Rayat Shikshan Sanstha's

Yashavantrao Chavan Institute of Science, Satara (Autonomous)

(Lead College, Karmaveer Bhaurao Patil University, Satara)

Syllabus for B.Sc. II

(Material Science Minor)

As per NEP 2020

w. e. f. 2024-25

1. Title: Material Science

2. Year of Implementation: The syllabus will be implemented from June, 2024.

3. Duration: The course shall be a full time.

4. Pattern: Semester examination.

5. Medium of Instruction: English

6. Structure of Course:

B.Sc. II Semester III

Sr. No.	Course Title	Theory			Practical		
		Course Code	Lectures per week	Credit	Course Code	Lectures per week	Credit
1	Methods of Testing of Material	BMST 235	2	2	Practical Course – III (BMSP 236)	4	2

B.Sc. II Semester IV

Sr. No.	Course Title	Theory			Practical		
		Course Code	Lectures per week	Credit	Course Code	Lectures per week	Credit
1	Applications in Energy Technology and Biomaterials	BMST 245	2	2	Practical Course – IV (BMSP 246)	4	2

B: B.Sc. MS: Material Science T: Theory, P: Practical

7. Titles of Courses of B.Sc.II

B.Sc. II (Semester III)

Theory: 30 lectures, 30 hours (for each Course)

Course – V: BMST 235: Methods of Testing of Material

Practical: 30 lectures: 30 hours (Total)

Practical Course III: BMSP 236: Methods Testing of Materials

B.Sc. II (Semester IV)

Theory: 30 lectures, 30 hours (for each Course)

Course – VI : BMSP 245: Applications in Energy Technology and Biomaterials

Practical: 30 lectures: 30 hours (Total)

Practical Course II: BMSP 246: Applications in Energy Technology and Biomaterials

Material Science (Minor) B.Sc. II

Semester – III

Course – V: BMST 235 : Methods of Testing of Material

Course Objectives: Student will be able to:

1. study elastic and an elastic behavior of materials.
2. understand plastic deformation.
3. study creep in materials.
4. understand different types of fractures in materials.

Credits (Total Credits 02)	**SEMESTER-III BMST 235 Methods of Testing of Material**	**No. of hours per unit/credits**
UNIT - I	**Elastic and inelastic Behavior of Materials**	**(9)**
	Elastomeric deformation, Thermoelastic effect, Elastic behavior, Atomic model of elastic behavior, Effect of temperature on elastic module. Anelastic deformation, relaxation process, Elasticity of polymers and glasses.	
UNIT - II	**Plastic Deformation**	**(9)**
	Mechanism of plastic deformation, Tensile Stress strain curve, plastic deformations by Slip, SCHMID's laws, dislocation movement, Deformation by twinning, Types of twins, Deformation in polycrystalline materials.	
UNIT - III	**Creep in Materials**	**(9)**
	Mechanism of creep, Creep test, Creep curve, Creep curve equation, Creep at constant temperature, Stress rupture test, Creep resistant materials.	
UNIT - IV	**Fractures in Materials**	**(9)**
	Ductile fractures, Brittle fractures, Fracture Toughness, The Ductile brittle Transition, Fracture mechanism maps, Method of Protection against fractures, fatigue fractures.	

Course Outcomes: Students should be able to:

1. explain elastic and inelastic behavior of materials
2. understand the concept of plastic deformation
3. analyze creep in materials.
4. differentiate different types of fracture in materials

References:

1. V. Raghavan, 2013, Material Science and Engineering. Delhi, PHI learning Pvt. Ltd.

2. Singh I.P., Subhash Chander, Prasad K.Rajesh. 2015, Material Science and Engineering.

3. William D. Callister, Jr.,2007, Materials Science and Engineering an Introduction, 2/e Edition, John Wiley & Sons, Inc.,

4. Callister, William D. 2003, Jr., Fundamentals of Materials Science and Engineering: An Integrated Approach 2nd Ed., John Wiley and Sons, .

5. Timoshenko, S.P., Young, D.H.,2003, Elements of Strength of Materials, East West Press, New Delhi, .

BMSP 236: Method of Testing of Materials

Course Objectives: Student will be able to:

1. understand how to conduct Hardness tests, sulphur tests and evaluate material properties.
2. to study and draw microstructures of different materials.

Credits (Total Credit 02)	**SEMESTER-III** **BMSP: 236** **Method of Testing of Materials**	**No. of hours per unit/credits**
	Group - A 1. To study the Brinell Hardness test. 2. To study the Rockwell Hardness test. 3. To verify Erichson Cupping test. 4. To study the magnafluxtest. 5. To study the dye penetrant test. 6. To study the specimen preparation for microscopy. 7. To verify sulphur print test. 8. Young's modulus of wooden bar by vibration. 9. Young's modulus of wooden bar by bending. **Group - B** 1. Perform spark test for classification of ferrous materials. 2. Study and drawing of microstructures of plain carbon steels of varying carbon percentage. 3. Study and drawing of microstructures of heat treated steels 4. Measure the hardenability of a steel using the Jominy end quench test. 5. Study and drawing of microstructures of cast irons. 6. Study and drawing of microstructures of non-ferrous alloys. 7. Hardening of steels of varying carbon percentage.	(30)

Course outcomes: After completion, students are able to:

1. conduct different hardness tests and evaluate material properties.
2. anlyze microstructures of different materials.

REFERENCE BOOKS:

1. Dieter, George E, 2013, Mechanical Metallurgy.
2. Dowling, Norman E. 1993. Mechanical behavior of materials: engineering methods for deformation, fracture, and fatigue. Englewood Cliffs (New Jersey): Prentice-Hall.
3. Newby, J R. 1985. "Metals handbook, 9th edition. Volume 8: Mechanical testing". United States.

SEMESTER- IV

Course – VI: BMST 245: Applications in Energy Technology and Biomaterials

Course Objectives: Students will be able to:

1. understand which type of metals and alloys are used to make a turbine blades.
2. imbibe the properties of materials while making a cars.
3. understand the different metals, alloys and polymers for medicinal purpose.
4. study the uses of biomaterials in medical field.

Credits (Total Credits 2)	**SEMESTER-IV** **BMST 245: Applications in Energy Technology and Biomaterials**	**No. of hours per unit/credits**
UNIT - I	**The turbine blade**	**(9)**
	Introduction, Properties required of a turbine blade, Nickel-based super-alloys, Engineering developments—blade cooling, Future developments: metals and metal–matrix composites, Future developments: high-temperature ceramics, Cost effectiveness, Examples	
UNIT - II	**Materials and energy in car design**	**(9)**
	Introduction, Energy and cars, Ways of achieving energy economy, Alternative materials: Primary mechanical properties, Secondary properties, Production methods.	
UNIT - III	**Materials used in Medicine**	**(9)**
	Introduction, Materials for use in the body, Metals: Steps in the fabrication of implants, Stainless Steels, Cobalt-based alloys, ASTM F799, ASTM F90, ASTM FS62,Titanium-based alloys, ASTM F136, Polymers.	
UNIT - IV	**Properties and Applications of Biomaterials**	**(9)**
	Physical Properties of Biomaterials, Chemical Properties, Uses of Biomaterials, Biomaterials in Organs, Joint Replacements, Drug Delivery Systems, Dental Implants, Breast Implants, Cardiovascular Biomaterials.	

Course Outcomes: Students should be able to:

1. understand the future developments of materials while making a turbine blade.
2. differentiate the different ways of achieving energy economy in cars.
3. understand the metals and polymers used in biomaterials.
4. understand the applications of biomaterials in the human body.

References:

1. Ashby, M. F., and David Rayner Hunkin Jones. 2019. Engineering materials 1: an introduction to properties, applications and design. Oxford, UK; Cambridge, MA, US: Butterworth-Heinemann.
2. Bronzino, Joseph D., and Joon Bu Park. 2003. Biomaterials: principles and applications. Boca Raton: CRC Press.
3. Wagner, William R., Shelly E. Sakiyama-Elbert, Guigen Zhang, Michael J. Yaszemski, Buddy D. Ratner, and Allan S. Hoffman. 2020. Biomaterials science an introduction to materials in medicine.
4. Park, Joon Bu, and Roderic S. Lakes. 2007. Biomaterials an introduction. New York, NY: Springer
5. Bandarenka, Aliaksandr. 2022. Energy materials: a short introduction to functional materials for energy conversion and storage.

Practical Paper : BMSP 246: Applications in Energy Technology and Biomaterials

Course Objectives: Students will be able to:

1. determine the crystal structure of a given specimen.
2. determine the band gap of the semiconductor.
3. determine resistivity by four probe methods.
4. compute resolving power of prism.
5. determine the refractive index of various liquids using hollow prisms.

Credits (Total Credit 02)	**SEMESTER-IV** **BMSP: 246** **Applications in Energy Technology and Biomaterials**	**No. of hours per unit/credits**
	Group - A 1. To determine the Energy Band Gap of a Semiconductor by using PN Junction Diode. 2. Resistivity measurement of Silicon by four probe method. 3. Resistivity measurement of metal oxide thin film two probe method. 4. Resistivity measurement of ITO substrate by four probe method. 5. Resistivity measurement of polyaniline thin film by four probe method. 6. To study the variation of magnetic field with distance along the axis of a circular coil carrying current. 7. To find the resolving power of the prism. 8. To find the temperature coefficient of resistance of a given coil. 9. To determine the Hall voltage developed across the sample material. 10. To calculate the Hall coefficient and the carrier concentration of the sample **Group - B** 1. Measurement of blood pressure 2. To find the refractive index of ethyl alcohol using hollow prism. 3. Magnetic susceptibility of FeCl3 Solution. 4. Determination of wavelengths of given laser sources by diffraction method. 5. Study of absorption and emission spectra of biomolecules. 6. Study of stethoscope. 7. Study of X ray diffractometer 8 Study of MRI scan visualize biological structure. 9. Study of crystal structure of thin film using XRD technique. 10. Use of polarimeter and determination of observed rotation α, specific rotation[α] and molar rotation [m'] for amino acids and sugars. 11. Use of pH meter and measuring the pH of the buffer solutions.	(30)

Course Outcomes: Students should able to:

1. determine the crystal structure of a given specimen.
2. understand the principle of medical instruments.
3. determine the pH of buffer solution.
4. determine resolving power of prism.
5. find the refractive index of ethyl alcohol using hollow prism.

REFERENCE BOOKS:

1. Streetman, Ben G., and Sanjay Banerjee. 2016. Solid state electronic devices.
2. Sanon Geeta, 2021, B.Sc. Practical Physics.
3. Singh Harnam, Hemne P.S., 2000, B. Sc. Practical Physics.
4. Newby, J R. 1985. "Metals handbook, 9th edition. Volume 8: Mechanical testing". United States.