SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

M.Sc. (Materials Science) Semester-I

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	**P2S01NCMAT01**	Basic Concepts and Interfacial Aspects of Materials Science	4-0-1	120	04

- **Course Learning Outcomes (CLOs)**

On completion of this course, students will be able to:

CLO1. Apply materials science concepts and Indian Knowledge System classification to analyze structure–processing–property relationships for sustainable material selection in engineering applications.

CLO2. Analyse principles of surface and interface science to understand surface energy, traditional coating and paints and surface characteristics, as well as evaluate the effect of surface modification and environmental factors on material performance and applications.

CLO3. Evaluate tribological behaviour of materials by understanding friction, wear, adhesion, and lubrication mechanisms, and evaluate the influence of surface energy, contact conditions, and environmental factors on material performance.

CLO4. Investigate adsorption–desorption processes and catalytic behaviour by applying theories such as Langmuir and BET, and relate surface properties, nanocatalysts, and material characteristics to catalytic performance and applications.

CLO5. Integrate concepts of materials science, surface and interface phenomena, tribology, and catalysis to evaluate material behaviour, surface interactions, and performance for engineering and industrial applications.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	**Basic Concepts** Ancient Indian classification of materials (Panchamahabhuta framework), Introduction to Materials and Materials Science, Extensive study of traditional materials. Type of Materials, Functional classification of materials, Smart materials, Properties of materials, Processing of materials, Structure-property-processing relationship. Environmental effect of Materials behaviour, Materials selection, Nanomaterials and their applications, Biomaterials and sustainable materials.	CL, CBL, PBL, Self-Directed Learning, ICT-Enabled Learning	CLO1 CLO5

M.Sc. (Materials Science) Semester-I

II	**Surface Science** Surface of materials, Interface, Phase, Interphase, Surface science and engineering in ancient India, Surface energy and surface tension, Factors affecting surface tension, Surface active agents-surfactants, Classification of surfactants. Surface chemistry, Contact angle, Structural evolution and levels of structure, Surface modification, Surface morphology and topography, Surface roughness and measurement, Traditional coatings and paints, Environmental effects on surface properties.	CL, Seminar, CBL, ICT-Enabled Learning, Experiential Learning, Research-Oriented Learning, Industrial Visit	CLO1 CLO2 CLO5
III	**Tribology: Friction, Adhesion, Wear and Lubrication** Brief history, Historical development of tribology in Indian systems, Tribology, Friction, Laws of friction and their interpretation, Adhesion between two dry solids, Low surface energy and high surface energy materials. Methods of achieving surface contact, Liquid-solid interface, Wetting characteristics, Young's equation. Wear of materials including metals, ceramics, polymers and their testing, Types of wear, Influence of environmental aspects, Lubrication, Types of Lubricants, Boundary and hydrodynamic theory.	CL, CBL, PBL, Collaborative Learning, Inquiry-Based Learning, ICT-Enabled Learning	CLO1 CLO3 CLO5
IV	**Adsorption and Catalysis** Adsorption-Desorption, Adsorption of gases by solids, Adsorption mechanism, Langmuir, BET and other theories-surface area, pore size and pore volume, Isotherms, Physisorption and Chemisorption, Traditional adsorption materials. Catalyst, Types of catalysts, Materials Science and catalysis, Role of different materials for catalysis, TOF and TON, Nanocatalyst, Applications of catalysts, Catalysis in ancient Indian processes.	CL, Seminar, CBL, PBL, ICT-Enabled Learning, Self-directed learning	CLO1 CLO4 CLO5

- **(*) Learning Pedagogies/Methods**

(a) Classroom Lecture (CL)
(b) Seminars (Student-led and Faculty-moderated)
(c) Case-Based Learning (CBL)
(d) Industrial Visit/Field Visit/Institutional Visit
(e) Problem-Based Learning (PBL)
(f) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)
(g) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)
(h) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)
(i) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)
(j) Inquiry-Based Learning
(k) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)

M.Sc. (Materials Science) Semester-I

- **Assessment Methodologies**

(A) Internal Assessment (50 marks)

a. Internal Formative assessment (25 marks)

(a) Assignment
(b) Seminar/Presentation
(c) Quiz
(d) Class regularity

b. Internal Summative Assessment (25 marks)

(a) Mid-term test

(B) Weightage of Learning Efforts for External Assessment (50 marks)

(a) Term End test

Unit	Aligned COs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
I	CLO1 CLO5	30	1	1	11	13
II	CLO1 CLO2 CLO5	32	1	1	10	12
III	CLO1 CLO3 CLO5	28	1	1	10	12
IV	CLO1 CLO4 CLO5	30	1	1	11	13
		120	**04**	**04**	**42**	**50**

- **Assessment and Evaluation**

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Seminars/Assignments, Self-learning, Quizzes, Class Regularity, Mid-term test	50
2	End-Semester Examination	Written Exam	50

(C) CLOs – PLOs Matrix

CLO	PLO											
	PLO 1	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PLO 6**	**PLO 7**	**PLO 8**	**PLO 9**	**PLO 10**	**PLO 11**	**PLO 12**
CLO1	3	3	-	2	-	2	-	3	3	3	2	2
CLO2	3	3	-	2	-	3	1	3	3	3	2	2
CLO3	3	3	-	-	-	2	1	2	2	3	2	2
CLO4	3	3	-	-	-	2	2	2	3	3	3	2
CLO5	3	3	1	1	-	3	2	3	3	3	3	3

Values to **CLO-PLO** matrix are assigned **by judging the importance of the particular CLO** in relation to the **PLOs**.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

- **Suggested Learning Materials Books:**

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	The Science and Engineering of Materials	Donald R. Askeland, Pradeep P. Fulay, Wendelin J. Wright	6th Edition/2010	Cengage Learning
2	Chemistry of Advanced Materials	Calista Rivers	1st Edition/2025	Brilliance Publications
3	Biomaterials	J. S. Temenoff, A. G. Mikos	1st Edition/ 2008	Pearson Education
4	Foundations of Materials Science and Engineering	Julie Barker	2023	Willford Press
5	Porous Materials: Processing and Applications	P.S. Liu and G.F. Chen	2014	Butterworth-Heinemann
6	Materials Science and Engineering: An Introduction	W. D. Callister and D. G. Rethwisch	2018	Wiley
7	Handbook of Adhesion	D.E Packham	2005	John Wiley & Sons
8	Solid Lubrication: Fundamentals and Applications	K. Miyoshi	2001	Marcel Dekker Inc.

9	Catalysis: Principles and Applications	B. Viswanathan, S. Sivasanker, A. V. Ramaswamy	2002	Narosa Publishing House Pvt. Ltd.
10	Indian Knowledge System of Materials in Science and Technology	Dr. Ravindra Singh Rana, Dr. Rajesh Purohit, Dr. Manish Vishwakarma, Dr. Vimlesh Kumar Soni, Dr. Satish Pal Singh Rajput	2023	Walnut Publication

- **Online Resources (Open Source)**

Sr. No.	Description of Resource(s)	Weblink
1	Video presentation - Introduction to Materials Science and Engineering	https://nptel.ac.in/courses/113102080
2	Video presentation - Properties of Materials	https://nptel.ac.in/courses/113104096
3	Video presentation - Mechanical behaviour of Materials	https://nptel.ac.in/courses/113104636
4	Surface tension wetting and contact angle	https://www.teachengineering.org/lessons/view/duk_surfacetensionunit_less3
5	Tribology and various type of frictions with Stribeck curve	https://www.machinerylubrication.com/tribology-31340
6	Friction and Lubrication	https://egyankosh.ac.in/bitstream/123456789/93806/1/Unit-10.pdf
7	Video presentation - Adsorption science and technology	https://nptel.ac.in/courses/103105461
8	BET surface area analysis	https://www.iitk.ac.in/che/PG_research_lab/pdf/resources/BET-TPX-Chemi-reading-material.pdf

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NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

M.Sc. (Materials Science) Semester-I

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	**P2S01NCMAT02**	Crystal Growth and Thin Film Materials	4-0-0	120	04

- **Course Learning Outcomes (CLOs)**

On completion of this course, students will be able to:

CLO1. Explain fundamental concepts of crystallography, including crystal structures, symmetry, lattice systems, Miller indices and reciprocal lattice.

CLO2. Analyse crystal defects and diffusion mechanisms in solids, including dislocations, grain boundaries and Fick's laws and evaluate their influence on material properties.

CLO3. Evaluate and compare various crystal growth techniques such as Bridgman, Czochralski, zone melting and vapor transport methods for material synthesis using modern and ancient knowledge.

CLO4. Interpret and apply vacuum technology, including vacuum generation, measurement, leak detection and substrate preparation for thin film deposition processes.

CLO5. Apply knowledge of thin film deposition techniques (PVD, CVD, MBE etc.) and analyse film growth mechanisms, thickness control, adhesion and electrical properties.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	**Fundamental Concepts of Crystal** Crystal lattice, Unit Cell, Bravais lattice, Lattice planes and direction, 2D and 3D crystal systems, Miller Indices and zone axis, Crystal symmetry, Direct and reciprocal lattice, Space and point group, Stereographic and gnomonic projection. Fundamental of defect, Type of defect, Diffusion in solids, Fick's law. Edge, screw and mixed, Frank read source, Grain boundaries, Twin boundaries and stacking faults, Observation of dislocation.	CL, PBL, CBL, Seminars, Micro-Projects, Research-Oriented Learning, ICT	CLO1 CLO2
II	**Classification of Crystal Growth Processes** Ancient "SPHATIKA"(crystal) formation techniques, Bridgman-Stockbarger technique, Czochralski technique, Zone-melting technique, zone-movement technique, Other crucible-less techniques. Growth by vapour sublimation condensation, direct and indirect vapour transport, Flame-fusion technique, Rotary crystallizer, Holden's rotary crystallizer.	CL, Experiential Learning, Field Visit, Simulation, Collaborative Learning	CLO3

M.Sc. (Materials Science) Semester-I

III	**Introduction of Vacuum Technology** Vacuum pumps, Oil sealed rotary pump, Oil diffusion pump, Adsorption and absorption, Sorption pumps, Getter pumps, Vacuum leak and Leak detection, Test and repair. Vacuum measurements, Vacuum gauges (direct and indirect) used for vacuum measurements. Substrate, Substrate function and its importance, Substrate materials and selection, Substrate cleaning methods.	CL, PBL, Research-Oriented Learning, Collaborative Learning	CLO4
IV	**Thin Film Growth** Ancient Indian gilding, Vark Making, Evaporation of compounds alloys and mixtures, Special film evaporation techniques, Flash evaporation techniques, Solution and wet chemical methods, Physical vapor deposition (PVD), Chemical vapor deposition (CVD, PECVD), Molecular beam epitaxy (MBE) techniques. Condensation, Nucleation and growth of continuous thin films, Film thickness and its importance and impact on properties, Deposition rate control, Adhesion and its importance, Methods of measurement of adhesion, Electrical properties of thin films.	CL, Mini Research Tasks, Field Visit, Research-Oriented Learning	CLO5

- **(*) Learning Pedagogies/Methods**

(a) Classroom Lecture (CL)
(b) Seminars (Student-led and Faculty-moderated)
(c) Case-Based Learning (CBL)
(d) Micro-Projects
(e) Field Visit
(f) Problem-Based Learning (PBL)
(g) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)
(h) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)
(i) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)
(j) Simulation (Academic, Professional, or Policy-based Scenarios)
(k) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)

- **Assessment Methodologies**

(A) Internal Assessment (50 Marks)

a. Internal Formative assessment (25 marks)

(a) Assignment
(b) Seminar/Presentation
(c) Quiz
(d) Class regularity

b. Internal Summative Assessment (25 marks)

(a) Mid-term tests

(B) Weightage of Learning Efforts for External Assessment (50 Marks)

(a) Term End Test

Unit	Aligned CLOs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Analyse & above (A)	
I	CLO1 CLO2	33	1	1	11	13
II	CLO3	29	1	1	10	12
III	CLO4	28	1	1	09	11
IV	CLO5	30	1	1	12	14
		120	**04**	**04**	**42**	**50**

- **Assessment and Evaluation**

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Seminars/Assignments, Self-learning, Quizzes, Class Regularity, Mid-term test	50
2	End-Semester Examination	Written Exam	50

- **CLOs – PLOs Matrix**

CLO	PLO											
	PLO 1	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PLO 6**	**PLO 7**	**PLO 8**	**PLO 9**	**PLO 10**	**PLO 11**	**PLO 12**
CLO1	3	2	-	-	3	3	-	-	3	3	2	1
CLO2	3	3	3	-	2	2	-	3	3	3	2	2
CLO3	3	3	3	-	3	3	-	3	3	2	3	2
CLO4	3	2	2	-	3	2	-	2	3	2	2	3
CLO5	3	3	3	-	3	3	2	3	3	3	3	3

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M.Sc. (Materials Science) Semester-I

Values to **CLO-PLO** matrix are assigned **by judging the importance of the particular CLO** in relation to the **PLOs**.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

- **Suggested Learning Materials Books:**

Sr.No.	Title	Author(s)	Edition/Year	Publisher
1	Materials Science for Engineers	L. H. Van Vlack	1970	Addison- Wesley
2	Crystal Growth Processes	J. C. Brice, J. C. Brice	1986	Blackie
3	The Science and Engineering of Materials	D.R. Askeland, P. R. Fulay & W. J. Wright	2010	Cengage Learning, Stamford, CT, USA
4	Science of Engineering Materials (Vol. 2) Materials	Manas Chanda	1981	Macmillan Press
5	Introduction to Crystallography	B. D. Cullity	2nd/1978, 3rd/2001	Prentice Hall
6	Vacuum science and Technology (Vol. 1)	V. V. Rao, T. B. Gosh, & K. L. Chopra	1998	Allied Publishers
7	Handbook of Thin Film Technology	R. Glang, L. I. Maissel	1970	McGraw- Hill
8	Thin film phenomena	K. L. Chopra	1979	R. E. Krieger Publishing

- **Online Resources (Open Source)**

Sr. No.	Description of Resource(s)	Weblink
1	Video Source: Introduction to Crystallography –Part-1	https://ocw.mit.edu/courses/3-60-symmetry-structure-and-tensor-properties-of-materials-fall-2005/resources/introduction-to-crystallography-part-1/
2	Video Source: Chemical Crystallography	https://onlinecourses.nptel.ac.in/noc22_cy48/preview
3	Video Source: Vacuum Technology & Process Application	https://nptel.ac.in/courses/127105231
4	Video Source: Nanoelectronics: Devices and Materials	http://digimat.in/nptel/courses/video/117108047/L36.html
5	Video Source: Lecture Series on VLSI Design	https://www.youtube.com/watch?v=S3e7BHBrOhk

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M.Sc. (Materials Science) Semester-I

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	**P2S01NCMAT03**	Polymer Science	4-0-0	120	04

- **Course Learning Outcomes (CLOs)**

On completion of this course, students will be able to:

CLO1. Explain the structure, classification and synthesis of monomers and polymers along with their fundamental properties.

CLO2. Describe the relationship between the chemical structure of monomers, physical and chemical properties of polymers.

CLO3. Demonstrate major polymerization techniques and evaluate their suitability for scientific, domestic and industrial applications.

CLO4. Apply various polymer characterization techniques to determine the structure and properties of polymers.

CLO5. Design and select appropriate methods for the preparation, modification and applications of polymers.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	**Basics of Polymers** Introduction to polymers, Ancient polymers, Monomers, Functionality. Degree of polymerizations, Classification of polymers, Polymerization and copolymerization methods and their kinetics, Glass transition, Melting transition, Criteria for rubberiness. Concept of intermolecular order: Amorphous, Crystalline orientation states, Factors affecting crystallinity, Crystalline transition, Effect of morphology on polymer properties.	CL, Seminars, ICT, Self-directed learning, PBL	CLO1 CLO2 CLO3
II	**Bonding, Reactivity and Rheological Properties of Polymers** Chemical bonds, Polymer solubility, Chemical reactivity. Effect of thermal, Photochemical and high-energy radiation, Aging and weathering, Diffusion and permeability, Toxicity. Rheoproperties such as stress and strain, Ideal elastic solid, Newtonian and non-Newtonian fluid, Apparent viscosity. The power law, Molecular hole concept, Weissenberg effect. Measurement of flow, Melt fracture, Time-dependent flow, Viscoelastic material and its mechanical model, Relaxation, Hysteresis and creep.	CL, Seminars, ICT, Self-directed learning, PBL	CLO2 CLO3 CLO4

M.Sc. (Materials Science) Semester-I

III	**Industrial Polymers: Thermoplastics, Thermosets, Elastomers and Biopolymers** Commodity and general-purpose thermoplastics: PE, PP, PS, PVC, Polyesters, Acrylic, PU polymers. Engineering Plastics: Nylon, PC, PBT, PSU, PPO, ABS, Fluoropolymers. Thermosetting polymers: Polyurethane, PF, MF, UF, Epoxy, Unsaturated polyester, Alkyds. Natural and synthetic rubbers: Recovery of NR hydrocarbon from latex; SBR, Nitrile, CR, CSM, EPDM, IIR, BR, Silicone, TPE, Speciality plastics: PEK, PEEK, PPS, PSU, PES, etc. Biopolymers such as PLA, PHA/PHB.	CL, Seminars, ICT, Self-directed learning, PBL	CLO2 CLO4 CLO5
IV	**Manufacturing Techniques for Plastics and Fibers** Compression moulding, Transfer moulding, Injection moulding, Blow moulding, Reaction injection moulding, Filament winding, SMC, BMC, DMC, Extrusion, Pultrusion, Calendaring, Rotational moulding, Thermoforming, Powder coating. Rubber processing in a two-roll mill, Internal mixer, Twin screw extruder. Commercial fiber-forming polymers like poly (ethylene terephthalate), Nylon 6, 11, 12, 66, 610, 612, Acrylics, Polyacrylonitrile, Polyethene, Polypropylene, Elastomeric fibers, Polyvinyl chloride, and Aramid fiber.	CL, Seminars, ICT, Self-directed learning, PBL	CLO2 CLO4 CLO5

- **(*) Learning Pedagogies/Methods**

  (a) Classroom Lecture (CL)
  (b) Seminars (Student-led and Faculty-moderated)
  (c) Problem-Based Learning (PBL)
  (d) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)
  (e) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)

- **Assessment Methodologies**

(A) Internal Assessment (50 Marks)

a. Internal Formative assessment (25 marks)

(a) Assignment
(b) Seminar/Presentation
(c) Quiz
(d) Class regularity

b. Internal Summative Assessment (25 marks)

(a) Mid-term test

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M.Sc. (Materials Science) Semester-I

(B) Weightage of Learning Efforts for External Assessment (50 Marks)

(a) Term End Test

Unit	Aligned Cos	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
I	CLO1 CLO2 CLO3	30	1	1	10	12
II	CLO2 CLO3 CLO4	32	1	1	11	13
III	CLO2 CLO4 CLO5	28	1	1	10	12
IV	CLO2 CLO4 CLO5	30	1	1	11	13
		120	**04**	**04**	**42**	**50**

- **Assessment and Evaluation**

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Seminars, Assignments, Quizzes, Class Regularity, Mid-term test	50
2	End-Semester Examination	Written Exam	50

(C) CLOs – PLOs Matrix

CLO	PLO											
	PLO 1	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PLO 6**	**PLO 7**	**PLO 8**	**PLO 9**	**PLO 10**	**PLO 11**	**PLO 12**
CLO1	2	2	–	2	1	–	–	–	3	1	–	–
CLO2	3	3	1	3	–	–	–	2	–	2	–	–
CLO3	2	2	–	3	2	–	1	2	1	2	–	–
CLO4	2	2	–	2	1	3	–	1	–	2	2	2
CLO5	3	2	1	3	3	2	2	2	1	3	2	2

Values to **CLO-PLO** matrix are assigned **by judging the importance of the particular CLO** in relation to the **PLOs**.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

M.Sc. (Materials Science) Semester-I

- **Suggested Learning Materials Books:**

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Polymer science	V.R.Gowariker, N.V. Viswanathan and J. Sreedhar	1986	New Age International
2	Polymer science and technology	P. Ghosh	2013	Tata McGraw-Hill Education
3	Plastics: Materials and Processing.	A. B. Strong	2006	United Kingdom: Pearson Prentice Hall
4	Plastics Materials	J. A. Brydson	6th Edition/2013	United Kingdom: Elsevier Science
5	Production of Synthetic Fibers	A. A. Vaidya	1988	Prentice-Hall of India Private Limited
6	Fundamentals of Polymer Science and Technology	S.D. Dala	2019	Lap Lambert Academic Publishing

- **Online Resources (Open Source)**

Sr. No.	Description of Resource(s)	Weblink
1	Video source: Introduction to Polymer Science	https://nptel.ac.in/courses/104/105/104105124
2	Video source: Processing of Polymers and Polymer Composites	https://nptel.ac.in/courses/112/107/112107221
3	Video source: Polymers, Concepts, Properties, Uses and Sustainability	https://onlinecourses.nptel.ac.in/noc24_ch50/preview

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M.Sc. (Materials Science) Semester-I

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	**P2S01NCMAT04**	Practical-I	0-8-0	120	04

- **Course Learning Outcomes (CLOs)**

On completion of this course, students will be able to:

CLO1. Operate vacuum coating unit and understand thin film deposition process.
CLO2. Perform crystal growth and structural analysis by electron diffraction and X-ray diffractogram.
CLO3. Evaluate mechanical property of metals and polymer. (Creep behaviour under controlled conditions).
CLO4. Evaluate electrical properties of materials and semiconductors through experiments including I–V characteristics, Hall effect, resistivity measurements, and band gap determination.
CLO5. Apply computational and fabrication techniques to design materials, including molecular modelling, thin film patterning, and electrical contact formation.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	**1.** Operation of Vacuum coating unit. **2.** Deposition of metallic thin film using vacuum coating unit and spin coating unit. **3.** Estimation of inter planer spacing and unit cell dimensions using electron diffraction pattern. **4.** Creep analysis of different materials at constant temperature and stress **5.** Calculate the Lattice parameters (a Å), volume of unit cell, density of unit cell, atomic radius(r) and average crystallite size(D), dislocation density(ρ) and microstrain (Ɛ) using diffractogram of NaCl crystal. **6.** Growth of single crystal using the slow evaporation (using seed crystal and without seed crystal) method. **7.** Crystal growth using Holden Rotary Crystallizer. **8.** Calculation of the materials constant and energy band-gap of P-N junction diode. **9.** Determination of resistivity of Germanium crystal at different temperature and estimation of energy band gap by using Four probe method. 10. Study of Hall effect and estimation of Hall coefficient R_H, carrier density (n) and carrier mobility (μ) of n-type and p-type semiconductor.	CL, Seminar, Experiential Learning, Field Visit, PBL Simulation and Role-Play, ICT-Enabled Learning, PBL, Inquiry-Based Learning	CLO1 CLO2 CLO3 CLO4 CLO5

	11. Study of Hall effect and estimation of Hall coefficient R_H, carrier density (n) and carrier mobility (μ) of n-type and p-type semiconductor. **12.** Computational Molecular Modelling: Geometry Optimization and Analysis of Atomic and Bond Properties. **13.** Thin Film Patterning via Masking and Electrical Contact Fabrication Using Conductive Silver Paste. **14.** Measurement of Current-Voltage (I-V) Characteristics of Thin Film Materials. **15.** Thin film fabrication using electro-deposition method. **16.** Crystal growth using Bridgman-Stockbarger technique.		

- **(*) Learning Pedagogies/Methods**
  (a) Classroom Lecture (CL)
  (b) Seminars (Student-led and Faculty-moderated)
  (c) Industrial Visit/Field Visit/Institutional Visit
  (d) Problem-Based Learning (PBL)
  (e) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)
  (f) Simulation and Role-Play (Academic, Professional, or Policy-based Scenarios)
  (g) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)
  (h) Inquiry-Based Learning

- **Assessment Methodologies**

(A) Internal Assessment (50 Marks)

a. Internal Formative assessment (25 marks)

(a) Working methodology: Handling of instruments and Observation skills
(b) Record book and Updating of practical journal
(c) Troubleshooting ability

b. Internal Summative Assessment (25 marks)

(a) Mid-term practical examination
(Working methodology: Handling of instruments and Observation skills, Result Interpretation and Viva-voce)

(B) Weightage of Learning Efforts for External Assessment (50 Marks)

(a) Term End Test

Unit	**Aligned CLOs**	**Total Learning Hours**	**Approximate weightage (Marks) to Learning levels (BT)**			**Total Marks**
			Remember (R)	**Understanding (U)**	**Application/ Analyse & above (A)**	
I	CLO1 CLO2 CLO3 CLO4 CLO5	120	10	10	30	50
		120	**10**	**10**	**30**	**50**

M.Sc. (Materials Science) Semester-I

- **Assessment and Evaluation**

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Working methodology: Handling of instruments and Observation skills, Record book and Updating of practical journal, Self-learning and Terms work, Troubleshooting ability, Mid-term practical examination	50%
2	End-Semester Examination	Practical examination (Working methodology: Handling of instruments and Observation skills, Result Interpretation and Viva-voce)	50%

(C) CLOs – PLOs Matrix

CLO	PLO											
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11	PLO 12
CLO1	2	-	-	2	3	2	1	1	-	1	1	3
CLO2	3	3	2	-	1	3	-	1	-	2	2	2
CLO3	2	2	3	-	1	2	2	-	-	2	2	3
CLO4	3	2	1	-	-	3	-	3	-	2	2	2
CLO5	3	-	-	2	3	2	1	3	1	3	3	2

Values to **CLO-PLO** matrix are assigned **by judging the importance of the particular CLO** in relation to the **PLOs**.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

- **Suggested Learning Materials Books:**

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Handbook of Physical Vapor Deposition (PVD) Processing	Donald M. Mattox	1st Edition/1998	Noyes Publications
2	Materials Science and Engineering: An Introduction	William D. Callister, David G. Rethwisch	10th Edition/ 2018	Wiley
3	Elements of X-ray Diffraction	B.D. Cullity, S.R. Stock	1st Edition/1956	Pearson
4	Introduction to the Thermodynamics of Materials	David R. Gaskel	7th Edition/ 2024	CRC Press

M.Sc. (Materials Science) Semester-I

- **Online Resources (Open Source)**

Sr. No.	Description of Resource(s)	Weblink
1	Video presentation – Applied Thermodynamics	https://nptel.ac.in/courses/112106419
2	Video presentation – Crystal Symmetry, X-Ray Diffraction and Physical Properties	https://nptel.ac.in/courses/113104634
3	Video presentation - Properties of Materials	https://nptel.ac.in/courses/113104096

SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

M.Sc. (Materials Science) Semester-I

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	**P2S01NCMAT05**	Practical-II	0-8-0	120	04

- **Course Learning Outcomes (CLOs)**

On completion of this course, students will be able to:

CLO1. Explain the relevance of the theoretical to the practical aspects.
CLO2. Apply stoichiometric calculations of raw materials and material handling.
CLO3. Handle laboratory equipment/set-up for polymer synthesis.
CLO4. Synthesize different types of resins using appropriate chemical processes.
CLO5. Analyze prepared resins with respect to their applications.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	**1.** Preparation of phenol-formaldehyde resin (Resole). **2.** Preparation of phenol-formaldehyde resin (Novolac). **3.** Preparation of urea-formaldehyde resin. **4.** Preparation of melamine-formaldehyde resin. **5.** Preparation of epoxy resin (Solid and liquid). **6.** Emulsion polymerization of methylmethacrylate. **7.** Preparation of unsaturated polyester. **8.** Determination of free phenol content in Novolac resin. **9.** Determination of free formaldehyde in PF resin. **10.** Determination of epoxy equivalent weight of epoxy resin. **11.** Determination of acid value in polyester. **12.** Determination of free formaldehyde in UF and MF resin.	Experiential Learning, Field Visit, Simulation and Role-Play, CBL, ICT-Enabled Learning, PBL	CLO1 CLO2 CLO3 CLO4 CLO5

- **(*) Learning Pedagogies/Methods**
  (a) Classroom Lecture (CL)
  (b) Seminars (Student-led and Faculty-moderated)
  (c) Case-Based Learning (CBL)
  (d) Micro-Projects/Mini Research Tasks
  (e) Industrial Visit/Field Visit/Institutional Visit
  (f) Problem-Based Learning (PBL)
  (g) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)
  (h) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)
  (i) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)
  (j) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)

(k) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)
(l) Inquiry-Based Learning
(m) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)

- **Assessment Methodologies**

(A) Internal Assessment (50 Marks)

a. Internal Formative assessment (25 marks)

(a) Working methodology: Handling of instruments and Observation skills
(b) Record book and Updating of practical journal
(c) Self-learning and Terms work
(d) Troubleshooting ability

b. Internal Summative Assessment (25 marks)

(a) Mid-term practical examination
(Working methodology: Handling of instruments and Observation skills, Result Interpretation and Viva-voce)

(B) Weightage of Learning Efforts for External Assessment (50 Marks)

(a) End term test

Unit	Aligned CLOs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
I	CLO1 CLO2 CLO3 CLO4 CLO5	120	10	10	30	50
		120	**10**	**10**	**30**	**50**

- **Assessment and Evaluation**

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Working methodology: Handling of instruments and Observation skills, Record book and Updating of practical journal, Self-learning and Terms work, Troubleshooting ability, Mid-term practical examination	50%
2	End-Semester Examination	Practical examination (Working methodology: Handling of instruments and Observation skills, Result Interpretation and Viva-voce)	50%

M.Sc. (Materials Science) Semester-I

(C) CLOs – PLOs Matrix

CLO	PLO											
	PLO 1	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PLO 6**	**PLO 7**	**PLO 8**	**PLO 9**	**PLO 10**	**PLO 11**	**PLO 12**
CLO1	3	2	–	3	–	–	–	–	2	3	–	1
CLO2	3	1	–	3	1	1	1	–	2	3	2	3
CLO3	3	–	–	3	–	2	2	–	1	3	1	3
CLO4	3	2	–	3	1	1	2	1	2	3	2	2
CLO5	3	2	–	3	–	3	1	1	2	3	2	2

Values to **CLO-PLO** matrix are assigned **by judging the importance of the particular CLO** in relation to the **PLOs**.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

- **Suggested Learning Materials Books:**

Sr.No.	Title	Author(s)	Edition/Year	Publisher
1	Polymer science and technology	P. Ghosh	2013	Tata McGraw-Hill Education
2	Plastics: Materials and Processing.	A. B. Strong	2006	United Kingdom: Pearson Prentice Hall
3	Plastics Materials	J. A. Brydson	6th Ed./2013	United Kingdom: Elsevier Science

- **Online Resources (Open Source)**

Sr. No.	Description of Resource(s)	Weblink
1	Video Source**:** Introduction to Polymer Science	https://nptel.ac.in/courses/104/105/104105124/
2	Video Source: Polymers: Concepts, Properties, Uses and Sustainability	https://onlinecourses.nptel.ac.in/noc24_ch50/preview

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M.Sc. (Materials Science) Semester-I

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	**P2S01NCMAT06**	Materials Testing and Analysis-I	2-0-1	60	02

- **Course Learning Outcomes (CLOs)**

On completion of this course, students will be able to:

CLO1. Understand the fundamental principles, importance, and applications of non-destructive and destructive testing methods.

CLO2. Apply knowledge of various non-destructive testing techniques (LPT, MPT, UT, RT, ECT) for detection of surface and subsurface defects in materials.

CLO3. Perform destructive testing methods such as tensile, hardness, impact, fatigue and creep tests to evaluate mechanical properties of materials.

CLO4. Analyse test results to interpret materials behaviour including stress–strain response, fracture mechanisms and failure modes.

CLO5. Evaluate and select appropriate testing techniques for quality control, defect analysis in industrial sectors.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	**Introduction to non-destructive testing** Importance and advantages over destructive methods, Visual inspection techniques, Liquid penetrant testing, magnetic particle testing, Ultrasonic testing (pulse echo method), Radiographic testing using X-rays and gamma rays, Eddy current testing, Acoustic emission testing, Infrared thermography, Principles, instrumentation and applications of various NDT techniques, Defect detection in metals, Welds and composites, Industrial applications in aerospace, Nuclear and automotive sectors.	Classroom Lecture (CL), Case-Based Learning (CBL), Seminar, Industrial Visit/Field Visit, Problem-Based Learning (PBL), Research-Oriented Learning, Collaborative Learning, ICT	CLO1 CLO2 CLO3 CLO5
II	**Introduction to destructive testing** Importance of destructive testing, Tensile testing and stress-strain behaviour, Compression testing, Impact testing (Izod and Charpy), Hardness testing methods (Brinell, Rockwell, Vickers), Fatigue testing and S-N curve, creep behaviour and creep curve, Fracture toughness, ductile and brittle fracture, Failure analysis techniques, Evaluation of mechanical properties, Applications in material selection and quality control.	Classroom Lecture (CL), Case-Based Learning (CBL), Micro-Projects, Problem-Based Learning (PBL), Experiential Learning, Research-Oriented Learning, Collaborative Learning, ICT	CLO1 CLO3 CLO4 CLO5

M.Sc. (Materials Science) Semester-I

- **(*) Learning Pedagogies/Methods**

(a) Classroom Lecture (CL)
(b) Seminars (Student-led and Faculty-moderated)
(c) Case-Based Learning (CBL)
(d) Micro-Projects/Mini Research Tasks
(e) Industrial Visit/Field Visit/Institutional Visit
(f) Problem-Based Learning (PBL)
(g) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)
(h) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)
(i) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)
(j) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)

- **Assessment Methodologies**

(A) Internal Assessment (25 Marks)

a. Internal Formative assessment (10 Marks)

(a) Assignment
(b) Seminar/Presentation
(c) Quiz
(d) Class regularity

b. Internal Summative Assessment (15 Marks)

(a) Mid-term test

(B) Weightage of Learning Efforts for External Assessment (25 Marks)

(a) Term End Test

Unit	Aligned CLOs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
I	CLO1 CLO2 CLO3	30	1	1	11	13
II	CLO1 CLO3 CLO4 CLO5	30	1	1	10	12
		60	**02**	**02**	**21**	**25**

M.Sc. (Materials Science) Semester-I

- **Assessment and Evaluation**

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Seminars/Assignments, Self-learning, Quizzes, Class Regularity, Mid-term test	50
2	End-Semester Examination	Written Exam	50

- **CLOs – PLOs Matrix**

CLO	PLO											
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11	PLO 12
CLO1	3	3	1	1	3	-	3	2	1	2	3	3
CLO2	3	3	3	2	3	-	3	2	1	1	3	3
CLO3	3	3	3	2	1	-	3	2	1	1	3	3
CLO4	3	3	3	2	1	-	3	3	1	1	3	3
CLO5	3	3	3	2	3	-	3	3	1	1	3	3

Values to **CLO-PLO** matrix are assigned **by judging the importance of the particular CLO** in relation to the **PLOs**.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

- **Suggested Learning Materials Books:**

Sr.No.	Title	Author(s)	Edition/Year	Publisher
1	Science of Engineering Materials: Volume 2 Materials.	Manas Chanda	1981	Macmillan International Higher Education.
2	Materials science and engineering: an introduction (Vol. 9)	W. D. Callister, & D.G. Rethwisch	2018	New York: Wiley.
3	The Science and Engineering of Materials.	D. R. Askeland, P. R.Fulay & W. J. Wright	2010	Cengage Learning, Stamford, CT, USA.
4	Non-Destructive Evaluation of Materials	J. Prasad	2nd Ed, 2003	McGraw-Hill Education (India)
5	Mechanical Behaviour of Materials	Marc Meyers, Krishan Chawla	2nd Ed., 2008	Cambridge University Press
6	Mechanical Testing of Materials	George E. Dieter	3rd Ed., 1986	McGraw-Hill

M.Sc. (Materials Science) Semester-I

- **Online Resources (Open Source)**

Sr. No.	Description of Resource(s)	Weblink
1	Video Source: Theory and Practice of Non-Destructive Testing	https://www.youtube.com/watch?v=5cNWF61Tmj0&list=PLyAZSyX8Qy5AePdV6vbGP4OJQOpbga-0Q
2	Video Source: Theory and Practice of Non-Destructive and Destructive	https://www.youtube.com/@introductiontomaterialsscience/videos