

Bloom's Taxonomy Levels:

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

Programme Name: ME (Metallurgical & Materials) (Material Technology) 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			2020-21			
ME (Metallurgical & Materials) (Material Technology) proramme											
Year	I	Core / Elective / Foundation Code: MME2102 Subject: Materials Characterization Techniques			Credits / Hours per week			04 Hrs/ week			
Semester	I	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 (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G) developmental	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)

								needs	
1	Importance of characterization in material science.	1	10	1-6	CO1	1	SD	G	ES
2	Thermal analysis techniques: Principle, working and application of DTA, TGA, TMA and DSC.	3	10	1,2	CO2	2	EMP	G	ES
3	Optical methods: 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		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		ENT	G	ES
5	Techniques for chemical analysis: XRF, EDS & WDS, Atomic absorption spectrometer, Emission spectroscopy & direct reading spectrometer, mass spectrometer.	8	15	1,2,3, 4,5,6	CO5		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	15	1,2,3, 4,5,6	CO5	3	ENT	G	ES
7	Surface characterization: XPS (ESCA), Auger electron spectroscopy.	2	05	1,2,3	CO5		ENT	G	ES
8	Magnetic characterization, characterization of soft magnet and hard magnets.	2	05	1,2,3	CO5		ENT	G	ES

Text Books

1	F. Weinberg, Editor, Tools & Techniques in Physical Metallurgy, Vol. I & Vol. II, Marcel Dekker, 1970.
2	John P. Sibilis, 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 of Materials 2 nd edition
6	B.D. Cullity, Elements of X-ray diffraction, Addison-Wesley Publishing Company, INC, 1978.
7	Bernhard Wunderlich, 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		2020-21				
		ME (Metallurgical & Materials) (Material Technology) proramme										
Year		I	Core / Elective / Foundation Code: MME2102L Subject: Materials Characterization Techniques Laboratory					Credits / Hours per week		04 Hrs/ week		
Semester		I	Year of Introduction: NA Year of Syllabus Revision: NA					Maximum Marks / Grade		100 Marks		
Mode of Transaction			Lectures, PPT, Tutorials, Factory Visit, Videos etc									
No.	Experiment						Conta ct Hr	Weightag e (%)	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	

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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						
ME (Metallurgical & Materials) (Material Technology) proramme									
Year	I	Core / Elective / Foundation Code: MME2208 Subject: Composite Materials	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 Overview of Basic of Composite Material CO2 Importance and Preparation of reinforcement materials Fibbers and Whiskers, Oxides and Non oxides base in details CO3 Classification of Composites on the basis of Matrix Material CO4 Interface and its importance in composites in details CO5 Composite Type I: PMC and MMC in details CO6 Composite Type II: CMC in details CO7 Special ceramic material CO8 Macro and micro mechanics of composites: Study Mechanical Probertites of composites, test required to check its mechanical properties, fatigue test, types of various fracture modes									
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	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)

								needs	
1	Introduction: Traditional ceramics, modern ceramics and role of ceramic in modern engineering.	4	5	1-6	CO1	1	SD	G	ES
2	Study of raw materials like clay minerals, talc, silica and silicates, refractory and other raw materials. An overall study of ceramic forming processes. Pressing, extrusion, slip casting, injection moulding, glass forming methods, etc	6	10	1,2	CO2	2	EMP	G	ES
3	Study of oxide structures, silicate structures and clays. Study of non-crystalline solids. Silicate glasses and non-silicate glasses.	4	5	1,2	CO3		EMP	G	ES
4	Study of phase diagrams of two component systems. Three component and multi-component ceramic systems with special reference to $\text{Al}_2\text{O}_3\text{-SiO}_2$, $\text{Al}_2\text{O}_3\text{-MgO-SiO}_2$ systems. Study of glasses and metastable phases.	6	5	1,2,3,4,5,6	CO4		ENT	G	ES
5	Basic aspects of microstructural examination of ceramic. Properties of ceramics. Thermal properties, electrical properties, dielectric and magnetic properties, mechanical properties.	5	20	1,2,3,4,5,6	CO5		EMP	G	ES
6	Application as cemented carbide tools, silicon nitride tools, sialon tools, alumina tools, Silicon carbide tools, etc.	5	15	1,2,3,4,5,6	CO5	3	ENT	G	ES
7	Study of various types of electronic ceramics. Dielectric ceramics, piezoelectric ceramics. semiconductive ceramic and magnetic ceramics	5	10	1,2,3,4,5,6	CO7	3	EMP	N and G	ES
8	Study of ceramic coatings and advances in high temperature ceramics, ceramic composites.	5	10	1,2,3,4,5,6	CO8	3	SD	N and G	ES

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.
4	Composite Materials Handbook – Schwartz.
5	Introduction to Composite Materials Stephen W. Tsai – H. Thomaswahn

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
6	Composite Materials – Leslie Holtiday
7	Composite Materials & Their structure – Jack R. Vision & TSU-Welchou
8	Composite Structure (Testing analysis & design) – J.N. Reddy, A.V. Krishnamurty

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Programme Specific Outcome (PSO)

Students will be able to

PSO 1 Understand and analyze engineering properties of various materials and able to provide the suitable material for engineering application.

PSO 2 Develop new ideas on material design with the help of best manufacturing practices.

PSO 3 Understanding the current scenario in the field of materials and acquire expertise to find out the root cause of real world failures in materials industry.

PSO 4 Expertise in problem solving of the Material engineering field through various dissertation projects.

PSO 5 Endowed technical competency, ethics, interdisciplinary working skill and contribute society philanthropically.

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Metallurgical & Materials Engineering	Academic Year	2020-21							
ME (Metallurgical & Materials) (Materials Technology) Regular Programme										
Part	I	Core / Elective / Foundation Code: MME2121 Subject: Ceramic Materials	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 ceramics & study of raw materials of ceramics and ceramic forming processes. CO2 Study of oxide structures, silicate structures, non crystalline solids, silicate glasses and non silicate glasses. CO3 Understand phase diagram of two component systems, three and multi component ceramic & basic knowledge about microstructure examination of ceramics. CO4 Application of ceramic Tools. CO5 Study of various electronic ceramics, dielectric ceramics, piezoelectric ceramics, magnetic ceramic, semiconductive ceramics & various coating of ceramics										
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: Traditional ceramics, modern ceramics and role of ceramic in modern engineering.	02	4	1,2,3,4	CO1	1,2,3	Emp, Ent, SD	G	PE,HV,ES
2	Study of raw materials like clay minerals, talc, silica and silicates, refractory and other raw materials. An overall study of ceramic forming processes. Pressing, extrusion, slip casting, injection moulding, glass forming methods, etc.	08	16	2,3,4,5	CO1	3,4			
3	Study of oxide structures, silicate structures and clays. Study of non-crystalline solids. Silicate glasses and non-silicate glasses.	06	12	2,3,4,5,6	CO2	4,5			
4	Study of phase diagrams of two component systems. Three component and multi-component ceramic systems with special reference to Al ₂ O ₃ -SiO ₂ , Al ₂ O ₃ -MgO-SiO ₂ systems. Study of glasses and metastable phases.	08	16	2,3,4,5,6	CO3	4,5			
5	Basic aspects of microstructural examination of ceramic. Properties of ceramics. Thermal properties, electrical properties, dielectric and magnetic properties, mechanical properties.	08	16	1,2,3,4,5,6	CO3	3,5			
6	Application as cemented carbide tools, silicon nitride tools, sialon tools, alumina tools, Silicon carbide tools, etc.	06	12	2,3,4	CO4	2,4			
7	Study of various types of electronic ceramics. Dielectric ceramics, piezoelectric ceramics. semiconductive ceramic and magnetic ceramics.	06	12	2,3,4,5	CO5	3,4			
8	Study of ceramic coatings and advances in high temperature ceramics, ceramic composites.	06	12	1,2,4,5,3	CO5	3,4,5			
	TOTAL	50 Hours	100%						
Reference Books									
1	Introduction to ceramics, W. D. Kingery. John Wiley Sons.								
2	Engineering Applications of Ceramic Materials, M. M. Schwartz, ASM Publication.								
3	Modern Ceramic Engineering, Properties\, processing and use in design, by D. W. Richerson, Marcel & Dekker Inc., New York, 1982								

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		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Metallurgical & Materials Engineering				Academic Year			2020-21			
ME (Metallurgical & Materials) (Materials Technology) Regular Programme												
Part	I	Core / Elective / Foundation Code: MME2101 Subject: Nanomaterials and Techniques of Nanosynthesis				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) CO1 Understanding the basics of nanomaterials and nanotechnology CO2 Learn basics of various phenomena at nano scale CO3 Learn the Functional properties of nanomaterials CO4 Understand the Synthesis & fabrication techniques & Consolidation methods for nanopowders CO5 Learn Characterization of nanomaterials CO6 Applications of nanomaterials												
Unit No.	Topic/Unit				Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G) developmental	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and

							(SD)	needs	Professional Ethics (PE)
1	Introduction to nanomaterials and nanotechnology, historical developments. An overview of scope & applications of nanotechnology. World-wide efforts and investment in nanotechnology. Classifications and types of nanomaterials.	6	12	1,2	1	1,3	Emp, Ent, SD	G	PE,HV,ES
2	Basic understanding of various phenomena at nano scale namely size confinement, interfacial surface phenomena.	8	16	1,2	2	2,3,4			
3	Introduction to basic building blocks namely atoms, molecules, self-assembly, carbon nanotubes, nanocrystals, nanoclusters, nanocapsules, fullerenes, quantum dots, quantum wires and nanoporous materials.	5	10	1,2,3	2	4,5			
4	Functional properties of nanomaterials such as physical, mechanical, electrical, magnetic, chemical and optical properties. Size dependence of material at nano scale. Bulk vs nano properties of materials.	5	10	1,2,3	3	4,5			
5	Synthesis & fabrication techniques: 'Top down' vs 'Bottom-up' approach of synthesis. Review of synthesis methods namely sol-gel method, chemical vapour deposition, physical vapour deposition, sputtering, plasma deposition process, microemulsion technique, inert gas condensation, mechanical milling, devitrification of amorphous phases, etc. Basics of nanofabrication techniques such as epitaxial growth, nanolithography & self-assembly.	8	16	2,3	4	3,4			
6	Consolidation methods for nanopowders such as cold isostatic pressing (CIP), hot isostatic pressing (HIP), Dynamic compaction, Conventional and Microwave sintering. Diffusion and growth kinetics of nanostructured materials during sintering. Effect of grain size on mechanical properties of nano structured materials.	8	16	1,2,3	4	2,5			

7	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.	5	10	1,2,3	5	4,5			
8	Applications of nanomaterials namely nanograined structural materials & nano-composites, nanomagnetic materials, chemical applications etc.	5	10	1,2,3	6	5			
	TOTAL	50 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
6	Handbook of Nanostructured Materials and Nanotechnology, ed. by H.S. Nalwa, Vol. 1-5, Academic Press, 2002.
7	Carbon Nanotubes: Science and Applications ed. by M. Meyyappan, CRC Press, Boca Raton Florida, 2004.
8	Processing and Properties of Structural Nanomaterials, Leon L. Shaw, C. Suryanarayana & Rajiv S. Mishra, TMS, 2003.

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PSO 5 Endowed technical competency, ethics, interdisciplinary working skill and contribute society philanthropically.

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Physics	Academic Year	2020-21							
ME (Metallurgical & Materials) (Material Technology) Regular Programme										
Part	I	Core / Elective / Foundation Code: MME2103 Subject: Phase transformation	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 phase transformation and nucleation process CO2 Study of Effect of strain energy CO3 Study and understand general growth method CO4 Study the martensitic transformation										
Unit No.	Topic/Unit	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurs hip (Ent)/ Skill	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G) developmental	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and	

							Development (SD)	needs	Professional Ethics (PE)
1	Introduction to thermodynamics of phase stability, kinetics, classification of transformation, quantitative transformation kinetics.	10	20	1,2,3,4	CO1	1,2,3	ENT	G	ES
2	Nucleation processes and growth, heterophase fluctuation, homogenous and heterogeneous nucleation, nucleation in two component systems.	08	16	2,3,4,5	CO1	4,5			
3	Effect of strain energy, diffusional growth processes, growth controlled by heat transfer	08	16	2,3,4,5, 6	CO2	3,4,5			
4	General growth models, morphology and growth, coarsening reaction kinetics, empirical kinetics	05	10	2,3,4,5, 6	CO3	4,5			
5	Precipitation reaction, free energy considerations, role of vacancies and dislocations, Strengthening mechanism, Spenoidal decomposition	08	16	1,2,3,4, 5,6	CO3	3,4,5			
6	Martensitic transformation, transformation with short-range diffusion.	06	12	2,3,4	CO4	4,5			
7	Order-disorder transformation, recovery and recrystallization, High-pressure phase transformation	05	10	2,3,4,5	CO4	2,4,5			
	TOTAL	50 Hours	100%						
Reference Books									
1	Phase Transformations In Materials, Romesh Sharma Cbs Publishers & Distributors, 2002								
2	Principles of Phase Transformations and Heat Treatment, A. K. Mallik, I.I. T., Bombay.								
3	Materials Science Forum, Vol.-3, (1988), Phase Stability and Phase Transformations.								
4	Proceedings of International Conference, Bombay, 1989, Trans Tech Publications.								
5	Transformation in Metals, P. G. Shewman.								

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Metallurgical & Materials Engineering			Academic Year		2020-21		
ME (Metallurgical & Materials) (Material Technology) Regular Programme									
Year		I	Core / Elective / Foundation Code: MME2103L Subject: Phase Transformation Lab			Credits / Hours per week		02 (Practical)	
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	4,5	
5	Exp:5			2	10	4,6	CO5	5	
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	
9	Tutorial :2			2	5	3,4,5	CO6	5	

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 सत्यं शिवं सुन्दरम्		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Chemical Engineering Department					Academic Year		2019-20		
ME (Metallurgical & Materials) (Materials Technology) Regular Programme											
Year		I		Core / Elective / Foundation MME2104 – Polymeric Materials				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 Knowledge of the fundamentals of polymers and biopolymers classification.											
CO2 Understanding of the kinetic aspects and the techniques associated with the synthesis of polymers by addition and condensation mechanisms											
CO3 Understanding of the theoretical aspects and classification of polymeric materials											
CO4 Knowledge of the manufacturing processes of selected thermoplastic polymers											
CO5 Understanding of important properties of thermoplastic and thermosetting polymers and their applications											
CO6 Knowledge of manufacture of selected rubbers and fibers, properties, processing, technical aspects and their applications											
CO7 Understanding of specialty polymers, properties and applications											
Unit	Topic/Unit			Contact	Weightage	BT	CO	PSO	Elements of	Relevance to	Relation to

No.		Hours	(%)	Level			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.	Indian Polymer Industries. Polymer classification, Basic concepts, Kinetics and mechanism of polymerization.	6	12	2,3,4	CO1	1,2	Emp, SD	L,N,R,G	ES
2.	Production, properties and applications of commodity plastics and their copolymers, blends and alloys.	6	12	2,3,4	CO2, CO3	2,3,4	EMP, SD	L,N,R,G	ES
3.	(A) Production, properties and applications of thermosetting/thermoplastics. (B) Production, properties and applications of engineering, specialty, high performance and biomedical Plastics.	8	16	2,3,4	CO4	4,5	EMP, SD	L,N,R,G	ES
4.	Mechanical processing and fabrication of plastics. Adhesives.	5	10	2,3,4	CO4	1,3,4	EMP, SD	L,N,R,G	ES
5.	Polymer properties, mechanical and other behaviors and testing	6	12	1,2,3	CO5	1,5,	EMP, SD	L,N,R,G	ES
6.	Production, properties and applications of engineering fibers including geotextiles, optical, agricultural, biomedical, reinforcing and hollow fibers. Mechanical Processing and fabrications of fibers.	10	20	1,2,3	CO7	4,5	EMP, SD	L,N,R,G	ES
7.	Production, properties and applications of synthetic rubbers, mechanical processing, compounding, fabrication and vulcanization of rubbers	6	12	1,2,3	CO6	5	EMP, SD	L,N,R,G	ES
8.	Polymers in protective coatings, laminings, adhesives and other uses.	3	6	1,2,3	CO7	2,5	EMP, SD	L,N,R,G	ES
	TOTAL	50 Hours	100%						

Reference Books

	F. W. Billmeyer, Text book of Polymer Science 3 rd Ed Wiley, 1984.
	Dryden's outlines of Chemical Technology M. Gopala Rao Marshall sitting.
	C. E. Carranher, Introduction to Polymer Chemistry, Taylor and Francis, 2007.
	F. Rodriguez, Principles of Polymer systems 4 th Ed., Taylor and Francis, 1996.

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Programme Specific Outcome (PSO)

Students will be able to

PSO 1 Understand and analyze engineering properties of various materials and able to provide the suitable material for engineering application.

PSO 2 Develop new ideas on material design with the help of best manufacturing practices.

PSO 3 Understanding the current scenario in the field of materials and acquire expertise to find out the root cause of real world failures in materials industry.

PSO 4 Expertise in problem solving of the Material engineering field through various dissertation projects.

PSO 5 Endowed technical competency, ethics, interdisciplinary working skill and contribute society philanthropically.

Syllabus of Courses

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Metallurgical & Materials Engineering			Academic Year			2020-21			
ME (Metallurgical & Materials) (Materials Technology) Regular Programme											
Year	I	Core / Elective / Foundation Code: MME2207 Subject: Diffusion in Solids			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 Understanding the basics of diffusion and Fick’s law CO2 Learn the atomic theory of diffusion CO3 Understand the diffusion in dilute alloys CO4 Understand the diffusion in concentration gradient and in non metal alloys CO5 Understand high diffusivity paths CO6 Applications of diffusivity											
Unit No.	Topic/Unit			Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurs hip (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/Glob al (G) developmental needs	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)

1	Equations of Diffusion: Fick's first law. Solutions to Fick's first law. Derivation of Fick's second law equation and solutions for common geometries. Solutions for variable D. Diffusion in non-cubic lattices.	6	12	1,2	1	1,3	Emp, Ent, SD	G	PE,ES,HV
2	Atomic theory of diffusion: Random movement and diffusion coefficient. Mechanisms of diffusion random walk problem. Calculation of D. Zener's theory of D_0 . Empirical rules for obtaining ΔH and D_0 . Calculation of ΔH & ΔS from first principles. Experimental Determination of $\Delta H_v, \Delta H_m$ and ΔS_v . Divacancy formation. Effect of hydrostatic pressure.	8	15	1,2,3	2	2,3,4			
3	Diffusion in dilute alloys: Anelasticity due to diffusion. Impurity diffusion in pure metals. Correlation effects. Diffusion in dilute binary alloys.	8	15	1,2	3	4,5			
4	Diffusion in a concentration gradient: The Kirkendall effect. Darken's analysis. Phenomenon logical equations. Relationship between chemical D_1 and Tracer D_1^* . Test of Darken's assumptions.	6	12	2,3	4	4,5			
5	Diffusion in non-metals: Defects in ionic solids. Diffusion and ionic conduction, Relation between σ and D_T and effect of impurities on conductivity in crystals with Frenkel disorder. Relation of σ and D_T in AgBr (Frenkel disorder). Diffusion in semi-conductors, ordered alloys and intermetallic.	6	12	2,3	4	2,5			
6	High diffusivity Paths: Analysis of grain boundary diffusion. Dislocation effects, diffusion driven by surface tension, Determination of D_s from grain boundary grooving.	6	12	2,3	5	2,5			
7	Thermal diffusion and electrolysis in Solids	6	12	2,3	6	4,5			
8	Experimental methods for determining diffusivity. Recent developments.	6	12	2,3,6	6	5			
	TOTAL	52 Hours	100%						
Reference Books									
1	Diffusion in Solids By P. G. Shewman.								
2	Mathematics of Diffusion by Crank								

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

Programme Name: ME (Metallurgical & Materials) (Materials Technology) Regular Programme

Programme Specific Outcome (PSO)

Students will be able to

PSO 1 Understand and analyze engineering properties of various materials and able to provide the suitable material for engineering application.

PSO 2 Develop new ideas on material design with the help of best manufacturing practices.

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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			
ME (Metallurgical & Materials) (Materials Technology) Regular Programme											
Year	I	Core / Elective / Foundation Code: Subject: Corrosion and Surface Protection			Credits / Hours per week			04			
Semester	II	Year of Introduction: Year of Syllabus Revision:			Maximum Marks / Grade			100			
Mode of Transaction		Lectures and Tutorials									
Course Outcome (CO) CO1 Understand principles of electrochemistry applied to corrosion. CO2 Learn about Passivation, Potential-PH diagrams-O-H System, Kinetics of electrochemical reaction, mixed potential theory. CO3 Types of corrosion e.g. Galvanic, Pitting, Crevics, Intergranular, KLA, Selective leaching, stress ,erosion cavitation damage, fatigue, freeting, hydrogen damage. CO4 Learn about High temperature corrosion, Oxidation, Sulphidation, Ash corrosion, corrosion by molten metal & Corrosion in cooling water systems. CO5 Learn about corrosion testing methods, corrosion prevention method and corrosion resistant materials.											
Unit No.	Topic/Unit			Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/Entrepreneurs hip (Ent)/	Relevance to Local (L)/ National (N)/ Regional(R)/Glo bal (G)	Relation to Gender (G), Environment and Sustainability (ES), Human

							Skill Development (SD)	developmental needs	Values (HV)and Professional Ethics (PE)
1	General review of the principles of electrochemistry applied to corrosion such as Single Electrode Potential, E.M.F. series, Nernst equation, polarization, over potential.	05	10	1,2,3,4,5	CO1	1,2,3	Emp, Ent, SD	G	PE,HV,ES
2	Passivation, Potential-pH diagrams, Fe-O-H system. Kinetics of electrochemical reaction. Mixed potential theory.	06	12	2,3,4,5,6	CO2	2,3,4			
3	Types of corrosion, galvanic, pitting, crevices, intergranular, KLA, selective leaching.	06	12	2,3,5,6	CO3	2,3			
4	Stress corrosion, erosion corrosion. cavitation damage, corrosion fatigue and fretting corrosion, hydrogen damage.	06	12	2,3,,5,6	CO3	4,5			
5	High temperature corrosion, oxidation, sulphidation, ash corrosion, corrosion by molten metal.	06	12	2,3,5,6	CO4	2,3,4			
6	Corrosion in cooling water systems. Corrosion testing methods. Weight loss and its limitation. Electrochemical methods. Accelerated test. Simulated environment. Sulfur-dioxide test. Boiling nitric acid test. Stress test. Other practices and standards.	08	16	1,2,3,4,5	CO4, CO5	2,3			
.7	Corrosion prevention methods. Cathodic protection. Anodic protection. Inhibitors. Metallic and non-metallic coatings (anodizing, phosphating &chromatization) Cladding. Improvement in design.	06	12	2,3,4,5	CO5	3,5			
8	Corrosion resistant materials. General features and classification of a stainless steels. Various types of phase diagrams. Austenitic, martensitic, ferritic stainless steel, Ni-alloys & Cu-alloys &Ti-alloys.	07	14	1,2,3,4,5	CO5	2,5			
	TOTAL	50 Hours	100%						
Reference Books									
1	Corrosion Engineering – M. G. Fontana and H. D. Green, Mc. Graw Hill.								

2	Corrosion And Corrosion Engineering – H. H. Uhlig, John Wiley.
3	Corrosion Vol.-I, II, III, L. L. Sheir, McwancesButterwerth.
4	Water Treatment – F. I. Belan, Mir Publishers.

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Metallurgical & Materials Engineering				Academic Year		2020-21		
ME (Metallurgical & Materials) (Materials Technology) Regular Programme										
Year	I	Core / Elective / Foundation Code: Subject: Corrosion and Surface Protection Laboratory				Credits / Hours per week		02 (Practical)		
Semester	II	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	Weigh tage (%)	BT Level	CO	PSO
1	Ex – Corrosion rate measurement by weight loss method					2	15	1,2	1,2,3	1,2,3,4
2	Ex – Measurement of electrode potential by different media					2	15	2,3	3	2,3
3	Ex – Galvanic corrosion measurement					2	15	2,3	3,4,5	5
4	Ex- Electroplating					2	15	1,2,3	1,2,3	2,3,4
5	Ex – Copper Powder production					2	10	1,2,3	1,2,3,4,5	2,3
6	Ex – Anodizing of Aluminium					2	10	1,2,3	1,2,3,4,5	2,4,5
7	Ex – Study of anodic dissolution					2	10	1,2	1,2,3,4,5	2,3,4
8	Ex- Potentiodynamic testing					2	10	2,3	1,2,3,4,5	2,3,4

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

Programme Name: ME (Metallurgical & Materials) (Materials Technology) Regular Programme

Programme Specific Outcome (PSO)

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Syllabus of Courses

 सत्यं शिवं सुन्दरम्		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Metallurgical & Materials Engineering		Academic Year		2020-21				
ME (Metallurgical & Materials) (Materials Technology) Regular Programme										
Year		I	Core/ Elective / Foundation Code: MME2210 Subject: Failure Analysis		Credits / Hours per week			04		
Semester		II	Year of Introduction: Year of Syllabus Revision:		Maximum Marks / Grade			100		
Mode of Transaction			Lectures and Tutorials							
Course Outcome (CO) CO1 Understanding the Fundamentals of failure analysis CO2 Learn various types of fractures and its characteristic CO3 Learn about the high temperature failures CO4 Understand the fatigue fracture and corrosion fatigue CO5 Understand wear failure CO6 Defects in materials and their role in failure of engineering components										
Unit No.	Topic/Unit		Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurs hip (Ent)/	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human

							Skill Development (SD)	developmental needs	Values (HV)and Professional Ethics (PE)
1	Fundamentals of failure analysis: general practice in failure analysis, causes of materials failure.	6	12	1,2	1	1,2,3	Emp, Ent, SD	G	PE,HV,ES
2	Ductile and brittle fracture: Types of loading and their effect on mode of fracture. Characteristics of ductile and brittle fracture. Fracture mechanics approach to investigation of fracture mode. Theories of ductile and brittle fracture. Concept of fracture toughness and its role in failure analysis.	6	12	2,3	2	2,3,4			
3	Study of optical, scanning and transmission electron fractrographic features of ductile and brittle fracture.	6	12	2,3	2	2,3			
4	Fatigue fracture: Basic theory of fatigue. Factors affecting fatigue failure and loading conditions and types of fatigue fracture. Various forms of loading conditions and fracture appearances in fatigue. Effect of stress concentration on fatigue. Optical and electron microscopic features of fatigue. Special form of fatigue such as corrosion fatigue, thermal fatigue, contact fatigue, etc.	8	16	2,3	4	3,5			
5	Corrosion fatigue: Forms of corrosion and various mechanism of corrosion. General aspect of analysis of corrosion related failures including hydrogen embrittlement	6	12	2,3	4	2,3,4			
6	Wear failure : Types of wear. General features of wear failure. Mechanism of wear.	6	12	1,2,3	5	2,3			
7	High temperature failures : Failure of boiler and power plant related equipment. Study of various types of tube failure in thermal power plants.	6	12	2,3	3	5			
8	Defects in materials and their role in failure of engineering components. Representative case studies in failure analysis.	6	12	2,3	6	2,4,5			
	TOTAL	50 Hours	100%						
Reference Books									
1	Analysis of Metallurgical Failures - Colangelo and Heiser, ASM Publication, Ohio.								

2	Understanding How Components Fail – Donald J. Wulpi, ASM Publication, Ohio.
3	Handbook on Fractography, Vol.-10, 8 th Edition, ASM Publication, Ohio.
4	Defects and Failure of Metals – Polunskin..

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Metallurgical & Materials Engineering				Academic Year		2020-21		
ME (Metallurgical & Materials) (Materials Technology) Regular Programme										
Year	I	Core/ Elective / Foundation Code: MME2210L Subject: Failure Analysis Laboratory				Credits / Hours per week		02 (Practical)		
Semester	II	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	Weigh tage (%)	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	2,5
5	Exp:5					2	10	4,6	CO5	3,4
6	Exp:6					2	10	5,6,	CO6	3,5
7	Exp:7					2	10	4,5,6	CO6	4,5
8	Tutorial : 1					2	5	2,3,4	CO6	5
9	Tutorial :2					2	5	3,4,5	CO6	4,5

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

Programme Name: ME (Metallurgical & Materials) (Materials Technology) Regular Programme

Programme Specific Outcome (PSO)

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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			
ME (Metallurgical & Materials) (Materials Technology) Regular Programme											
Year	I	Core / Elective / Foundation Code: Subject: Fracture Mechanics			Credits / Hours per week			04			
Semester	II	Year of Introduction: Year of Syllabus Revision:			Maximum Marks / Grade			100			
Mode of Transaction		Lectures and Tutorials									
Course Outcome (CO) CO1 Understanding conventional design concept CO2 Learn mechanics of fracture and types of fracture CO3 Understanding designing and testing for fracture resistance CO4 Learn microscopic aspects of plastic deformation CO5 Learning the physical meaning of fracture toughness CO6 Learning fracture under different conditions											
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 Values (HV)and

							Development (SD)	developmental needs	Professional Ethics (PE)
1	Conventional design concepts and their relation to occurrence of fracture, inadequacies of conventional design concepts.	06	12	1,2	CO1	1,2,3	Emp, Ent, SD	G	PE,ES,HV
2	The mechanics of fracture, types of fracture, types of fracture under uniaxial testing loading, the mechanics of elastic crack propagation, the mechanics of plastically induced fracture, physical significance of fracture toughness.	06	12	1,2,3	CO2	3,4			
3	Designing and testing for fracture resistance, principles of fracture safe design, visual analysis of fracture, testing procedures, time dependent fracture.	08	16	2,3,4	CO3	4,5			
4	Microscopic aspects of plastic deformation and crack propagation, cleavage crack propagation (Mode I), normal rupture and ductile rupture.	06	12	2,3,4	CO4	4,5			
5	Cleavage crack nucleation and ductile to brittle transition, flaw- free low- strength materials.	06	12	1,2,3	CO4	3,4,6			
6	Relation between macroscopic and microscopic aspects of plane strain fracture, physical meaning of fracture toughness.	06	12	1,2,3	CO5	2,4			
7	Fracture under cyclic loading, effect of environment and temperature on fatigue.	06	12	1,2,3	CO6	3,5			
8	Fracture under static loading, creep, S.C.C., hydrogen embrittlement, fracture of steels, non-ferrous metals and composite materials as examples.	06	12	1,2,6	CO6	2,4,5			
	TOTAL	50 Hours	100%						
Reference Books									
1	An Introduction to Fracture Mechanics-Tetelman and Mc Eliue.								
2	Fatigue and Fracture Control in Structures-Rolfe.								

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Metallurgical & Materials Engineering				Academic Year		2020-21		
ME (Metallurgical & Materials) (Materials Technology) Regular Programme										
Year		I	Core / Elective / Foundation Code: Subject : Fracture Mechanics Laboratory				Credits / Hours per week		02 (Practical)	
Semester		II	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	Weigh tage (%)	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
5	Exp:5					2	10	4,6	CO5	4,5
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	3,4,5
9	Tutorial :2					2	5	3,4,5	CO6	5

Bloom's Taxonomy Levels:

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

Programme Name: ME (Metallurgical & Materials) (Materials Technology) Regular Programme**Programme Specific Outcome (PSO)**

Students 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	2020-21	
ME (Metallurgical & Materials) (Materials Technology) Regular Programme				
Year	I	Core / Elective / Foundation Code: MME2214 Subject: Powder Metallurgy	Credits / Hours per week	04
Semester	II	Year of Introduction: Year of Syllabus Revision:	Maximum Marks / Grade	100
Mode of Transaction		Lectures and Tutorials		
Course Outcome (CO) CO1 Understanding basic history of powder metallurgy CO2 Learn different methods of powder production CO3 Learn the characterization of powders CO4 Learn various powder metallurgical process CO5 Understand the sintering mechanism CO6 Applications and advances in powder 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) developmenta l needs	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	Brief review and history of developments in powder metallurgical science and technology. Scope and limitation of powder metallurgy.	06	12	1,2	CO1	1,2,3	Emp, Ent, SD	G	PE,HV,ES
2	Advanced powder and particulate production techniques- such as subsonic and ultrasonic atomization, rapid solidification process (RSP) by splat quenching, spray-coprecipitation technique, freeze-drying process, sol-gel method, spray-drying method, mechanical alloying etc.	08	16	1,2,3	CO2	2,3,4			
3	Powder characterization: Morphological characterization, crystallographic characterization and chemical characterization- a general review of fundamentals	06	12	2,3,4,5	CO3	2,3			
4	Special consolidation processes such as injection moulding, isostatic pressing, hot pressing, hot isostatic pressing, forging and rolling of powder metallurgical billets, powder extrusion, spray and plasma coating of powders, dynamic compaction processes	06	12	1,2,3	CO4	1,2,4			
5	Sintering of metal and alloy powders: Sintering practice, sintering atmosphere, sintering furnaces, atmosphere generators. Concept of solid-state sintering, liquid phase sintering, infiltration process	06	12	1,2,3	CO5	2,3,4			
6	Sintering mechanisms: Driving forces in sintering reaction and different activated sintering processes	06	12	1,2,3	CO5	2,3			
7	Application of Powder Metallurgy in cutting tools, friction and antifricition components, porous materials, dispersion strengthened alloy systems, electrical and magnetic materials, and automobile applications of Powder Metallurgy parts.	06	12	1,2,3	CO6	3,4			
8	Advance topics in Powder Metallurgy	06	12	1,2,6	CO6	5			
	TOTAL	50 Hours	100%						

Reference Books

1	Metal Handbook, Vol.-7, Powder Metallurgy, 9 th Ed.
2	Advances in Powder Metallurgy, 1981, Seminar, Edited by G. Y. Chin, ASM Ohio.
3	Powder Metallurgy-Recent Advances by V. S. Arunachanlam & O. V. Roman, Oxford & IBH Publication House, Bombay
4	R. M. German, Powder Metallurgy Sciences, MPIE, Princeton, New Jersey.
5	Powder Metallurgy by Hirshon ASM, Ohio

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Metallurgical & Materials Engineering				Academic Year		2020-21		
ME (Metallurgical & Materials) (Materials Technology) Regular Programme										
Year	I	Core / Elective / Foundation Code: MME2214L Subject : Powder MetallurgyLaboratory				Credits / Hours per week		02 (Practical)		
Semester	II	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	Weigh tage (%)	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	2,5
5	Exp:5					2	10	4,6	CO5	5
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	3,5
9	Tutorial :2					2	5	3,4,5	CO6	5

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

Programme Name: ME (Metallurgical & Materials) (Materials Technology) Regular Programme**Programme Specific Outcome (PSO)**

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 सत्यं शिवं सुन्दरम्		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Metallurgical & Materials Engineering	Academic Year	2020-21
ME (Metallurgical & Materials) (Materials Technology) Regular Programme				
Year	I	Core / Elective / Foundation Code: Subject : Surface Phenomena in Materials	Credits / Hours per week	04
Semester	II	Year of Introduction: Year of Syllabus Revision:	Maximum Marks / Grade	100
Mode of Transaction		Lectures and Tutorials		
Course Outcome (CO) CO1 Understanding basic structure of surface of solids CO2 Learn different types of surface phenomenon CO3 Learn the applications of surface science CO4 Learn various degradation of surface layer CO5 Understand the mechanical properties of oxide layers CO6 Applications of surface degradation				

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	Structure of the surface of solids. Surface Tension and Surface Energy.	06	12	1,2	CO1	1,2,3	Emp, Ent, SD	G	G, ES, HV, PE
2	Adsorption – Types of adsorption isotherms. Theories of gas adsorption. Enthalpies and entropies of adsorption. Adsorption by porous solids, chemisorption and catalysis. Reactions catalyses of surfaces of solids.	08	16	1,2,3	CO2	2,3,4			
3	Solid-liquid interface-contact angle, Surface films on solids. Surface and interfacial tension of single-phase solids. Interphase Interface, The properties and effect of grainboundries, Gel formation behavior..	06	12	2,3,4,5	CO2	2,3			
4	Application of surface science to friction, lubrication and wear. Theories and mechanisms.	06	12	1,2,3	CO3	5			
5	Chemical degradation of surfaces, formation of metal oxides. Equilibrium and kinetics, cyclic oxidation.	06	12	1,2,3	CO4	2,3,4			
6	Mechanical properties of oxide layers, Interaction between oxidation, sulfidation and carburization.	06	12	1,2,3	CO5	2,3			
7	Internal and Intergrannular oxidation of alloys. Role of oxides in abrasion, erosion and wear.	06	12	1,2,3	CO4	2,5			
8	Material degradation in gassifiers, gas turbines, coating for protection of metals, coating substrate compatibility.	06	12	1,2,6	CO6	3,4,5			
	TOTAL	50 Hours	100%						

Reference Books

1	Colloid and Interface Chemistry, R. D. Vold and M. J. Vold, Addison Wesley, 1983.
2	Imperfections in nearly perfect crystals, W. Shockley Ed, John Wiley, 1952.
3	Foundation of Colloid Science, Vol. I, R. J. Hunler, Oxford Science Pub., 1987.
4	Metallic and ceramic coatings, M. G. Hocking, Longman Scientific and Technical Pub., 1989.

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Programme Specific Outcome (PSO)

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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		
ME (Metallurgical & Materials) (Materials Technology) Regular Programme											
Year	I	Core / Elective / Foundation Code: MME2209 Subject: Metallic Materials			Credits / Hours per week				04		
Semester	II	Year of Introduction: Year of Syllabus Revision:			Maximum Marks / Grade				100		
Mode of Transaction		Lectures and Tutorials									
Course Outcome (CO) CO1 introduction to Classification of metallic materials and review of Fe-Fe ₃ C phase diagram CO2 Study of Effect of alloying element in steels CO3 Study different types of steels and cast Irons CO4 Study the special purpose alloys CO5 Understand various non ferrous metal and alloys											
Unit No.	Topic/Unit			Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurs hip (Ent)/	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human

							Skill Development (SD)	developmental needs	Values (HV)and Professional Ethics (PE)
1	Classification of metallic materials ferrous alloys: Classification based on carbon content and alloy content. Brief Review of iron-carbon diagram. Classification of steels on the basis of carbon content and alloy content.	08	16	1,2,3,4	CO1	1,3	Emp, Ent, SD	G	HV,ES,PE
2	Effect of alloying element in steels. Study of typical low-alloy steels such as spring steels, ball bearing steels, silicon steels, HSLA steels, rail steels for structural applications.	05	10	2,3,4,5	CO2	2,3,4			
3	High alloy steels: Study of typical compositions, properties and applications of stainless steels, tool steels.	05	10	2,3,4,5,6	CO3	4,5			
4	Marging steels, hadfield manganese steel and ausforming steels.	06	12	2,3,4,5,6	CO3	4,5			
5	Cast irons, their important mechanical properties. Types of cast iron such as grey cast iron, white cast iron, malleable cast iron, S.G. iron, alloy cast iron. Typical compositions & uses.	06	12	1,2,3,4,5,6	CO3	2,4			
6	Study of special purpose alloys such as nickel, cobalt and iron-base superalloys; their typical compositions, properties & applications. Basic aspects of shape memory alloys & metallic smart materials, Titanium & its alloys.	06	12	2,3,4	CO4	2,5			
7	Nonferrous metals and alloys: Properties of pure copper and purpose of alloying copper. Study of important copper alloys namely brasses & bronzes. Their types, typical composition and applications.	06	12	2,3,4,5	CO5	4,5			
8	Effect of addition of various alloying elements to aluminium. Typical compositions, properties & uses of aluminium alloys like duralumin, Y-alloy, magnalium, etc. Basic aspects of various white metals such as tin-base, Lead-base and copper-base alloys as bearing materials. Recent developments in metallic materials	08	16	1,2,3,4	CO5	4,5			
	TOTAL	50 Hours	100%						

Reference Books	
1	Michael Ashby & David Jones, Engineering Materials, Perfamon Press, 1988.
2	B.K. Agrawal, Introduction to Engineering Materials. Tata McGraw Hill Company, 1988
3	C.P. Sharma, Engineering Materials, Practice Hall of India, New Delhi, 2007.

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

Programme Name: ME (Metallurgical & Materials) (Materials Technology) Regular Programme

Programme Specific Outcome (PSO)

Students will be able to

PSO 1 Understand and analyze engineering properties of various materials and able to provide the suitable material for engineering application.

PSO 2 Develop new ideas on material design with the help of best manufacturing practices.

PSO 3 Understanding the current scenario in the field of materials and acquire expertise to find out the root cause of real world failures in materials industry.

PSO 4 Expertise in problem solving of the Material engineering field through various dissertation projects.

PSO 5 Endowed technical competency, ethics, interdisciplinary working skill and contribute society philanthropically.

Syllabus of Courses

 सत्यं शिवं सुन्दरम्	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Metallurgical & Materials Engineering	Academic Year		2020-21					
ME (Metallurgical & Materials) (Materials Technology) Regular Programme									
Year	I	Core / Elective / Foundation Code: MME2211 Subject: Thin Film Technology	Credits / Hours per week				04		
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 various pumps such as vacuum pump, mechanical pumps, diffusion pumps, getter pumps, cryogenic and cryosoption. CO2 Understand vacuum materials & Preparation of thin film. CO3 Learn about nature about thin films, condensation, nucleation and growth of thin film, thin film thickness measurements. CO4 Learn about properties & Application of thin films. CO5 Understand about magnetic and super conducting devices of thin film & Conductor and resistance material & Their application.									
Unit No.	Topic/Unit	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurs hip (Ent)/ Skill Development	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

							(SD)		Ethics (PE)
1	High vacuum technology, vacuum pumps, mechanical pumps, diffusion pumps, cryogenic and cryosorption pumps, getter pumps.	06	12	1,2,4	CO1	1,2,3	Emp, Ent, SD	G	HV,PE,ES
2	Vacuum materials, outgasing of materials-isothermal desorption, gas release by diffusion and permeation, vacuum measurements and leak detection.	08	16	2,3,4	CO2	3,4			
3	Preparation of thin film – various methods of thin film preparation, their advantages and disadvantages, evaporation of alloys, compounds and mixtures.	06	12	2,3,4,5, 6	CO2	4,5			
4	Nature of thin films, condensation, nucleation and growth of thin films, thin film thickness measurements.	06	12	2,4,5,6	CO3	4,5			
5	Properties of thin films – Mechanical, electrical and dielectric properties of thin films, Piezo resistive and ferromagnetic properties of thin films.	06	12	2,3,4,6	CO4	3,4			
6	Application of thin films – Thin film resistors, thin film capacitor, thin film active devices.	06	12	2,3,4	CO4	2,4			
7	Magnetic devices, superconducting thin films and devices. Thin films in integrated circuits.	06	12	2,3,4	CO5	3,5			
8	Conductors and resister materials and their resistivity ranges, their applications. Semiconducting materials and their fabrication. Some semiconductor devices and their applications.	06	12	3,4,5,6	CO5	2,5			
	TOTAL	50 Hours	100%						
Reference Books									
1	Thin film Phenomena, K. L. Chopra, Mc.Graw-Hill Pub. Co. N.Y.								
2	Thin film Technology and Applications, K. L. Chopra and L. K. Malhotra, McGraw-Hill, New York.								
3	Handbook of Thin film Technology, L. T. Maissel and R. Glang, McGraw-Hill, Pub. Co. New York.								
4	Active and Passive Thin Film Devices, J. J. Coutts, Academic Press.								

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Metallurgical & Materials Engineering				Academic Year		2020-21			
ME (Metallurgical & Materials) (Materials Technology) Regular Programme										
Year	I	Core / Elective / Foundation Code: MME2210L Subject: Thin Film Technology Laboratory				Credits / Hours per week		02 (Practical)		
Semester	II	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	4,5
5	Exp:5					2	10	4,6	CO5	3,5
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
9	Tutorial :2					2	5	3,4,5	CO6	5