



Karmaveer Bhaurao Patil University, Satara

Syllabus for

B. Sc. II Materials Science

Under

Faculty of Science and Technology

(As per NEP 2020)

With effect from Academic Year 2025-2026

Syllabus for Bachelor of Science (B. Sc.) Part – II Materials Science

PREAMBLE:

The B.Sc. Materials Science course will be introduced in the academic year 2025-2026. This syllabus is framed to focus on the fundamental aspects of materials science which every materials scientist is supposed to be familiar with. The course discusses the fundamental properties of materials, classification of materials. It has been designed to meet the specific needs of B.Sc. Materials Science students in accordance with the NEP 2020 guidelines. The curriculum has been developed to reflect the expanding scope of materials science. The focus is on equipping students with up-to-date knowledge while maintaining a strong foundation in materials science. The course also includes new practical exercises, providing students with hands-on experience with the latest techniques currently in use. Additionally, the course is intended to inspire students to pursue higher studies in materials science, become entrepreneurs, and seek employment in materials-based industries.

1. TITLE: **Materials Science**
2. YEAR OF IMPLEMENTATION: **2025-2026**
3. DURATION: **01 year**
4. PATTERN: **Semester examination**
5. MEDIUM OF INSTRUCTION: **English**
6. STRUCTURE OF COURSE:
7. COURSE TITLE

As per NEP-2020 (2.0)

Level	Sem	Subject				OE	VSC/SEC	AEC/VEC/IKS/	Total
		DSC		DSE*					
		T	P	T	P				
5.0	III	Major V (2)	Major P III (2)	Minor V (2)	Minor P III (2)	OE III (2)	VSC I (2) (Major Specific) SEC I (2) (P)	AEC I (2) (English) IKS II (2) (Major Specific)	22
		Major VI (2)		Minor VI (2)					
5.0	IV	Major VII (2)	Major P IV (2)	Minor VII (2)	Minor P IV (2)	OE IV (2)	VSC II (2) (Major Specific) SEC II (2) (P)	AEC II (2) (English) VEC II (2) (Environmental Studies)	22
		Major VIII (2)		Minor VIII (2)					

B.Sc. – II Minor

Semester –III

Course Title	Theory			Practical		
	Course Code	Lectures Per week	Credits	Course Code	Lectures per week	Credits
Methods of Testing of Material	BMST 234	2	2	BMSP 236	4	2
Advanced Industrial Materials	BMST 235	2	2			

B.Sc. – II Minor

Semester –IV

Course Title	Theory			Practical		
	Course Code	Lectures Per week	Credits	Course Code	Lectures Per week	Credits
Materials for Semiconductor Technology	BMST 244	2	2	BMSP 246	4	2
Applications in energy technology and Biomaterials	BMST 245	2	2			

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	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Science & Technology	
	Programme: B.Sc.II	Semester - III
	Type: DSE (Minor V)	Marks: 50
	Credits: 2	From: A. Y. 2025-26
Name of the Course: BMST 234: Methods of Testing of Material		
Course Objectives: student should be able to..... 1) understand the elastic and anelastic behaviour of materials. 2) learn the mechanisms of plastic deformation in materials. 3) know the creep behaviour and its effects on the properties of materials. 4) describe the various types of fractures in materials based on their characteristics and mechanisms.		
Course Outcomes: After completion of syllabus, student will be able to.... 1) define the fundamentals of advanced industrial materials. 2) identify the different types of alloys and their properties. 3) demonstrate the various types of polymeric materials based on their characteristics. 4) analyse the properties and applications of ceramic materials.		
Module	Title and Contents	Hrs
Module 1	Elastic and anelastic behavior of materials. 1.1 Elastomeric deformation 1.2 Thermoelastic effect 1.3 Elastic behavior 1.4 Atomic model of elastic behavior 1.5 Effect of temperature on elastic module 1.6 Anelastic deformation 1.7 Relaxation Process 1.8 Elasticity of polymers and glasses	08
Module 2	Plastic Deformation 2.1 Mechanism of plastic deformation, 2.2 Tensile Stress strain curve, 2.3 Plastic deformations by Slip, 2.4 SCHMID's laws, 2.5 Dislocation movement, 2.6 Deformation by twinning, 2.7 Types of twins, 2.8 Deformation in polycrystalline materials	07
Module 3	Creep in materials 3.1 Mechanism of creep 3.2 Creep test 3.3 Creep curve 3.4 Creep curve equation, 3.5 Creep at constant temperature	08

	3.6 Stress rupture test 3.7 Creep resistant materials	
Module 4	Fractures in materials 4.1 Ductile fractures 4.2 Brittle fractures 4.3 Fracture Toughness 4.4 The Ductile-Brittle Transition 4.5 Fracture mechanism maps 4.6 Method of Protection against fractures 4.7 Fatigue fractures	07
Reference Books: - 1) Raghavan, V. <i>Materials Science and Engineering</i> . 5th ed. (Publisher: PHI Learning Pvt. Ltd., Delhi, 2013) 2) Singh, I. P., Subhash Chander, and Rajesh K. Prasad. <i>Materials Science and Engineering</i> . 14th ed. (Publisher: Jain Brothers, New Delhi, 2015) 3) Callister Jr, W.D. Rethwisch D. G., <i>Materials Science and Engineering: An Introduction</i> , 10th ed., (Publisher: John Wiley & Sons, 2018) 4) Dowling, N. E., <i>Mechanical Behavior of Materials</i> , 5th ed., (Publisher: Pearson, 2019)		
Evaluation Pattern: 40:60		
Total Marks: 50		
Internal Continuous Evaluation: 20 Marks - Internal Work -1: CCE-I-10 Marks - Internal Work -2: CCE-II- 10 Marks - Internal Work -3: CCE-III-10 Marks (Best of Two CCE)		End Semester Examination: 50 Marks - Question No.1 is compulsory. - Attempt any two questions out of three questions. - Attempt any four questions out of six questions. - Question - 1: 2 Mark x 5 = 10 Marks - Question - 2: 10 Mark x 2 = 20 Marks - Question - 3: 5 Mark x 4 = 20 Marks (50 Marks converted to 30 Marks)

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	Programme: B.Sc.II	Semester – III
	Type: DSE (Minor VI)	Marks: 50
	Credits: 2	From: A. Y. 2025-26
Name of the Course: BMST 235: Advanced Industrial Materials		
Course Objectives: student should be able to..... 1) explain the fundamentals of advanced industrial materials. 2) learn the different types of alloys based on their properties and applications. 3) know the various types of polymeric materials and their characteristics. 4) analyse the properties and applications of ceramic materials.		
Course Outcomes: After completion of syllabus, student will be able to.... 1) define the creep behaviour of materials. 2) describe the mechanisms of plastic deformation in materials. 3) distinguish between the elastic and anelastic behaviour of materials. 4) identify the different types of fracture in materials.		
Module	Title and Contents	Hrs
Module 1	Need of advanced materials 1.1 Introduction 1.2 Demand of advanced materials 1.3 Design principles and processing 1.4 Structural Materials: Porous matrix ceramics- composites 1.5 Metallic foam 1.6 Cellular Materials 1.7 Nano tubes 1.8 Nano wires	08
Module 2	Engineering alloys 2.1 Production of iron and steel 2.2 Aluminium alloys 2.3 Copper alloys 2.4 Stainless steel 2.5 Titanium alloys 2.6 Special purpose alloys and their applications	07
Module 3	Polymeric materials 3.1 Introduction to polymeric materials 3.2 Processing of plastic materials 3.3 General-purpose thermoplastic: Polyethylene, Polypropylene Polyacrylonitrile, Polymethyl Methacrylate (PMMA) & their applications	08

Module 4	Ceramics 4.1 Introduction to ceramics 4.2 Processing of ceramics 4.3 Traditional and Engineering ceramics 4.4 Mechanical properties of ceramics 4.5 Thermal properties of ceramics 4.6 Electrical properties of ceramics	07
Reference Books: - 1) Gandhi, Mukesh V., and Brian S. Thompson. <i>Smart Materials and Structures</i> , (Publisher: Chapman & Hall, London, 1992) 2) Smith, William F., Javad Hashemi, and Ravi Prakash. <i>Materials Science and Engineering</i> , (Publisher: McGraw-Hill Education, New Delhi, 2014) 3) Rama Rao, P. <i>Advances in Materials and Their Applications</i> , (Publisher: Wiley Eastern Limited, New Delhi, 1993)		
Evaluation Pattern: 40:60		
Total Marks: 50		
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	Programme: B.Sc.II	Semester - III
	Type: DSE (Minor P III)	Marks: 50
	Credits: 2	From: A. Y. 2025-26
Name of the Course: BMSP 236: Practical III: LAB III		
Course Objectives: student should be able to..... 1) understand hardness tests and evaluate the mechanical properties of materials. 2) learn specimen preparation techniques for microscopy. 3) study and illustrate the microstructures of materials. 4) know the principles and applications of X-ray diffraction (XRD) techniques.		
Course Outcomes: After completion of syllabus, student will be able to.... 1) define the different hardness tests and evaluate the material properties. 2) explain the specimen preparation techniques for microscopy. 3) differentiate the microstructures of different materials. 4) analyse the X-ray diffraction (XRD) patterns of given materials.		
Practical No.	Title and Contents	Hrs
1	To study the Brinell Hardness test.	4
2	To study the Rockwell Hardness test.	4
3	To study the Izod Impact test.	4
4	To study the Charpy Impact test.	4
5	Preparation of solid epoxy resin.	4
6	Determine the deflection and bending stress of cantilever beam.	4
7	To study the Vicker's hardness test.	4
8	To study the specimen preparation for microscopy.	4
9	Identification of different rubbers and plastics	4
10	Determine the deflection and bending stress of simply supported beam	4
11	Fabrication of glass, Ceramics and refractory materials	4
12	Characterization of glass and ceramics by XRD, IR analysis	4
13	Microstructure analysis of glass and ceramics	4
14	Study of microstructure of polymeric materials.	4
15	Preparation and processing of synthetic polymers.	4
16	Study and drawing of microstructures of plain carbon steels of varying carbon percentage.	4
17	To study the Compression Test on mild steel	4
18	To study the Compression Test on cast iron.	4
19	Visit to Cooper Foundry	4
20	Industrial Visit	4

Reference Books: -

- 1) Dieter, George E. *Mechanical Metallurgy*, 3rd ed., (Publisher: McGraw-Hill Education, New Delhi, 2013)
- 2) Dowling, Norman E. *Mechanical Behavior of Materials*, (Publisher: Prentice Hall, . Englewood Cliffs, NJ, 1993)
- 3) Newby, J. R. *ASM Metals Handbook: Mechanical Testing*, 9th ed., (Publisher: American Society for Metals, Metals Park, OH 1992)

Evaluation Pattern: 40:60**Total Marks: 50****Internal Continuous Evaluation: 20 Marks**

- Internal Work -1: **20 Marks**

End Semester Examination: 30 Marks

- Question -1: **30 Marks**

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	Programme: B.Sc.II	Semester - IV
	Type: DSE (Minor VII)	Marks: 50
	Credits: 2	From: A. Y. 2025-26
	Name of the Course: BMST 244: Materials for Semiconductor Technology	

Course Objectives: student should be able to.....

- 1) understand the electrical properties of semiconductor materials.
- 2) know the various types of metal–semiconductor contacts and their characteristics.
- 3) learn the structure, working principle, and applications of the p–n junction.
- 4) study the properties and applications of optical materials.

Course Outcomes: After completion of syllabus, student will be able to....

- 1) discuss intrinsic and extrinsic semiconductors based on their electrical properties.
- 2) differentiate between Ohmic and Schottky contacts and their applications.
- 3) describe the working principle and applications of p–n junction devices.
- 4) analyze the design parameters and select appropriate electronic materials from metals for specific applications.

Module	Title and Contents	Hrs
Module 1	Electrical Properties of Semiconductor 1.1 Semiconductor 1.2 Energy Band Diagram 1.3 Intrinsic Semiconductors: The Mechanism of Electrical Conduction 1.4 Electrical Charge Transport in the Crystal Lattice of Pure Silicon 1.5 Extrinsic Semiconductors: n-Type (Negative-Type) & p-Type (Positive-Type)	08
Module 2	Semiconductor Devices 2.1 The pn Junction: The pn Junction Diode at Equilibrium 2.2 Applications for pn Junction: Rectifier Diodes 2.3 Forward bias 2.4 Reverse-bias 2.5 Applications for pn Junction: Rectifier Diodes 2.6 Breakdown Diodes 2.7 Tunnel diode 2.8 Photodiode	07
Module 3	Semiconductor interface structure 3.1 Metal-n type semiconductor junction and its rectifying action, 3.2 Metal-p type semiconductor junction and its rectifying action, 3.3 Schottky contact and ohmic contact, 3.4 Metal-metal contact and its rectifying action, 3.5 Semiconductor - insulator interface	08

Module 4	Selection of Materials 4.1 Introduction 4.2 Material properties -design parameters 4.3 Electronic materials - Light Emitting Diode 4.4 Optical Materials- introduction, optical properties, optical system and devices 4.5 Glass for smartphones and tablets	07
Reference Books: - 1) Smith, William F., and Javad Hashemi. <i>Foundations of Materials Science and Engineering</i> . 6th ed. (Publisher: McGraw-Hill Education, New York, 2019) 2) Singhal, R. L. <i>Solid State Physics</i> . (Publisher: Kedar Nath Ram Nath & Co., Meerut, 2007) 3) Shackelford, James F., and Michael P. Clode. <i>Introduction to Materials Science for Engineers</i> . 6th ed. (Publisher: Pearson Prentice Hall, 2005) 4) Neamen, Donald A. <i>Semiconductor Physics and Devices: Basic Principles</i> . 3rd ed. (Publisher: McGraw-Hill, New York, 2003)		
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Total Marks: 50		
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	Programme: B.Sc.II		Semester - IV
	Type: DSE (Minor VIII)		Marks: 50
	Credits: 2		From: A. Y. 2025-26
Name of the Course: BMST 245: Applications in energy technology and Biomaterials			
Course Objectives: student should be able to.... 1) understand the metals and alloys used in the fabrication of turbine blades and explain their properties. 2) know the properties and selection criteria of materials used in automobiles. 3) study the metals, alloys, and polymers used for medical applications. 4) learn the uses and applications of biomaterials in the medical field.			
Course Outcomes: After completion of syllabus, student will be able to.... 1) explain the future developments of materials used in turbine blade fabrication. 2) describe the different approaches for achieving energy economy in automobiles. 3) differentiate the metals and polymers used in biomaterials. 4) analyse the applications of biomaterials in the human body.			
Module	Title and Contents		Hrs
Module 1	The turbine blade 1.1 Introduction 1.2 Properties required of a turbine blade 1.3 Nickel-based super-alloys 1.4 Engineering developments— blade cooling 1.5 Future developments: metals and metal– matrix composites 1.6 Future developments: high-temperature ceramics 1.7 Cost effectiveness 1.8 Examples		08
Module 2	Materials and energy in car design 2.1 Introduction, 2.2 Energy and cars, 2.3 Ways of achieving energy economy, 2.4 Alternative materials: Primary mechanical properties, 2.5 Secondary properties, 2.6 Production methods		07
Module 3	Materials used in Medicine 3.1 Introduction, 3.2 Materials for use in the body, 3.3 Metals: Steps in the fabrication of implants, 3.4 Stainless Steels, 3.5 Cobalt- based alloys, ASTM F799, ASTM F90, ASTM FS62, 3.6 Titanium-based alloys, ASTM F136 3.7 Polymers		08

Module 4	Properties and Applications of Biomaterials 4.1 Physical Properties of Biomaterials, 4.2 Chemical Properties, 4.3 Uses of Biomaterials, 4.4 Biomaterials in Organs, 4.5 Joint Replacements, 4.6 Drug Delivery Systems, 4.7 Dental Implants, 4.8 Breast Implants, 4.9 Cardiovascular Biomaterials	07
Reference Books: - 1) Ashby, Michael F., and David R. H. Jones. <i>Engineering Materials 1: An Introduction to Properties, Applications and Design</i> . 3rd ed., (Publisher: Elsevier, Oxford, 2005) 2) Park, Joon B., and Joseph D. Bronzino. <i>Biomaterials: Principles and Applications</i> . 1st ed. (Publisher: CRC Press, Boca Raton, FL, 2002) 3) Ratner, Buddy D., Allan S. Hoffman, Frederick J. Schoen, and Jack E. Lemons. <i>Biomaterials Science: An Introduction to Materials in Medicine</i> . (Publisher: Academic Press, San Diego, CA, 1996) 4) Park, Joon, and R. S. Lakes. <i>Biomaterials: An Introduction</i> . 3rd ed. (Publisher: Springer, New York, 2007) 5) Bandarenka, Aliaksandr S. <i>Energy Materials: A Short Introduction to Functional Materials for Energy Conversion and Storage</i> . 1st ed., (Publisher: CRC Press, Taylor & Francis Group, Boca Raton, FL, 2022)		
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	Programme: B.Sc.II	Semester - III
	Type: DSE (Minor P IV)	Marks: 50
	Credits: 2	From: A. Y. 2025-26
Name of the Course: BMSP 246: Practical IV: LAB IV		
Course Objectives: student should be able to..... 1) understand the band gap of semiconductor materials. 2) know the shear stress in materials. 3) study the tensile stress of materials. 4) Learn about the resolving power of a prism.		
Course Outcomes: After completion of syllabus, student will be able to.... 1) explain the band gap of semiconductor materials. 2) discuss the concept of shear stress in materials. 3) differentiate the tensile stress behaviour of different materials. 4) analyse the resolving power of a prism.		
Practical No.	Title and Contents	Hrs
1	To determine the Energy Band Gap of a Semiconductor by using PN Junction Diode	4
2	Resistivity measurement of Silicon by four probe method.	4
3	To study the Tensile test on the mild steel.	4
4	To study the Tensile test on Cast Iron.	4
5	Compression Test on mild steel	4
6	To study the direct shear stress on the mild steel rod.	4
7	To study the direct shear stress on the timber specimen.	4
8	To find the resolving power of the prism.	4
9	To find the temperature coefficient of resistance of a given coil.	4
10	Visit to hospital and demonstration of biomedical equipment's in ICU & operation theatre.	4
11	Visit to Medical Imaging centres and demonstration of CT scan, MRI, Ultrasonography, Angiography	4
12	To find the refractive index of paraffin oil using hollow prism.	4
13	To find the refractive index of ethyl alcohol using hollow prism.	4
14	Use of sphygmomanometer for measurement of blood pressure	4
15	Identification of different block/sub system of circuits in X-Ray machine	4
16	Determination of wavelengths of given laser sources by diffraction method.	4
17	Use of polarimeter and determination of observed rotation α , specific rotation $[\alpha]$	4

	and molar rotation [m'] for amino acids and sugars.	
18	Operation and function of all the controls of hospital X-Ray machine (visit to Hospital)	4
19	To study the Bending Test on mild steel.	4
20	To study the Torsion Test on mild steel.	4
Reference Books: 1) Streetman, Ben G., and Sanjay Kumar Banerjee. <i>Solid State Electronic Devices</i>. 7th ed. (Publisher: Pearson Education India, 2018) 2) Sanon, Geeta. <i>B.Sc. Practical Physics</i>. 10th ed., (Publisher: S. Chand & Company Ltd., New Delhi 2021) 3) Singh, Harnam, and P. S. Hemne. <i>B.Sc. Practical Physics</i>. (Publisher: S. Chand & Company Ltd., New Delhi, 2000) 4) Newby, J. R. <i>ASM Metals Handbook: Mechanical Testing</i>. 9th ed., (Publisher: American Society for Metals, Metals Park, OH, 1992) 5) Khandpur, R. S. <i>Handbook of Biomedical Instrumentation</i>. 2nd ed., (Publisher: McGraw-Hill Publishing Co. Ltd., New Delhi, 2003)		
Evaluation Pattern: 40:60		
Total Marks: 50		
Internal Continuous Evaluation: 20 Marks		End Semester Examination: 30 Marks
• Internal Work-1: 20 Marks		• Question-1: 30 Marks