SARDAR PATEL UNIVERSITY
Vallabh Vidyanagar, Gujarat
(Reaccredited with 'A' Grade by NAAC (CGPA 3.25)
Syllabus with effect from the Academic Year 2022-2023

PROGRAMME STRUCTURE
Master of Science in Material Science
MSc (Material Science) Semester: IV

Programme Outcome (PO) - For MSc Material Science Programme	Materials Science is an interdisciplinary subject of great importance. The syllabi in this program cover various aspects of physics, chemistry and engineering relevant to different types of materials. As the rapid progress is being made in the development of sophisticated tailor made materials of desired properties and specifications to suit specific needs, this program will help the students to be technologically sound with the scientific knowledge of chemical and physical sciences.
Programme Specific Outcome (PSO) - For MSc Material Science	This program will help the students ➢ to strengthen their knowledge on the fundamental aspects of materials science ➢ to acquire knowledge on the properties of different types of materials ➢ to get acquainted with different experimental and technical methods used for the characterization of materials ➢ the area of applications where different tailor made materials can be used.

To Pass	At least 40% Marks in the University Examination in each paper and 40% Marks in the aggregate of University and Internal examination in each course of Theory , Practical & 40% Marks in Viva-voce.

Course Type	Course Code	Name Of Course	Theory/ Practical	Credit	Exam Duration in hrs	Component of Marks		
						Internal Total	External Total	Total Total
Core Course	PS04CMTS51	Engineering Polymers	T	4	3	30	70	100
	PS04CMTS52	Selected Topics in Nanoscience and Nanotechnology	T	4	3	30	70	100
	PS04CMTS53	Optical, Magnetic and Dielectric Properties of Materials	T	4	3	30	70	100
	PS04CMTS54	Project Work		8	12	30	70	100
	PS04CMTS55	Comprehensive Viva		1	-	-	50	50
Elective Course (Any One)	PS04EMTS51	Materials and Environment	T	4	3	30	70	100
	PS04EMTS52	Ceramic Technology	T	4	3	30	70	100

Master of Science – Materials Science

(M.Sc.) (Materials Science) Semester –IV

Course Code	PS04CMTS51	Title of the Course	Engineering Polymers
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	1.Structure, synthesis, characterization, propertie, application and processing parameters of polymer blends, engineering plastics, ion exchange resins, conducting polymers and bio-implants

Course Content		
Unit	Description	Weightage* (%)
1.	Introduction, types and methods for preparation, characterization and applications of polyblends, alloys and Inter penetrating polymer networks with PMR 15 and Thermid 600 based IPNs for advanced applications.	25%
2.	Adhesive bonding, theories of adhesion, requirements for a good bond, mechanism of bond failure, types of adhesives, surface preparation, primers and adhesion promotors, role of surfactants and other additives in adhesives, coatings, paints, commercial adhesives based on casein, starch, polyvinyl alcohol, rubber based adhesives, high temperature adhesives, hot melt adhesive, pressure sensitive adhesives.	25%
3.	Structures, synthesis, properties and applications of selected engineering plastics such as, polyphenylene, poly (Phenylene oxide)s, poly (ether ketone)s, polyimides, polyamide-imide, poly(phenylenesulfide)s, polysulfones, poly ether-imides, Polycarbonates, Polybutylene terephthalates, polyacetals, polymeric adsorbents, polymer electrolyte membrane, selected heterocyclic polymers.	25%
4.	Polymers for miscellaneous applications: Action of ion exchange resins, ion exchange chromatography, ion exchange in organic and aqueous organic solvents, chelating ion exchange resins, liquid ion exchange resins. Insulating polymers, semiconducting polymers, semiconducting and metallic conjugated polymers, other highly conductive polymers, method of preparation, applications of conducting polymer. Classes of biomedical materials, biocompatibility of biomedical materials, biocompatibility tests, selected polymer based bio-implants, recycling of polymers.	25%

Teaching-Learning Methodology	Group discussion/ Panel/Presentation

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learnerwill be able to	
1.	Get thorough knowledge of engineering polymeric materials used in advanced applications

Suggested References:	
Sr. No.	References
1.	Fundamentals of plastics and Elastomers by C. A. Happers
2.	Plastic Materials by J. A. Brydson
3.	Handbook of adhesive tech by Pizzi, A , Mittal K. A
4.	Textbook of quantitative chemical analysis by A.I. Vogel
5.	Electrochemistry of conducting polymers by J.Plocharski and S. Roth.
6.	Biomaterials Science & Engineering by John Bupark.
7.	Surfactants in polymers, coatings, inks and adhesives,vol 1 by david R. Karsa
8.	Advances in polymeric science by Sinha Pandey Kumar Kumar

On-line resources to be used if available as reference material
On-line Resources
Polymers: concepts, properties, uses and sustainability, Prof. Abhijit P Deshpande, IITM https://nptel.ac.in/courses/103/106/105106205/

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Master of Science – Materials Science

(M.Sc.)(Materials Science) Semester –IV

Course Code	PS04CMTS52	Title of the Course	Selected Topics in Nanoscience and Nanotechnology
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To make aware with Nano things of science and technology 2. To correlate the bulk and nano level phenomena and properties 3. To get knowledge on new techniques for nanomaterials synthesis and characterization

Course Content		
Unit	Description	Weightage* (%)
1.	Nanoscience, Nanotechnology, Nanomaterials, Nanostructure and bulk materials, Zero dimensional, one dimensional, two dimensional materials nanomaterials, Surface to volume ratio, Nanoparticles, Nanofibers, Thin films, Characterization techniques for nanomaterials Quantum confinement and materials	25
2.	Top-down and bottom-up approach, Fabrication of Nanomaterials, Mechanical techniques, Thermal techniques, Techniques for nanostructured materials, Physical vapour deposition, Chemical vapour deposition, Lithography, Template method, Mechanical properties, Thermal properties, Surface properties and Optical properties of nanomaterials	25
3.	Carbon nanomaterials, Third allotrope of carbon - fullerenes, Discovery of fullerene and carbon nanotubes, Preparation of carbon nanotubes, Structure carbon nanotubes, Various properties of carbon nanotubes, Important applications of carbon nanotubes, Graphene	25
4.	Fabrication of nanocomposites, Microfillers and nanofillers, Nanofibers and their composites, Nanoclays-polymer nanocomposites, Preparation, characterization and industrial applications, Polymer nanocomposite coatings, Functionalization of CNTs, Carbon nanocomposites, Ceramic nanocomposites, Current topics	25

Teaching-Learning Methodology	Group discussion/ Panel/Presentation

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Students will be benefited by enhancing knowledge on nanomaterials, which is strongly associated with emerging field in Materials Science.
2.	Students will have more scope to shape up their future at leading research centers and industries.
3.	Get new idea for recent concept in atomic level science.

Suggested References:	
Sr. No.	References
1.	Handbook of Nanophase Materials by Avery N. Goldstein
2.	Nanotechnology by Gregory Timp
3.	Nanostructured Materials by Carl C. Koch
4.	Introduction to Nanotechnology by Chrles P. Poole & F. J. Owens
5.	Polymer Nanocomposites Coatings by Vikas Mittal
6.	Nanostructures & Nanomaterials: Synthesis, Properties and Applications by Guozhong Cao

On-line resources to be used if available as reference material
On-line Resources
https://www.understandingnano.com/resources.html
https://nptel.ac.in/courses/113/106/113106093/

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Master of Science – Materials Science

(M.Sc.)(Materials Science) Semester –IV

Course Code	PS04CMTS53	Title of the Course	Optical, Magnetic and Dielectric Properties of Materials
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	1.To get familiar with different physical properties of materials and theories behind them

Course Content		
Unit	Description	Weightage* (%)
1.	Electromagnetic radiation, interaction of light with matter, atomic and electronic interactions, optical properties of metals and non-metals, reflection, refraction, transmission and absorption, dark and photo conductivity.	25%
2.	Introduction, classification of materials based on electrical conductivity, dielectric properties of materials, dielectric constant, strength and loss factor, capacitance and capacitors, field vector and polarization, types of polarization. Concept of symmetry, classification of materials based on symmetry, piezoelectric and converse effect, piezoelectric materials, pyroelectricity and pyroelectric materials, ferroelectricity, ferroelectric materials and antiferroelectric materials	25%
3.	Introduction and basic concepts, magnetic dipoles and field vectors, magnetic induction, magnetization and magnetic susceptibility. Origin of magnetic moments, magnetic moments of body, magnetic moments of atoms, calculation of atomic magnetic moments, Bohr magnetron.	25%
4.	Classification of magnetic materials, magnetic domains and walls, hysteresis, classification into soft and hard magnetic materials, applications, influence of temperature on magneticbehavior.	25%

Teaching-Learning Methodology	Group discussion/ Panel/Presentation

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learnerwill be able to	
1.	Follow the reasons behind different behaviour exhibited by materials
2.	Distinguish between electrical, optical as well as magnetic properties shown by different materials
3.	Select different materials for the application in hand

Suggested References:	
Sr. No.	References
1.	Materials Science and Engineering by William D. Callister Jr.and P.Leaver
2.	An Introduction Materials Science for Engineering by J.C.Anderson, ,K.D.Leaver, R.D.Rawllings
3.	Materials Science by Manas Chandra

On-line resources to be used if available as reference material
On-line Resources
Electromagnetism, Prof. Nirmal Ganguli, IISER Bhopal https://nptel.ac.in/courses/115/106/115106122/

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Master of Science – Materials Science

(M.Sc.)(Materials Science) Semester –IV

Course Code	PS04CMTS54	Title of the Course	Project Work
Total Credits of the Course	8	Hours per Week	12

Course Objectives:	1. To develop knowledge and skill through lab experience 2. To inculcateexperiential learning 3. To educate with advanced synthesis and characterization techniques for materials

Course Content		
Unit	Description	Weightage* (%)
1.	The students are assigned an individual/group research project. Under the project, the students have to carry out thorough literature survey using library, internet and available literature in the department. They have to carry out various experiments including testing and characterization using various sophisticated instruments. These findings are compiled in the form of a dissertation to be evaluated by the External examiner for the partial fulfillment of M.Sc. degree.	100%

Teaching-Learning Methodology	Demonstration/Group discussion/ Panel/Hands on training

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Do experimental study on materials synthesis and characterization
2.	Learn data interpretation, instrumental techniques and Hands-on training/demonstration
3.	Improvetheir skillfor analysis of different materials

Suggested References:	
Sr. No.	References
1.	Students have to carry out thorough literature survey using library, internet and available literature in the Department.

On-line resources to be used if available as reference material
On-line Resources
Students are using INFLIBNET facility in the Department for On line referencing.

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Master of Science – Materials Science

(M.Sc.)(Materials Science) Semester –IV

Course Code	PS04CMTS55	Title of the Course	Comprehensive Viva
Total Credits of the Course	1	Hours per Week	1 hr

Course Objectives:	1.

Course Content		
Unit	Description	Weightage* (%)
1.	Students have to appear for viva voce examination	100%

Teaching-Learning Methodology	

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	
2.	

Suggested References:	
Sr. No.	References
1.	
2.	
3.	
4.	

On-line resources to be used if available as reference material
On-line Resources

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Master of Science – Materials Science

(M.Sc.)(Materials Science) Semester –IV

Course Code	PS04EMTS51	Title of the Course	Materials and Environment
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	1. Concept of environmental pollution related to air, water, solid waste 2. Attack by radiation, microbes etc. 3. Effect of insects rodents in packaging

Course Content		
Unit	Description	Weightage* (%)
1.	Introduction to Environmental pollution, atmospheric pollutants, source of air pollutions, water pollution. Industrial effluents, pollution due to sewage and sludge, pesticides pollution, solid waste problems, metal pollutants, Environmental carcinogens, control of pollution.	25%
2.	Weathering, Air and Moisture, Radiation and heat, Pollutants, Microbial degradations, Control of deterioration, thermal protection, Optical properties, solar cells, lubrication, sublimation/ evaporation, loss of materials, Thermal Shock. Electrochemical nature of corrosion, Concepts of reaction at an electrodes. Nernst equation. Tafel equation and polarisation. Corrosion velocities, Bimetallic effects. Differential aeration, Pourbaix diagrams, Formulation of stainless steels. Corrosion of Iron, Zinc, Aluminium, Co-operation and selected alloys. Protection against corrosion.	25%
3.	Packing, Insect proof packaging, Rodent proof packing, Air Conditioning, Constant damp heat and cyclic damp heat, humidity and cycles of humidity, Isolation from environment radiations.	25%
4.	Trends in waste generation, maximum energy recovery from furnaces, recovery of waste Materials and raw materials from plants components, waste commission for energy recovery, economic refractory, control and Instrumentation, measuring and measuring devices.	25%

Teaching-Learning Methodology	Group discussion/ Panel/Presentation

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	After studying this course, student can able to understand the concepts of green environment with minimum waste, side effects and high rate of production.
2.	Knowledge will be useful for the individual and for society at home and outside the home

Suggested References:	
Sr. No.	References
1.	Theory of corrosion and protection of metals, Tomashov N. D.
2.	Corrosion engineering - M. G. Fontana
3.	Science of Engineering Materials – Manas Chanda
4.	Waste recycling for energy conservation – Davidkut and Gerard Nare

On-line resources to be used if available as reference material
On-line Resources
https://babel.hathitrust.org/cgi/pt?id=uc1.31210023605015&view=1up&seq=1
https://www.britannica.com/science/water-pollution
https://nptel.ac.in/courses/113/104/113104061/
https://nptel.ac.in/courses/122/106/122106030/

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Master of Science – Materials Science

(M.Sc.)(Materials Science) Semester –IV

Course Code	PS04EMTS52	Title of the Course	Ceramic Technology
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To improve knowledge in ceramic processing and product development 2. To get updated with novel manufacturing techniques for ceramics 3. To provide information on use of advanced ceramic materials

Course Content		
Unit	Description	Weightage* (%)
1.	Raw to powder ceramics, Laws of size reduction, Processing of traditional ceramics, Ball milling, Crushing, Pug mill, Planetary mill, Filter press, Cake forming, Mechanical press, Jigger and Jolly process, Hydraulic press, Pascal's law, Spray drying	25
2.	Pressing techniques: Dry and wet pressing, Die pressing, Isostatic Pressing, CIP and HIP, Extrusion, Injection moulding, Casting: Slip, Gel and Tape casting, Tiles manufacturing	25
3.	Advanced non-oxide and oxide ceramics processing, Additives, Flocculation, Lubricants, Binders, Firing, Porosity and sintering, Glazing raw materials, Glazing techniques, Defects of glazing, Powder preparation by Important techniques, Waste materials, Thermal processing, CVD, CVR, CVI, Polymer pyrolysis, Plasma processing	25
4.	Glass Processing, Characterization and industrial applications of Glass and Ceramics, Bioceramics and applications, Optical properties, Mechanical properties, Tribological properties of ceramics, Mechanisms of tribological wear	25

Teaching-Learning Methodology	Group discussion/ Panel/Presentation

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Get additional technological knowledge on ceramic products and it can open the gateway to become entrepreneurs.
2.	Students will get opportunity to build their career at ceramic based industries and at research centers.
3.	Enhance knowledge in ceramic processing for industrial products.

Suggested References:	
Sr. No.	References
1.	Science of Engineering Materials by Manas Chanda
2.	Ceramic Science for Materials Technologists by I. J. McColm
3.	Industrial Ceramic by F. Singer, S. Singer
4.	Handbook of Ceramics by S. Kumar

On-line resources to be used if available as reference material
On-line Resources
https://www.cgcri.res.in/students/
https://ceramics.org/about/what-are-engineered-ceramics-and-glass
https://matmatch.com/learn/material/glass-ceramics

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