriel, SEM : A user's manual for materials Science, American Society for Metals, 1985.

Reference Books:

1	www.ekglab.com
2	ASM International hand book Volume 8: Mechanical Testing and Evaluation
3	ASM Volume 9: Metallography and Microstructures
4	ASM Volume 10: Materials Characterization
5	www.mri.psu.edu
6	Use instrument website for applications study

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**	**Academic Year**	**2024-25**

BE (Metallurgical & Materials Engineering) proramme

Year	**III**	~~**Core**~~ **/ Elective-III** ~~**/ Foundation**~~ **Code:** **Subject: Advance Characterization Techniques**		**Credits / Hours per week**	**01**
Semester	**II**	Year of Introduction: NA Year of Syllabus Revision: 2024		**Maximum Marks / Grade**	**100 Marks**
Mode of Transaction		Lectures, PPT, Tutorials, Factory Visit, Videos etc			

No.	**Experiment**	**Contact Hr**	**Weightage (%)**	**BT Level**	**CO**	**PSO**
1	Exp;1	2	15	1,2,3	CO1	1,2,3
2	Exp:2	2	15	2,3	CO2	2,3,4
3	Exp:3	2	15	4	CO3	3,4
4	Exp:4	2	15	4,5	CO4	5,6
5	Exp:5	2	10	4,6	**CO5**	7,8
6	Exp:6	2	10	5,6,	CO6	3,4
7	Exp:7	2	10	,4,5,6	CO6	4,5
8	Tutorial : 1	2	5	2,3,4	CO6	5,6,7
9	Tutorial :2	2	5	3,4,5	**CO6**	6,7

SS BE –III Minor Elective-IV 5.1

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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2024-25**
BE (Metallurgical & Materials) Regular Programme				
Year	**III**	**~~Core~~ / Elective- III ~~/ Foundation~~** **Code:** **Subject: Powder Metallurgy**	**Credits / Hours per week**	**03**
Semester	**II**	Year of Introduction: Year of Syllabus Revision: 2024	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Laboratory		

Course Outcome (CO)

CO1 To understand of developments, history, advantages and limitations of powder metallurgy.
CO2 To Learn characteristics of metal powder.
CO3 To study manufacturing methods of metal powder.
CO4 To learn fundamental of powder conditioning methods.
CO5 To study of powder compaction like rolling, powder extrusion, powder forging, etc.
CO6 To understand importance of powder sintering.
CO7 To learn various applications of powder metallurgical parts.

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: Historical and modern developments in powder metallurgy, advantages, limitations and applications of powder metallurgy.	04	10	1,2,3	CO1	1,2	Emp, Ent, SD	G	PE,HV
2	Metal powder Characterization: Particle size, shape and size distribution, apparent density, tap density, flow rate, friction conditions.	05	13	4,5	CO2	1,2,3			
3	Metal powder manufacturing: Machining, milling, atomization, electro-deposition, reduction from oxide, carbonyl process, production of alloy powders and new development.	08	20	1,2,3, 4,6	CO3	3,4			
4	Metal powder conditioning: Mechanical method and thermal method.	03	8	2,4	CO4	4,6			
5	Consolidation of metal powder: Single and double action die compaction, isostatic pressing (hot and cold), powder rolling, powder forging, powder extrusion and explosive forming technique. Density distribution in green compacts, compaction presses, tooling and role of lubricants.	10	25	3,2	CO5	4,6,7			
6	Sintering of metal powder: Definition, mechanism, stages, variables, sintering atmospheres and sintering furnaces. Liquid phase sintering and infiltration method.	05	12	2,3	CO6	3,7,8			
7	Applications of powder metallurgy: Sintered bearings, cutting tools, metallic filters, friction and antifriction parts and electrical contact materials.	05	12	2,3,4	CO7	2,4			
	TOTAL	**40 Hours**	**100%**						

Reference Books

1	Powder Metallurgy :- W. D. Jones
2	Introduction to Powder Metallurgy :- A. K. Sinha
3	Principles of Powder Metallurgy :- T. Shukerman
4	Handbook of Powder Metallurgy :- H. H. Hausner

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**	**Academic Year**	**2024-25**

BE (Metallurgical & Materials) Regular Programme

Year	**III**	**~~Core~~ / Elective- III / ~~Foundation~~** **Code:** **Subject: Powder Metallurgy Laboratory**	**Credits / Hours per week**	**01** (Practical)
Semester	**II**	Year of Introduction: Year of Syllabus Revision: 2024	**Maximum Marks / Grade**	**50** (TW/VIVA)
Mode of Transaction		Laboratory Experiments, discussion and viva		

No.	Experiment	Contact Hr	Weightage (%)	BT Level	CO	PSO
1	Introduction to powder Metallurgy applications, advantages and disadvantages	3	15	1,2	CO1	1,2,3
2	Various machine parts produced by powder metallurgy technique	3	15	2	CO2	3,4
3	Sieve Analysis	3	15	2,4	CO3	4,6
4	Microscopic Analysis	3	15	1,3,4	CO4	4,6,7
5	Study of apparent density ,Tap density & Flow rate of Cu powder	3	10	5,6	CO4	3,7,8
6	Study of compacting pressure on green density of metal powder	3	10	1,3	CO5	2,4
7	Electro-deposition of Metal Powder	3	10	2,5	CO1	1,2,3
8	Sintering of Metal Compact	3	10	5,6	CO2	3,4

SS BE –III Minor Elective-IV 5.2

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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2024-25**
BE (Metallurgical & Materials) Regular Programme				
Year	**III**	**Elective IV** **Code:** **Subject: Special alloys for Automotive Industries**	**Credits / Hours per week**	**03 (Credit)**
Semester	**II**	Year of Introduction: 2025 Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lecture and Tutorials		

Course Outcome (CO)

CO1 To understand air standard cycles and to estimate efficiencies of air standard cycles
CO2 To understand the functions of engine block and materials for engine block
CO3 To study various components used in automobile and selection of materials
CO4 To understand the functioning of electric vehicles

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	Reciprocating engines, Otto cycle, Diesel cycle, four stroke and two stroke engines, working principle and constructional details of two stroke and four stroke engine, engine components, automobile construction, recent trends in automobile technology	10	20%	1,3	CO1	1,6,7	SD,Ent,Emp	N,G	HV,PE,ES
2	Engine cylinder: Structure and functions, types, cylinder blocks materials and manufacturing processes, improving engine components with surface modifications,.	6	20%	1,3,4	CO2	4,6,7			
3	Piston: Structures and functions, types, piston materials, piston manufacturing processes.	4	10%	3,4,5	CO3	1,4,8			
4	Structure, function and materials for piston rings, camshaft, valves and valve seats, valve springs, connecting rod, crankshafts, turbocharger and exhaust manifold; tailor welds.	4	10%	3,4,5	CO3	1,4,8			
5	Types of chassis layout and chassis materials, vehicle frames, materials used for car body, front axle and steering system, drive line, propeller shaft, universal joints, wheels and suspension system.	8	20%	1,3,4	CO3	3,6,7			
6	Working principle of electric vehicles, fundamental of drives and DC machine, drives and Control of EV Using DC Machines, materials used in electric cars.	8	20%	2,4,5	CO4	3,4,7			
		40 Contact Hours	**100%**						

Reference Books

1	Ganesan.V, Internal Combustion Engines, Tata-McGraw Hill Publishing Co., New Delhi, 1994
2	Hiroshi Yamagata, The Science and Technology of Materials in Automotive Engines, Woodhead Publishing in Materials, 2005.
3	Sheldon S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer, 2013

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**	**Academic Year**	**2024-25**

BE (Metallurgical & Materials) Regular Programme

Year	**III**	**Elective-IV** **Code:** **Subject**: **Special alloys for Automotive Industries**	**Credits / Hours per week**	**01 (Credit)**
Semester	**II**	Year of Introduction: NA Year of Syllabus Revision: NA	**Maximum Marks / Grade**	**50** (TW/VIVA)
Mode of Transaction		Laboratory Experiments, discussion and viva		

No.	**Experiment**	**Contact Hr**	**Weightage (%)**	**BT Level**	**CO**	**PSO**
1	Exp;1	2	15	1,2,3	CO1	1,2,3
2	Exp:2	2	15	2,3	CO2	2,3,4
3	Exp:3	2	15	4	CO3	3,4
4	Exp:4	2	15	4,5	CO4	5,6
5	Exp:5	2	10	4,6	**CO3**	7,8
6	Exp:6	2	10	5,6,	CO4	3,4
7	Exp:7	2	10	,4,5,6	CO2	4,5
8	Tutorial : 1	2	5	2,3,4	CO1	5,6,7
9	Tutorial :2	2	5	3,4,5	**CO1**	6,7

SS BE –III Minor Elective-IV 5.3

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)

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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engg**		**Academic Year**	**2024-25**
BE (Metallurgical & Materials) Regular Programme				
Year	**III**	**Elective-IV** **Code:** **Subject:** Materials for Locomotive industries	**Credits / Hours per week**	**03 (Credit)**
Semester	**II**	Year of Introduction: 2025 Year of Syllabus Revision: NA	**Maximum Marks / Grade**	**100 Marks**
Mode of Transaction		Lectures and tutorials		

Course Outcome (CO)

CO1 Overview and history of locomotives in an industrial revolution.
CO2 Classification of various locomotives and its applications.
CO3 Study of numerous ferrous materials used in locomotive parts
CO4 Study of diverse Non -ferrous materials used in locomotive parts
CO5 Comparison of different material to enhance efficiency of locomotive.
CO6 Knowledge of advance locomotives and futuristic applications of multidimensional materials

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 of Locomotives:** History of Locomotives ,Importance of locomotives in an industrial revolution	06	10	1,2,3	CO 1	1,2	**Emp/Ent**	**N/R/G**	**ES**
2	**Types of Locomotives:** Steam locomotive, Diesel locomotive, Gas turbine locomotive, Electric locomotives, Hybrid locomotive, remote control locomotive	06	15	1,2,3,4	CO2	1,2,3			
3	**Ferrous Materials used in Locomotives:** Iron, steel, stainless steel, Manganesesteel, Cast Iron used in various parts	06	20	1,2,3,4 ,5	CO3, CO4	2,3,4,5			
4	**Non Ferrous Materials used in Locomotives:** Aluminum and its alloys, copper and its alloys used in various parts of locomotives	06	20	1,2,3,4 ,5	CO3, CO4	2,3,4,5			
5	**Advance materials used in Locomotives:** Composite materials, Glasses, FRP used to reduce weight ,increase speed	08	20	2,3,4,5	CO5	2,3,4,5			
6	**Recent developments of Locomotive:** World's biggest locomotives, various locomotive builders at international levels	08	15	2,3,4, 5,6	CO6	1,2,7			
		40	100						

Text/Reference Books:

1	ASM Handbook, Volume 1: Properties and Selection: Irons, Steels, and High-Performance Alloys
2	ASM Handbook Volume 2: Properties and Selection: Nonferrous Alloys and Special-Purpose Materials
3	ASM Handbook Volume 20: Materials Selection and Design

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**	**Academic Year**	**2024-25**

BE (Metallurgical & Materials) Regular Programme

Year	**III**	**Elective-IV** **Code:** **Subject**: **Materials for Locomotive industries**	**Credits / Hours per week**	**01 (Credit)**
Semester	**II**	Year of Introduction: 2025 Year of Syllabus Revision: NA	**Maximum Marks / Grade**	**50** (TW/VIVA)
Mode of Transaction		Laboratory Experiments, discussion and viva		

No.	**Experiment**	**Contact Hr**	**Weightage (%)**	**BT Level**	**CO**	**PSO**
1	Exp;1	2	15	1,2,3	CO1	1,2,3
2	Exp:2	2	15	2,3	CO2	2,3,4
3	Exp:3	2	15	4	CO3	3,4
4	Exp:4	2	15	4,5	CO4	5,6
5	Exp:5	2	10	4,6	**CO5**	7,8
6	Exp:6	2	10	5,6,	CO6	3,4
7	Exp:7	2	10	,4,5,6	CO6	4,5
8	Tutorial : 1	2	5	2,3,4	CO6	5,6,7
9	Tutorial :2	2	5	3,4,5	**CO6**	6,7

SS BE –III Minor Elective-IV 5.4

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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2024-25**
BE (Metallurgical & Materials) Regular Programme				
Year	**III**	**~~Core~~ / Elective / ~~Foundation~~** **Code:** **Subject: Materials for defense application**	**Credits / Hours per week**	**03**
Semester	**II**	Year of Introduction: 2025 Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Laboratory		

Course Outcome (CO)

CO1 To understand of basics of defense materials
CO2 To Learn application of different steels in defense sector
CO3 To study different non ferrous metals for armor application
CO4 To learn use of aluminium and its alloys in defense sector
CO5 To study non metals like ceramics and composite materials in defense application

CO6 To understand importance of smart materials in various application of defense.

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	Defense materials: Overview, challenges and opportunities.	04	10	1,2,3	CO1	1,2	Emp, Ent, SD	G	PE,HV
2	Steel for defense application: Carbon steel, structural steel and stainless steel.	05	13	4,5	CO2	1,2,3			
3	Titanium alloys, Nickel alloys, Tungsten, Zirconium, Hafnium and Niobium metals for defense application.	08	20	1,2,3,4, 6	CO3	3,4			
4	Aluminium alloys: classifications, properties, requirements and application.	03	8	2,4	CO4	4,6			
5	Ceramic materials: Classification, properties, structures and application.	10	25	3,2	CO5	4,6,7			
6	Composite Materials: Overview, classifications, properties, manufacturing methods and application.	05	12	2,3	CO5	3,7,8			
7	Smart materials for advance application in defense. Polymers.	05	12	2,3,4	CO6	2,4			
	TOTAL	**40 Hours**	**100%**						

Reference Books

1	Physical Metallurgy for Engineers, Donald Clark and Wilbur Varney
2	Introduction to physical metallurgy, Sidnney H Avner
3	Aluminium alloys: Structure and Properties, L. F. Mondolfo
4	Aluminium properties and physical metallurgy, John Hatch
5	Composite Materials Science and Engineering, K K Chawla

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**	**Academic Year**	**2024-25**

BE (Metallurgical & Materials) Regular Programme

Year	**III**	~~**Core**~~ **/ Elective IV /** ~~**Foundation**~~ **Code:** **Subject: Materials for defense application**	**Credits / Hours per week**	**01**
Semester	**II**	Year of Introduction: 2025 Year of Syllabus Revision:	**Maximum Marks / Grade**	**50** (TW/VIVA)
Mode of Transaction		Laboratory		

No.	**Experiment**	**Contact Hr**	**Weightage (%)**	**BT Level**	**CO**	**PSO**
1	Exp 1	2	15	1,2,3	CO1	1,2,3
2	Exp 2	2	15	2,3	CO2	2,3,4
3	Exp 3	2	15	4	CO3	3,4
4	Exp 4	2	15	4,5	CO4	5,6
5	Exp 6	2	10	4,6	CO4	7,8
6	Exp 7	2	10	5,6	CO5	3,4
7	Exp 8	2	10	4,5,6	CO1	4,5
8	Tutorial 1	2	5	2,3,4	CO2	5,6,7
9	Tutorial 2	2	5	3,4,5	CO6	6,7

SS BE –III Minor Elective-IV 5.5

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.
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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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2024-25**
BE (Metallurgical & Materials) Regular Programme				
Year	**III**	**Elective - II** **Code** **Subject: Materials for Power Plant applications**	**Credits / Hours per week**	**03(Credit)**
Semester	**II**	Year of Introduction: 2025 Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lecture and Tutorials		

Course Outcome (CO)
CO1: To understand the various materials for power plant
CO2: To study various materials for boiler part
CO3: To understand various properties of materials for its final application

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	Classification of Ferrous and Non-ferrous material for Power Plant Application and their importance properties. Basic concept Component used in power plant.	06	15	1,2,3,4	CO1	4,5,7	SD,Ent,Emp	N,G	HV,PE,ES
2	**Boiler part:**Low alloy steel grade, property requirement for boiler, carbon steel and high strength low alloy steel (HSLA)	06	15	2,3,5	CO2	1,4,6			
3	**Boiler part:** High Ferritic steel grades, Cr-Mo-V steels, composition role of alloying element, mechanical property, weldability, applications	06	15	2,3,4,5	CO3	1,2,8			
4	**Boiler part:**High Martensitic grade alloy steel grades,High Chromium steel grades, compositions, mechanical property,application,weldability	06	15	2,4,5	CO1,2	3,7,8			
5	**Boiler part:**Austenitic Stainless-steel grades, various grades of Austenitic SS, composition, mechanical property, alloying elements, weldability	08	20	4,5	CO1,2	2,3,5			
6	**Header, Economizer,Drum, :** property requirements, function , various grades of alloy steels, composition, mechanical properties, weldability	08	20	2,4,5,6	CO1,2,3	4,5,8			
		40 Contact hours	**100%**						

Reference Books

1	Material for Ultra super critical & Advanced Super critical power plant , Augusto di
2	High Temperature Materials and Technology, Campbell and Sherwood, John Willey & Sons, (1967).
3	Physical Metallurgy Principles, Robert E Reed Hill, Cengage Learning, Incpublications, 1992

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**	**Academic Year**	**2024-25**

BE (Metallurgical & Materials) Regular Programme

Year	**III**	**Elective-IV** **Code:** **Subject**: **Materials for Power Plant applications**	**Credits / Hours per week**	**01 (Credit)**
Semester	**II**	Year of Introduction: 2025 Year of Syllabus Revision: NA	**Maximum Marks / Grade**	**50** (TW/VIVA)
Mode of Transaction		Laboratory Experiments, discussion and viva		

No.	**Experiment**	**Contact Hr**	**Weightage (%)**	**BT Level**	**CO**	**PSO**
1	Exp;1	2	15	1,2,3	CO1	1,2,3
2	Exp:2	2	15	2,3	CO2	2,3,4
3	Exp:3	2	15	4	CO3	3,4
4	Exp:4	2	15	4,5	CO1	5,6
5	Exp:5	2	10	4,6	**CO2**	7,8
6	Exp:6	2	10	5,6,	CO3	3,4
7	Exp:7	2	10	,4,5,6	CO1	4,5
8	Tutorial : 1	2	5	2,3,4	CO2	5,6,7
9	Tutorial :2	2	5	3,4,5	**CO3**	6,7

Enclosure C

FS BE IV CORE-1

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.
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Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2025-26**
BE (Metallurgical & Materials) Regular Programme				
Year	**IV**	**Core / ~~Elective / Foundation~~** **Code: MME xxxx** **Subject :**Phase transformation	**Credits / Hours per week**	**03**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO)

CO1 understand the mechanism of transformation
CO2 Learn the variables affecting transformation
CO3 Learn the Martensitic transformation for ferrous system and non ferrous system
CO4 Understand the mechanism of tempering heat treatment in steel
CO5 Understand mechanism of carbide precipitation,sigma phase formation and fine precipitates in ferrous and non ferrous system.
CO6 Application & heat treatment and phase transformation of non ferrous alloys

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	Mechanism and kinetics of pearlite to austenite transformation. Grain growth of austenite and factors affecting it.	5	10	2	1	1,3	Emp, Ent, SD	G	PE,HV,ES
2	Mechanism and kinetics of transformation of austenite to pearlite. TTT and CCT diagrams. Mechanism and kinetics of bainitic transformation, variables affecting the transformation.	7	14	1&2	1& 2	2,3,4			
3	Martensitic transformation-classification, characteristics, mechanism, variables and kinetics for ferrous systems.	5	10	2	3	1,5,6			
4	Martenstic transformation in non-ferrous systems such as In-Th, Fe-Ni and Cu-Al system. Special features such as stabilization and effect of plastic deformation.	6	12	2& 3	3	1,2,3			
5	Mechanism and kinetics of tempering in steel, secondary hardening, temper-brittleness.	5	10	2 &3	4	3,4,7			
6	Order-disorder phenomenon, carbide precipitation in stainless steel, sigma phase formation.	6	12	1,2,3	5	1,3			
7	Characteristics of formation of fine precipitates in ferrous and non-ferrous systems.	5	10	1,2	5	2,4			
8	Phase transformation in copper, aluminum, nickel, titanium base alloys.	5	10	1,2,3	6	3,7			
9	Heat treatment and applications of Non-ferrous alloys..	6	12	1,2,3	6	7,8			
	TOTAL	**50 Hours**	**100%**						

Reference Books

1	Physical Metallurgy Principles – Robert E. Reed-hill, Affiliated East-West Press, New Delhi.
2	Fundamentals of Physical Metallurgy – John D. Verhoeven, John Wiley & Sons, New York.
3	Engineering Metallurgy – Part 1 and 2 – Raymond A. Higgings, The English Language Book Society and Hodder &Staughton, U.K.
4	Introduction of Physical Metallurgy – Sindey H. Avner, McGraw – Hill, New Delhi.
5	Physical Metallurgy Vol. I & II – A Gulyaev, MIR Publishers, Moscow.

6	Heat Treatment – Principles & Techniques – T.V. Rajan, C.P. Sharma and Ashok Sharma, Prentice Hall of India, New Delhi.

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**	**Academic Year**	**2025-26**

BE (Metallurgical & Materials) Regular Programme

Year	**IV**	**Core / ~~Elective / Foundation~~** **Code: MME 1701L** **Subject: Phase transformation Laboratory**	**Credits / Hours per week**	**06**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Laboratory Experiments, discussion and viva		

No.	**Experiment**		**Course Code**	**BT Level**	**CO**	**PSO**
1	To study microstructure observation of standard steel samples			1,2	CO1	1,2,3
2	To study microstructure observation of cast iron samples			2	CO2	3,4
3	To study microstructure observation of alloy steel samples			2,4	CO3	4,6
4	To study microstructure observation of Cu and Cu alloys			1,3,4	CO4	4,6,7
5	To study case depth measurement			5,6	CO4	3,7,8
6	To study grain size measurement by ASTM method			1,3	CO5	2,4
7	To study microstructure observation of Al & Ti alloys			2,5	CO1	1,2,3
8	To study electrolytic etching of stainless steel samples			5,6	CO2	3,4
9	To determine type of inclusion by ASTM method			1,2	CO1	1,2,3
10	To study microstructure observation of welded steel structure			2	CO2	3,4
11	Tutorial - Multiple Choice Questions			2,4	CO3	4,6
12	Tutorial -Heat treatment of Al, Ti,& Cu alloys			1,3,4	CO4	4,6,7

FS BE IV CORE-2

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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2025-26**
BE (Metallurgical & Materials) Regular Programme				
Year	**IV**	**Core / ~~Elective / Foundation~~** **Code: MMExxxx** **Subject:Electrometallurgy and Corrosion**	**Credits / Hours per week**	**03**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO)

CO1 Understanding the basics of Electrolytic and electrochemical cells
CO2 Learn about the Electroplating, pre-electroplating preparations
CO3 Understanding Corrosion of metals
CO4 Learn about the polarization
CO5 Learning the types of corrosion
CO6 Learning corrosion prevention methods

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	Electrolytic and electrochemical cells: Electrolysis, Faraday's Law, current efficiency, energy efficiency, decomposition voltage, over voltage, throwing power, covering power of electrolyses.	05	10	1,2	1	1,2	Emp, Ent, SD	G	HV,PE
2	Electroplating, pre-electroplating preparations, electroplating of metals like copper, nickel, chromium.	06	12	1,2,3	2	2,4			
3	Principles of alloy plating: Applications like electro galvanizing, electro aluminizing, anodizing, electropolishing, and etching.	06	12	1,2,3	2	1,3,4			
4	Corrosion of metals: Electrochemical principles applied to corrosion such as electrode potential, E.M.F. series, Nearnst equation.	07	14	1,2,3, 4	3	2,5,6			
5	Polarization: types, Tafel's equation, limiting current density, exchange current density, passivity.	06	12	2,3,4	4	1,5,6			
6	Types of Corrosion: Uniform, galvanic, pitting, crevice corrosion, filiform corrosion, intergrannular corrosion, knife-line attack, selective leaching.	07	14	2,3,4	5	2,4			
7	Stress Corrosion: erosion corrosion, tretting corrosion. Calvitation damage, corrosion fatigue, hydrogen damage and embrittlement.	06	12	2,3,5	5	7,8			
8	Corrosion Prevention Methods: Material selection & design, cathodic protection, Use of inhibitors etc.	07	14	1,2,4, 5	6	8			
	TOTAL	**50 Hours**	**100%**						

Reference Books

1	Corrosion Engineering – Mars G. Fontana and Norbert D. Green, McGraw-Hill, New Delhi.
2	Eletrodeposition and Corrosion Processes – J.M. West, D. Van Nostrand Company Ltd., London.
3	An Introduction to Electrometallurgy – Satya Narayan &RajendraSharan, Standard Publishers & Distributors, New Delhi.

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**	**Academic Year**	**2025-26**

BE (Metallurgical & Materials) Regular Programme

Year	**IV**	**Core / ~~Elective / Foundation~~** **Code: MMExxxx** **Subject:Electrometallurgy and corrosion Laboratory**	**Credits / Hours per week**	**02**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**50**
Mode of Transaction		Laboratory Experiments, discussion and viva		

No.	**Experiment**		**Course Code**	**BT Level**	**CO**	**PSO**
1	Ex – Corrosion rate measurement by weight loss method			1,2,3	1,2	1,2
2	Ex – Measurement of electrode potential by different media			1,2,3	2,4	2,4
3	Ex – Galvanic corrosion measurement			1,2,3,4	1,3,4	1,5,6
4	Ex- Electroplating			2,3,4	2,5,6	2,4
5	Ex – Copper Powder production			2,3,4	1,5,6	7,8
6	Ex – Anodizing of Aluminium			2,3,5	1,2	8
7	Ex – Study of anodic dissolution			1,2,3	2,4	1,2
8	Ex- Potentiodynamic testing			1,2,3	1,3,4	2,4
9	Ex- PH measurement			1,2,3,4	2,5,6	5,6

FS BE IV CORE-3

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

Programme Name: BE (Metallurgical & Materials) Regular Programme

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Syllabus of Course:

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year:**	**2025-26**
BE (Metallurgical & Materials) Regular Programme				
Year	**IV**	**Core / ~~Elective / Foundation~~** **Code: MME xxxx** **Subject: Principles of Metal Joining**	**Credits / Hours per week**	**04 (Theory)**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO)

CO1 Introduction to basic concepts of Metal joining & terms used
CO2 Understanding of arc & arc physics, arc characteristics etc.
CO3 Different reactions in welding & estimation of stresses during it
CO4 Study of different processes based on different power sources to generate heat
CO5 Study of allied processes & its applications
CO6 Weldability of different materials
CO7 Quality control & defects in welding

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	History, Importance of Metal Joining Processes : Theory of Metal joining, barriers of welding, classification of welding processes.	02	04	1,2	CO1, CO2	1,2,3	Emp, Ent, SD	N,G	ES,PE
2	Fusion welding: Joint design and edge preparation, methods and selection, nature of heat sources, physics of arc, electrical characteristic of arc, machine characteristics.	05	08	1,2,3, 5	CO2, CO3	2,3,4			
3	Metal transfer, forces acting on the arc, different modes of metal transfer, heat flow in metals, prediction of heating and cooling rates.	05	12	1,2,3, 4	CO3	2,3			
4	Gas-metal and slag-metal reactions, evolution of gases, formation of porosity, inclusions in weld metal, weld pool solidification, residual stresses, weld cracking, solidous and sub-solidous, dilution.	04	12	1,2,3, 6	CO4	5,6,			
5	Fusion welding: SMAW – ‘unction of coatings, based on slag metal, gas metal reactions, classification of coating types, formulation of continuous welding by coated electrodes, SAW, electroslag welding.	04	12	1,2,3, 4,5	CO4	6,7,8			
6	GTAW, GMAW, FCAW, Plasma Welding, type of guns.	04	12	1,2,4, 5,6	CO5	5,6,			
7	Electron beam welding: Laser beam welding, gas welding, cutting methods. Solid phase welding, cold pressure welding, hot pressure welding, friction	05	12	1,2,5, 6	CO6	2,5,6			

	welding, explosive welding, ultrasonic and diffusion welding.								
8	Resistance welding: Contact resistance, spot, seam projection, resistance butt, flash butt etc. Soldering and brazing, theory, types of alloy systems, methods of heating type of joints, adhesive joining.	04	10	1,2,5, 6	CO7	7,8			
9	Weldability of carbon and low allow steels. Hydrogen embrittlement, Brittle fracture, weldability of stainless steels, weldability tests, weldability of non-ferrous systems.	06	08	1,2,3, 4,5	CO6, CO7	1,2,7 ,8			,,,
10	Quality control in welding, procedure for control of material, establishment of correct welding procedure, qualification of operators, testing and inspection during and after welding. Welding defects.	06	10	1,2,3, 4	CO7	1,2,7 ,8			
		45	100						

Text / Reference Books	
1	The Metallurgy of Welding, Brazing and Soldering – J.F. Lancaster, George Alien and Unwin Ltd., London.
2	Introduction to Welding and Brazing – D.R. Milner & R.L. Apps. Pergamon Press, London.

	The Maharaja Sayajirao University of Baroda **Faculty of Technology and Engineering** **Department of Metallurgical & Materials Engg**	**Academic Year**	**2025-26**

BE (Metallurgical & Materials) Regular Programme

Year	**IV**	**Core / ~~Elective / Foundation~~** **Code: MMExxxx** **Subject: Principles of Metal Joining Laboratory**	**Credits / Hours per week**	**02**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**50**
Mode of Transaction		Laboratory Experiments, discussion and viva	**PSO7 is common for all experiments**	

No.	**Experiment**	**Contact hours**	**% Weightage**	**BT Level**	**CO**	**PSO**
1	Basics & Terms used in Welding	2	8.33	1,2	CO1	4,5,6

2	Welding Edge & Joint preparation & classification of groove & fillet welds	2	8.33	1,2,3,4	CO1	2,3,4
3	Demonstration & practice of Manual Metal Arc welding	2	8.33	2,3,4,5	CO4	6,7,8
4	Demonstration & practice of Gas Metal Arc welding	2	8.33	2,3,4,5	CO4	4.7.8
5	Demonstration & practice of Gas tungsten Arc welding	2	8.33	2,3,4,5	CO4	1,2
6	Demonstration & practice of oxy-acetylene gas welding	2	8.33	2,3,4,5	CO4	5,6
7	Demonstration & practice of Resistance spot welding	2	8.33	2,3,4,5	CO5	7,8
8	Demonstration of Submerged Arc welding	2	8.33	2,3,4,5	CO4,5	4,5
9	Study of Weld & welding defects	2	8.33	3,4,5,6	CO7	6,7,8
10	Demonstration of plasma arc cutting process	2	8.33	2,3,4,5	CO5	4,5,6

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

Programme Name: BE (Metallurgical & Materials) Regular Programme

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Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2025-26**
BE (Metallurgical & Materials) Regular Programme				
Year	**IV**	**Core / ~~Elective / Foundation~~** **Code: MME xxxx** **Subject: Non Destructive Testing of Materials**	**Credits / Hours per week**	**3**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and practical		

Course Outcome (CO)

CO1 Understanding and evaluation with identification of different material testing processes
CO2 Product imperfection and its evaluation
CO3 Skill development in non destructive testing
CO4 Students can become entrepreneur
CO5 Quality enhancement in industrial products and control the economy

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	Fundamentals of and introduction to non-destructive testing. Scope and limitations of NDT Visual examination methods. Different visual examination aids.	4	10	1,2,6	1,2	1,2	Emp, Ent, SD	L,N,R,G	ES, HV
2	Leak and pressure testing of industrial components. Various methods of pressure and leak testing underlying principles of these testing systems.	3	5	1,2,3, 4	3,4,5	1,2,3			
3	Dye penetrant and magnetic particle methods of NDT.	4	10	1,2,3, 4	1,3,4 ,5	2,4,5			
4	Ultrasonic methods of NDT-Basic principles of wave propagation, types of waves, methods of UT, their advantages and limitations. Various types of transducers. Calibration methods, use of standard blocks.	6	15	1,2,3, 4	3,4,5	1,2,6			
5	Characterization of defects in castings, forgings, rolled and welded products by UT. Thickness determination by ultrasonic method. Study of A,B and C scan presentations.	7	20	1,2,3, 4	1,3,4 ,5	1,2,3, 4			
6	Radiographic testing of metallic components. X-ray and Gamma-Ray radiography. Their principles, methods of generation. Industrial radiography techniques. Types of films, screens and penetra-meters. Interpretation of radiographs. Real time X-ray radiography.	4	10	1,2,5	2,3,4 ,5	2,3,5, 7			
7	Electrical methods of NDT-Conductivity & resistivity methods and their applications. Eddy current testing.	3	5	1,2	2,3,4 ,5	5,6,7, 8			
8	Thermal methods of NDT.	4	10	1,2,3, 4,5	2,3,4 ,5	5,6			

9	Study of advanced methods of NDT like acoustic emission, holography, tomography, MRI etc.	5	15	1,2,3	2,3,4,5	7,8			
		40	100						

Reference Books

1	Practical Non-destructive Testing – Baldev Raj, T. Jayakumar & M. Thavasimuthu, Norosa Publishing House, New Delhi.
2	Non-destructive testing, Warren J. McGonnagle, Gordon Breach, Science Publishers Ltd.
3	Ultrasonic Testing of Materials, J. Krautkramer & Herbert Krautkramer, Narosa Publishing House, New Delhi.
4	Treaties on Non-destructive testing, Vol. 1,2 & 3 Edited by Dr. E.G. Krishnadas Nair, NDT Centre, Hal, Bangalore.
5	Non-destructive testing, R. Hatmshaw.
6	Ultrasonic Methods of Testing Materials, Leszek Filipezynski, Zdzislaw Pawlowski & Jerzywehr, Butterworths, London.

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**	**Academic Year**	**2025-26**

BE (Metallurgical & Materials) Regular Programme

Year	**IV**	**Core / ~~Elective / Foundation~~** **Code: MME xxxx** **Subject: Non Destructive testing of materials Laboratory**	**Credits / Hours per week**	**2**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**50**
Mode of Transaction		Laboratory Experiments, discussion and viva		

No.	**Experiment**		**Course Code**	**BT Level**	**CO**	**PSO**
1	Tutorial- Manufacturing Processes and its Surface defects			1,2,4,5	1,2	1,2,3
2	Liquid Penetrant test on welded sample			3,4,5	3,4	2,4,5
3	Magnetic Partical test on welded sample			3,4,5	3,5	1,2,6
4	Ultrasonic machine calibration on V1 & V2 calibration block with normal and angle probe			3,4,5	3,4,5	1,2,3,4
5	Industrial Visit for Radiographic Testing			3,4,5	1,2	2,3,5,7
6	Tutorial on NDT standards and codes			1,2,6	4,5	7,8

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Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2025-26**
BE (Metallurgical & Materials) Regular Programme				
Year	**IV**	**Core / ~~Elective / Foundation~~** **Code: MME xxxx** **Subject: Structural Metallurgy**	**Credits / Hours per week**	**03**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO)

CO1 Understanding the basics of crystal geometry
CO2 Applications of stereographic projections
CO3 Understanding basics of X-ray generation
CO4 Learn the electron microscopy
CO5 understanding zone theory
CO6 Applications of electron microscopy

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	Crystal geometry, crystal systems &bravais lattices, laws of rational indices, zones &zone axis, summitry class & point groups, directions & planes, slip planes & screw axis,atom sizes and coordination.	5	10	1	1	1,2,3	Emp, Ent, SD	G	HV,PE
2	Stereographic projections and its application. Polymorphism – definition,thermodynamic concept of polymorphism and examples.	5	10	1,2	2	2,3,4			
3	X-rays: generation, properties, electromagnetic radiation, continuous spectrum,characteristic spectrum, absorption filters, detection and safety precautions. X-raydiffraction.	5	10	1,2	3	2,3			
4	The Bragg's Law, Diffraction methods, X-ray scattering, structure factor and itsdetermination..	5	10	1,2	3	5,6,			
5	Crystal structure determination, phase diagram determination. Electron and neutrondiffraction.	5	10	1,2	3,6	2,3,4			
6	Crystallite size determination. Stress measurement, preferred orientation and chemicalanalysis by X-rays.	5	10	1,2	3,6	2,3			
7	Electron microprobe analyzer, X-ray microscopy and field ion microscopy.	5	10	3	3,4,6	5,6,			
8	Scanning electron microscopy. Free-energy composition diagram.	5	10	2,3	3,4,6	6,7,8			
9	Free electron & zone theory of metals. Zone theory of alloy phases.	5	10	2,3	5	5,6,			
10	Conductors, semi-conductors and insulators based on free electron & zone theory ofMetals. Ferromagnetism, diamagnetism and paramagnetism. Superconductivity.	5	10	1,2,3	5	2,3,4			
	TOTAL	**50 Hours**	**100%**						

Reference Books

1	Structure of Metals – Crystallographic Methods, Principles & Data-Charles S. Barrett &T.B. Massalski, Eurasia Publishing House (Pvt.) Ltd., New Delhi.
2	Theoretical Structural Metallurgy – A.H. Cottrell, The English Language Book Society &Edward Arnold (Publishers) Ltd., U.K.
3	Elements of X-ray Diffraction – B.D. Cullity, Addison – Wesley Publishing CompanyInc., USA.
4	Physical Metallurgy Principles – Robert E-Ree-Hill, Attiliated East-West Press PrivateLtd., New Delhi.

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**	**Academic Year**	**2025-26**

BE (Metallurgical & Materials) Regular Programme

Year	**IV**	**Core / ~~Elective / Foundation~~** **Code: MMExxxx** **Subject: Structural Metallurgy Laboratory**	**Credits / Hours per week**	**02**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**50**
Mode of Transaction		Laboratory Experiments, discussion and viva		

No.	Experiment	Contact Hr	Weightage (%)	BT Level	CO	PSO
1	Tutorial 1	2	10	1,2	1,2,3	2,3,4
2	Tutorial 2	2	10	2,3	3	2,3
3	Tutorial 3	2	10	2,3	3,4,5	5,6,
4	Tutorial 4	2	10	1,2,3	1,2,3	2,3,4
5	Tutorial 5	2	10	1,2,3	1,3,6	2,3
6	Tutorial 6	2	10	1,2,3	1,2,5, 6	5,6,
7	Tutorial 7	2	10	1,2	3,4,6	2,3,4
8	Tutorial 8	2	10	2,3	1,2,3, 6	2,3
9	Tutorial 9	2	5	2,3	4,5,6	5,6
10	Scanning Electron Microscope and EDX	2	5	1,2	1,2,3	2,3,4
11	X Ray Diffraction	2	5	2,3	3	2,3
12	Indexing of x ray pattern	2	5	2,3	3,4,5	5,6,

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Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2025-26**
BE (Metallurgical & Materials) Regular Programme				
Year	**IV**	**Elective-V** **Code: xxxx** **Subject: Super Alloys**	**Credits / Hours per week**	**03 (Credit)**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lecture and Tutorials		

Course Outcome (CO)
CO1 To study of classification of super alloy.
CO2 To learn about characteristics of super alloy.
CO3 To understand about ceramics based on oxides and non-oxides.
CO4 To understand about ceramics based on non-oxides.

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	Historical review, Classification of Super alloys based on Fe, Co and Ni, specifications.	4	10%	1,2	CO1	1	SD,Ent,Emp	N,G	HV,PE,ES
2	Super alloys Preparation and physical characteristics, Role/effect of alloying elements. Applications of super alloys.	8	15%	2,3,4	CO2	1,2,3,4			
3	Different properties analysis of super alloys. such as Metallurgical , Mechanical , Thermal etc.	8	15%	2,3,4,5	CO2	1,2,3,4,7			
4	Influence of aggressive environments such as those involving chlorine and sulphurs.	6	15%	2,3,4	CO2	1			
5	Structural ceramics, their properties and advantages over conventional high temperature materials and super alloys.	4	15%	1,2,4	CO2	1,2,3			
6	Structural ceramics based on Oxides (Alumina, Zirconia and Thoria etc).	5	15%	1,2,3	CO3	1,2,3,4			
7	Structural ceramics based on Non-Oxides (Carbides, Nitrides, Silicides, etc). Their synthesis, properties and applications.	5	15%	1,2,3	CO4	1,2,3,4			

References

1	Powder Metallurgy of Super alloys ,G.H. Gessinger ,Butterworths Monographs ,1984
2	Modern developments in Powder Metallurgy Vol. 1 & 5 ,E. N. Aqua , C. I. Whitman ,Metal Powder Industries Federation 1985
3	Super Alloys “A Technical Guide” ,Mathew J. Donachie, Stephen J. Donachie ,ASM International 2002
4	Super alloys “ Fundamentals and applications ,Roger C.Reed , Cambridge University Press 2006

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BE (Metallurgical & Materials) Regular Programme

Year	**IV**	**Elective - V** **Code: xxxx** **Subject: Super Alloys**	**Credits / Hours per week**	**02**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**50** (TW/VIVA)
Mode of Transaction		Laboratory Experiments, discussion and viva		

No.	**Experiment**	**Contact Hr**	**Weightage (%)**	**BT Level**	**CO**	**PSO**
1	Exp;1	2	15	1,2,3	CO1	1,2,3
2	Exp:2	2	15	2,3	CO2	2,3,4
3	Exp:3	2	15	4	CO3	3,4
4	Exp:4	2	15	4,5	CO4	5,6
5	Exp:5	2	10	4,6	**CO5**	7,8
6	Exp:6	2	10	5,6,	CO6	3,4
7	Exp:7	2	10	,4,5,6	CO6	4,5
8	Tutorial : 1	2	5	2,3,4	CO6	5,6,7
9	Tutorial :2	2	5	3,4,5	**CO6**	6,7

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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2025-26**
BE (Metallurgical & Materials) Regular Programme				
Year	**IV**	**Elective V** **Code: xxxx** **Subject:** Computational Material Engineering	**Credits / Hours per week**	**03**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100 Marks**
Mode of Transaction		Lectures, PPT, Tutorials, Factory Visit, Videos etc		

Course Outcome (CO)
CO1: To understand the different methodologies of materials modelling and simulation
CO2: To explore materials structure, properties, and behaviour under externally imposed variables
CO3: To design materials for different applications
CO4: To know about multiscale modelling and simulation for materials design

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) development al needs	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	Introduction: Overview of different modeling approaches; aims and scopes; concept of multiscale modeling and simulation; significance of materials modeling and simulation. Polymers, Composite and Nano-materials.	**02**	**10**	1/2/3/4	CO 1	**1,2,3 6,7**	Emp, Ent, SD	G	G, ES, HV, PE
2	DFT Modeling: Quantum Mechanics principles; Schrodinger's wave equation; waves and wave functions; solution of Schrodinger's wave equation;	**06**	**15**	1/2/3/5	CO 2	**1,2,3 6,7**			
3	Electron density; Hohenberg-Kohn theorems; Kohn-Sham approach; Kohn-Sham equations; exchange-correlation functionals; local density approximation; generalized gradient approximation; solution of Kohn-Sham equations; treating solids with pseudopotential approach; Bloch's theorem; plane wave expansions	**06**	**10**	1/2/3/5	CO 2	**1,2,3 6,7**			
4	Atomistic Modeling: Classical Newtonian mechanics; overview of molecular dynamics (MD) simulation and its field of applicability; statistical mechanics principles; N-body problem; ensembles and ergodicity; interatomic potentials; initialization and thermal equilibration; boundary conditions; force calculation; potential energy cut-off and truncation schemes; integration algorithms with their relative merits and demerits; thermostatting; barostatting.	**06**	**15**	1/2/3	CO 3	**1,2,3 6,7**			
5	Evaluation of different physical, mechanical, structural, thermodynamic, and transport properties of materials using MD simulation technique; illustration of equilibrium MD and no equilibrium MD techniques; MD exercises with LAMMPS; overview of probability theory based Monte Carlo (MC) simulation and its field of applicability; Metropolis algorithm; Kawasaki dynamics; kinetic Monte Carlo method; simulation of phase evolution and phase transformation using Monte Carlo method	**10**	**20**	1/2/3	CO 3	**1,2,3 6,7**			
6	Stochastic Simulation: Overview; Brownian dynamics; modeling diffusion of a particle in a fluid medium.	**04**	**10**	1/2/3	CO 4	**1,2,3 6,7**			
7	Continuum Modeling: Overview; types; outline of continuum modeling using FEM technique; illustration of solving structural mechanics and heat transfer problems using FEM simulation.	**05**	**10**	1/2/3	CO 4	**1,2,3 6,7**			
8	Multiscale Approaches: Overview and examples; bridging the scale gaps between different simulation levels;	**05**	**10**	1/2	CO 5	**1,2,3 6,7**			

	simultaneous integration of models; sequential integration of models (hierarchical approach); illustration of coupled MD-MC model, coupled MD-FEM model, coupled MD-stochastic model.								

References

1.	Understanding Molecular Simulation: D. Frenkel and B. Smit, Academic Press, 2002
2.	The Art of Molecular Dynamics Simulation: D.C. Rapaport, Cambridge University Press, 2004
3.	Statistical mechanics: Donald A. Mcquarrie, Harper Row, 1976
4.	Handbook of Materials Modeling: Ed.: Sydney Yip, Springer, 2005
5.	Monte Carlo Methods in Statistical Physics, M.E.J. Newman and G.T. Barkema, Clarendon Press, 1999
6	Density functional theory of atoms and molecules, R. G. Parr and W. Yang, Oxford University Press, 1989
7	Electronic Structure of Materials, A. P. Sutton, Clarendon Press, 1994
8	An Introduction to the Finite Element Method, J.N. Reddy, Mc-Graw Hill, 2006
9	Materials Modelling using Density Functional Theory: Properties and Predictions, F. Giustino, Oxford University Press, 2014

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BE (Metallurgical & Materials) Regular Programme

Year	**IV**	**Elective –V** **Code: xxxx** **Subject:** Computational Material Engineering	**Credits / Hours per week**	**02**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**50** (TW/VIVA)
Mode of Transaction		Laboratory Experiments, discussion and viva		

No.	**Experiment**	**Contact Hr**	**Weightage (%)**	**BT Level**	**CO**	**PSO**
1	Exp;1	2	15	1,2,3	CO1	1,2,3
2	Exp:2	2	15	2,3	CO2	2,3,4
3	Exp:3	2	15	4	CO3	3,4
4	Exp:4	2	15	4,5	CO4	5,6
5	Exp:5	2	10	4,6	**CO5**	7,8
6	Exp:6	2	10	5,6,	CO6	3,4
7	Exp:7	2	10	,4,5,6	CO6	4,5

8	Tutorial : 1	2	5	2,3,4	CO6	5,6,7
9	Tutorial :2	2	5	3,4,5	**CO6**	6,7

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

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PSO8 Develop the right attitude in the metallurgical and materials engineering field so that they become an employable or to pursue higher studies

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2025-26**
BE (Metallurgical & Materials) Regular Programme				
Year	**IV**	**Elective -V** **Code: xxxx** **Subject :**Non-Ferrous Alloys	**Credits / Hours per week**	**03**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO)

CO1 Learn the various phase diagrams of non ferrous alloys
CO2 Understandphysical Metallurgy of aluminium alloys and copper alloys
CO3 Understand physicalMetallurgy of Magnesium alloys and Nickel alloys
CO4 Understand the complex Nickel base alloys
CO5 Understand physicalMetallurgy of Titanium and its alloys
CO6 Fabrication and corrosion behaviour of various non-ferrous alloys

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	Phase diagrams of various non-ferrous alloys (Al-alloys, Cu-alloys, Ni-alloys, Ti-alloys, Mg-alloys, Zn-alloys) and strengthening mechanisms in non-ferrous alloys.	4	12	1,2	1	1,3	Emp, Ent, SD	G	PE,HV
2	Alumnium and its alloys: Physical metallurgy of aluminium alloys. Principles of agehardening. Ageing processes. Mechanical behaviour.	5	12	2,3	1, 2	2,3,4			
3	Wrought aluminium alloys and cast aluminium alloys: Compositions, heat treatments, properties and applications.	5	10	2,3	1, 2	1,5,6			
4	Copper and its alloys: Compositions, heat treatments, properties and applications.	5	12	1,2,3	1,2	1,2,3			
5	Magnesium and its alloys: Zinc and its alloys, Compositions, heat treatments, properties and applications.	4	12	1,2	1,3	3,47			
6	Nickel and its alloys: Ni-Cr alloys, Ni-Al alloys, Ni-Cr-Al alloys, Ni-Cr-Al-Ti alloys: Compositions, heat treatment, properties and applications.	4	10	1,2,3	1,3	1,3			
7	Complex Nickel-base alloys: Solid-solution strengthening of Gamma, solid-solution strengthening of gamma prime, amount of gamma prime. Anti-phase boundary energy, Lattice mismatch. Coarsening of gamma prime. Oxidation and corrosion resistance. Longtime phase stability. Applications.	5	12	2,3	4	2,4			
8	Titanium and its alloys: Compositions, heat treatments, properties and applications.	4	10	1,2,3	1, 5	3,7			
9	Fabrication and corrosion behaviour of various non-ferrous alloys.	4	10	1,2,3,6	6	7,8			

Reference Books

1	Physical Metallurgy for Engineers – Donald S. Clark, & Wilbur R. Varney, CBS Publishers & Distributors, New Delhi.
2	Metals Handbook Ninth Edition – Vol.2, Properties and Selection: Non ferrous alloys and Pure Metals, American Society for Metals, Metals Park, Ohio.
3	Introduction to Physical Metallurgy – Sidney H. Avner, McGraw-Hill Book Company, New Delhi.
4	Relevant Indian and Foreign Standards.
5	Heat Treatment, Structure and Properties of Non-ferrous Alloys – Charlie R. Books, 1982, ASM.

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BE (Metallurgical & Materials) Regular Programme

Year	**IV**	**Elective –V** **Code: xxxx** **Subject:** Non-Ferrous Alloys	**Credits / Hours per week**	**02**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**50** (TW/VIVA)
Mode of Transaction		Laboratory Experiments, discussion and viva		

No.	Experiment	Contact Hr	Weightage (%)	BT Level	CO	PSO
1	Exp;1	2	15	1,2,3	CO1	1,2,3
2	Exp:2	2	15	2,3	CO2	2,3,4
3	Exp:3	2	15	4	CO3	3,4
4	Exp:4	2	15	4,5	CO4	5,6
5	Exp:5	2	10	4,6	**CO5**	7,8
6	Exp:6	2	10	5,6,	CO6	3,4
7	Exp:7	2	10	,4,5,6	CO6	4,5
8	Tutorial : 1	2	5	2,3,4	CO6	5,6,7
9	Tutorial :2	2	5	3,4,5	**CO6**	6,7

FS BE IV 5.1 ELECTIVE VI

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

Programme Name: BE (Metallurgical & Materials) Regular Programme

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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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2025-26**
BE (Metallurgical & Materials) Regular Programme				
Year	**IV**	~~**Core**~~ **/ Elective / ~~Foundation~~** **Code:** **Subject:** Welding metallurgy	**Credits / Hours per week**	**03**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO)

CO1 Understanding the basic concept of metallurgy in welding
CO2 Learn about metallurgy of various welding process
CO3 Learn the various phenomenon involved in welding process
CO4 Understand the solidification of weldments
CO5 Understand welding metallurgy of various alloys
CO6 Different applications of welding

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	Importance of Metallurgy in Welding. Concept of weldability. Review of classification of welding processes.	04	08	1,2	CO1	1,2,3, 4	Emp, Ent, SD	G	
2	Metallurgy of solid phase welding, Effect of variables such as deformation & temperature. Mechanism of welding in various solid phase welding processes such as cold pressure, ultrasonic friction and diffusion welding.	06	12	1,2,3	CO2	2,3			
3	Heat flow equation and its refinements, weld simulation. Effect on microstructure. Effect of preheat and post heat on rate of cooling of weldments.	07	14	1,2,3, 4	CO2	5,6,			
4	Physical chemistry of slag metal reactions. Transfer of alloying elements from fluxes. Effect of dilution on chemical composition. Gas absorption and effect of gases on weldments. Gas flow equation for hydrogen. Principles of consumable developments for various fusion welding processes.	06	12	2,3,4, 5	CO3	6,7,8			
5	Epitaxial nucleation. Mode of solidification and segregation. Kinetics of phase transformation in carbon steels, low alloy steels and stainless steels.	07	14	2,3,4, 5	CO4	7,8			
6	Mechanism of cracking and embrittlements. Fracture toughness and its testing applied to weldments. Solidification cracking. Liquation cracking. Lamellar tearing. Cold cracking. Reheat cracking and strain age embrittlement. Tests for above.	08	16	2,3,4, 5	CO4	2,3,4			
7	Weldability of non-ferrous alloys especially aluminium, nickel and titanium alloys.	04	08	1,2,3	CO5	6,7,8			
8	Joining metallurgy of the dissimilar metals, clad metals etc. Welding metallurgy of various types of cast irons. Metallurgy of repair welding.	08	16	1,2,3, 6	CO6	5,6,			

	Welding metallurgy of spray coating. Metallurgy of cutting.								
	TOTAL	**50 Hours**	**100%**						

Reference Books	
1	Introduction to Physical Metallurgy of Welding – Kenneth Easterling, Butterworths & Company (Publishers) Ltd., London.
2	The Metallurgy of Welding, Brazing and Soldering – J.F. Lancaster, Geroge Allen and Unwin Ltd., London.

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BE (Metallurgical & Materials) Regular Programme

Year	**IV**	~~**Core**~~ **/ Elective /** ~~**Foundation**~~ **Code:** **Subject:** Welding Metallurgy Laboratory	**Credits / Hours per week**	**02**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**50** (TW/VIVA)
Mode of Transaction		Lectures and Tutorials		

No.	**Experiment**		**Course Code**	**BT Level**	**CO**	**PSO**
1	Ex 1					
2	Ex 2					
3	Ex 3					
4	Ex 4					
5	Ex 5					
6	Ex 7					
7	Ex 8					
8	Ex 9					

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,

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Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2025-26**
BE(Metallurgical & Materials)				
Year	**IV**	~~**Core**~~ **/ Elective /** ~~**Foundation**~~ **Code: MMExxxx** **Subject**: Selection of Material and Failure Analysis	**Credits / Hours per week**	**03**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Laboratory		

Course Outcome (CO)

CO1 Understand about Criteria for selection of engineering materials & selection of mechanical properties e.g. strength, toughness, fatigue, creep and temperature resistance
CO2 Learn about selection for surface durability corrosion résistance, wear resistance.
CO3 Selection of material based on available property data and optimization to select best material.
CO4 Learn about material selection like bearing, gears, and aircraft components.
CO5 Understand about fundamental causes of failure.
CO6 Identification and characterization of brittle and ductile type failure and fatigue failure.
CO7 Corrosion type failure like stress corrosion cracking, hydrogen embrittlement, high temperature power plant equipment like tube and pipe sand boiler failure.

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	Philosophy of material selection, relationship to available resources, concept of resource base. Criteria for selection of engineering materials – service requirements, ease of manufacturing, availability of materials and cost effectiveness.	05	10	1,2,3,4	CO1	1,2,3	Emp, Ent, SD	G	PE,HV
2	Selection for mechanical properties like strength, toughness, stainless, fatigue, creep and temperature resistance	05	10	2,3,4,5	CO1	3,4			
3	Selection for surface durability like for corrosion resistance, wear resistance. Relationship between material selection and material processing.	05	10	2,3,4,5	CO2	4,6			
4	Identification of required properties. Selection of material based on available property data and optimization to select the best material.	05	10	2,3,5,6	CO3	4,6,7			
5	Case studies in material selection like materials for bearings, gears, aircraft components etc.	05	10	1,2,3,4, 5	CO4	3,7,8			
6	Importance of failure analysis and its relationship to material selection, fundamental causes of failure. General practice in failure analysis.	05	10	2,3,4,5	CO5	2,4			
7	Identification and characterization of ductile and brittle type of failures	05	10	1,2,3,4, 5	CO6	5,6,			
8	Identification and characterization of fatigue failures. Types of fatigue, corrosion fatigue and contact fatigue etc.	05	10	2,3,4,5	CO6	6,7,8			
9	Corrosion and corrosion related failures such as hydrogen embrittlement, stress-corrosion cracking and high temperature failures.	05	10	1,2,3,4	CO7	5,6,			
10	Failure of boiler and related high temperature power plant equipment, tube and piping. High temperature related degradation studies.	05	10	2,3,4,5, 6	CO7	5,6,7			
	TOTAL	**50 Hours**	**100%**						

Reference Books

1	Selection & Users of Engineering Materials – F.A.A. Crane & J.A. Charles, Butlerworth& Com. (Publishers) Ltd., London.
2	Engineering Materials – Vol. 1 and 2 – Michael F. Ashby & David R.H. Jones, Pergamon Press, New York.

3	Engineering Materials – Selection and Value Analysis – H.J. Sharp, Elsevier Publishing Company Inc., New York.
4	Analysis of Metallurgicval Failures – V.J. Colangelo& F.A. Heiser, John Wiley & Sons, New York.
5	Metals Hand Book – Eighth Edition – Failure Analysis and Prevention, American Society for Metals, Metals Park, Ohio.
6	Metals Hand Book – Eightgh Edition – Factography, American Society for Metals, Metals Park, Ohio.

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Year	**IV**	~~**Core**~~ **/ Elective /** ~~**Foundation**~~ **Code: MMExxxx** **Subject**: Selection of Material and Failure Analysis Laboratory	**Credits / Hours per week**	**02**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**50** (TW/VIVA)
Mode of Transaction		Lectures and Laboratory		

No.	**Experiment**	**Contact Hr**	**Weightage (%)**	**BT Level**	**CO**	**PSO**
1	Tutorial: Classification of manufacturing defects and its remedies	2	15	1,2,3	CO1	1,2,3
2	Criteria for selection of engineering materials	2	15	1,2,6	CO2	3,4
3	Case study on failure analysis of lifting lug	2	10	2,3,4,5	CO3	4,6
4	Case study on failure analysis of boiler tube	2	10	2,3,4,5	CO4	4,6,7
5	Case study on failure analysis of shaft	2	10	2,3,4,5	CO4	3,7,8
6	Material selection of ball bearing steel	2	10	1,2,6	CO5	2,4
7	Assignment: seminar on failure analysis in oil & gas industries	2	10	1,2	CO1	1,2,3
8	Material selection for aerospace application	2	10	1,2,6	CO2	3,4
9	Characterization techniques required for failure analysis	2	10	1,2,4,6	CO3	7,8

FS BE IV 5.3 ELECTIVE VI

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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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2025-26**
BE (Metallurgical & Materials) Regular Programme				
Year	**IV**	**Elective -VI** **Code xxxx** **Subject: Practical Applications of Alloy Design**	**Credits / Hours per week**	**03**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lecture and Tutorials		

Course Outcome (CO)
CO1 Understand types of materials and properties
CO2Know different methods for materials selection
CO3Selection of materials for Specific engineering applications
CO4Know different methods for processes selection
CO 5Understand importance of macro and micro shapes in applications

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	Technologically important properties of materials – Physical, chemical, mechanical, thermal, optical, environmental and electrical properties of materials.	6	15%	1,2,3,4	CO1	1,3,5	SD,Ent,Emp	N,G	HV,PE,ES
2	Material property charts – Modulus – density, strength-density, fracture toughness-strength.	6	15%	1,2,3,4	CO1	1,3,5			
3	Types of design, Design tools and materials data – Materials and shape – microscopic and micro structural shape factors – limit to shape efficiency Comparison of structural sections and material indices – case studies	6	15%	2,3,5	CO2	2,6,8			
4	Service, Fabrication and economic requirements for the components – Methodology for selection of materials – Collection of data on availability, requirements and non functional things- its importance to the situations – case studies	6	15%	2,3,4,5	CO3	2,3,7			
5	Classifying process- -systematic selection of process – Selection charts – Ranking of processes – case studies .	6	15%	2,4,5	CO4,5	1,4,7			
6	Influence of manufacturing aspects and processing route on properties of materials and its influence on selection of materials	6	15%	2,4,5	CO4,5	1,4,7			
7	Selection of materials for automobile, nuclear, power generation, aerospace, petrochemical, electronic and mining industries.	4	10%	2,3,4	CO5	3,4,8			

References

1	M.F.Ashby, " Materials Selection in Mechanical Design' – Third edition, Elsevier publishers, Oxford, 2005.
2	GladiusLewis,"Selection of Engineering Materials", Prentice Hall Inc, New Jersey, USA, 1995
3	Charles.J.A. and Crane,F.A.A., "Selection and Use of Engineering Materials", Butterworths, London,1989.
4	Angelo P C and Ravisankar B, "Introduction to Steel- Processing, Properties and Applications", CRC Press, Taylor & Francis Group, Florida, U.S.A. 2019

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**	**Academic Year**	**2025-26**

BE (Metallurgical & Materials) Regular Programme

Year	**IV**	**Elective - VI** **Code: xxxx** **Subject: Practical Applications of Alloy Design**	**Credits / Hours per week**	**02**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**50** (TW/VIVA)
Mode of Transaction		Laboratory Experiments, discussion and viva		

No.	**Experiment**	**Contact Hr**	**Weightage (%)**	**BT Level**	**CO**	**PSO**
1	Exp;1	2	15	1,2,3	CO1	1,2,3
2	Exp:2	2	15	2,3	CO2	2,3,4
3	Exp:3	2	15	4	CO3	3,4
4	Exp:4	2	15	4,5	CO4	5,6
5	Exp:5	2	10	4,6	**CO5**	7,8
6	Exp:6	2	10	5,6,	CO6	3,4
7	Exp:7	2	10	,4,5,6	CO6	4,5
8	Tutorial : 1	2	5	2,3,4	CO6	5,6,7
9	Tutorial :2	2	5	3,4,5	**CO6**	6,7

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

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2025-26**
BE (Metallurgical & Materials) Regular Programme				
Year	**IV**	**Elective-VI** **Code: xxxx** **Subject:** Process Modeling and simulation	**Credits / Hours per week**	**03**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100 Marks**
Mode of Transaction		Lectures, PPT, Tutorials, Factory Visit, Videos etc		

Course Outcome (CO)

CO1 Understand basics of computational methods
CO2 Learn basics of modeling
CO3 Learn various types of modeling
CO4 Applications of modeling
CO5 Learn characterization and case studies

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	Basics of computional methods: Finite difference method and finite element analysis. Solution of ordinary and partial differential equations. Integral transformations.	04	10	1,2,3	CO 1	1,2,3	Emp, Ent, SD	G	G, ES, HV, PE
2	Basics of modeling: Classification, functions, limitations and inter-relationship of different types of models.	04	10	1,2,3, 4,5	CO 2	2,3,4			
3	Physical modeling: Geometric, kinematic, dynamic, thermal and chemical similarity. Semi rigorous models.	04	10	1,2,3, 4	CO 3	2,3			
4	Model materials and measurement techniques	04	10	1,2	CO 3	5,6,			
5	Mathematical modeling: Types, role in process analysis and development	04	10	1,2,3, 4	CO 3	2,3,4			
6	Steps: Preparation, mathematical formulation, validation, application.	04	10	1,2,3	CO 3	2,3			
7	Applications: Application of mathematical models to control metallurgical processes. Static and dynamic models.	04	10	3,4,5	CO 4	5,6,			
8	Characterization of structure and properties. Development and execution of illustrative computer programs.	04	10	3,2,4, 5,	CO 5	6,7,8			
9	Case studies in process metallurgy topics.	04	10	4,5,6	CO 5	5,6,			
10	Case studies in physical metallurgy topics.	04	10	4,5,6	CO 5	2,3,4			

References

1	An introduction to Numerical computations by S. Yakowitz and Szidarovszky – Maxwell Macmillian.
2	The Mathematical and Physical Modeling of Primary Metals Processing Operations by J.S. Szekely, J.W. Evans and J.K. Brimacombe – Wiley.
3	Numerical Methods for Engineers by S.C. Chopra and R.P. Canale – Mc Graw Hill.
4	Numerical Recipes by W.H. Press, B.P. Flannery, S.A. Teukolsky and W.D. Vetterling.
5	Engineering in Process Metallurgy – R.I.L. Guthrie, Oxford, 1989.

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**	**Academic Year**	**2025-26**

BE (Metallurgical & Materials) Regular Programme

Year	**IV**	**Elective-VI** **Code: xxxx** **Subject**: Process Modeling Laboratory	**Credits / Hours per week**	**02**
Semester	**I**	Year of Introduction: NA Year of Syllabus Revision: NA	**Maximum Marks / Grade**	**50** (TW/VIVA)
Mode of Transaction		Laboratory Experiments, discussion and viva		

No.	Experiment	Contact Hr	Weightage (%)	BT Level	CO	PSO
1	Exp;1	2	15	1,2,3	CO1	1,2,3
2	Exp:2	2	15	2,3	CO2	2,3,4
3	Exp:3	2	15	4	CO3	3,4
4	Exp:4	2	15	4,5	CO4	5,6
5	Exp:5	2	10	4,6	**CO5**	7,8
6	Exp:6	2	10	5,6,	CO6	3,4
7	Exp:7	2	10	,4,5,6	CO6	4,5
8	Tutorial : 1	2	5	2,3,4	CO6	5,6,7
9	Tutorial :2	2	5	3,4,5	**CO6**	6,7

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
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Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**		**Academic Year**	**2025-26**
BE (Metallurgical & Materials) Regular Programme				
Year	**IV**	**Elective-VI** **Code: xxxx** **Subject: Material Separation and Purification**	**Credits / Hours per week**	**03**
Semester	**I**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lecture and Tutorials		

Course Outcome (CO)
CO1 To learn about extraction metallurgy.
CO2 To understand pyro, hydro and electro metallurgy.
CO3 To learn about refining and new separation techniques.
CO4 To calculate the numericals based on theory.

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	Fundamental of Separation techniques, Fundamental of extractive metallurgy, General methods of extraction Unit process I extractive metallurgy	4	10%	1,2,3,4	CO1	3,8,5	SD,Ent,Emp	N,G	HV,PE,ES
2	**Pyrometallurgy:**Roasting types, Roasting Furnaces, Roasting practices, Calcinations, Smelting, smelting furnaces, matte smelting, flash smelting Properties and importance of Ellingham diagram for oxides, sulphidesetc Ellingham limitation, Vacuum pyrometallugy.	6	15%	2,3,5	CO2	2,1,7			
3	**Hydrometallurgy:** Leaching, theory of leaching, types of leaching, Role of oxygen in leaching operation, bacterial leaching, metal recovery from leach solution by cementation, filters.	6	15%	2,3,4,5	CO2	6,5,3			
4	Classification of electrometallurgy, advantages and disadvantages of electrometallurgy , Laws of electrolysis, electrolysis of aqueous solution, electrolysis of fused salts, electro plating, electro winning of metals.	6	15%	2,4,5	CO2	4,8,7			
5	**Refining:** Basic approach of refining, electro refining, Zone refining, Fire refining, Preparation of pure compounds, Purification of crude metals produced in bulk	6	15%	2,3,4,5	C03	3,8,5			
6	**New separation techniques:** Reactive Distillation, Reactive Extraction, Reactive absorption, Reactive crystallization**,** Numerical form above topics.	6	15%	2,3,4,5	C03	4,6,1			
7	Numerical form above topics	6	15%	3,4,5	C04	1,4,5			

REFERENCES

1	Principles of Extractive Metallurgy : A. Ghosh & H.S. Ray IIN Publications , Kolkata
2	Principles of Extractive Metallurgy: Rosenquist T McGrawhill –Kogakusha International
3	Non-Ferrous extractive Metallurgy: H.S. Ray, K.P. Abraham, and R. Sreedhar

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Metallurgical & Materials Engineering**	**Academic Year**	**2025-26**

BE (Metallurgical & Materials) Regular Programme

Year	**IV**	**Elective-VI** **Code: xxxx** **Subject**: **Material Separation and Purification**	**Credits / Hours per week**	**02**
Semester	**I**	Year of Introduction: NA Year of Syllabus Revision: NA	**Maximum Marks / Grade**	**50** (TW/VIVA)
Mode of Transaction		Laboratory Experiments, discussion and viva		

No.	**Experiment**	**Contact Hr**	**Weightage (%)**	**BT Level**	**CO**	**PSO**
1	Exp;1	2	15	1,2,3	CO1	1,2,3
2	Exp:2	2	15	2,3	CO2	2,3,4
3	Exp:3	2	15	4	CO3	3,4
4	Exp:4	2	15	4,5	CO4	5,6
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6	Exp:6	2	10	5,6,	CO6	3,4
7	Exp:7	2	10	,4,5,6	CO6	4,5
8	Tutorial : 1	2	5	2,3,4	CO6	5,6,7
9	Tutorial :2	2	5	3,4,5	**CO6**	6,7