B.Sc.-Materials Science, Sardar Patel University **Course Structure**

Year	Semester	Course Type (Credits)							Total Credits per Semester
I	1	Major-1: Atomic Structure and Related Properties of Materials (04) (3 T+1 P) US01MAMTS01	Major-2: Concepts of Physics – 1 (04)	Minor-1*: Fundamentals of Chemistry-1 (04) (3 T+1 P)	MD-1*: Basic Computing and Productivity Tools (04) (3 T+1 P)	AEC-1: Functional English-1 (02)	SEC-1: Basic Experiments of Materials (02)	IKS-1: Foundations of Indian Knowledge Systems (02)	22
	2	Major-3: Understanding of Materials (04) (3 T+1 P)	Major-4: Physics Paper-2 (04)	Minor-2*: Chemistry Paper-2 (04)	MD-2*: Multidis ciplinar y-2 (04)	AEC-2: English-2 (02)	SEC-2: Basic Device for Materials Testing (02)	VAC-1: Entrepreneurship Fundamentals (02)	22
Total Credits (1st Year)		Major: 16; Minor :08; MD: 08; AEC: 04; SEC: 04; IKS/VAC:04							44

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Bachelor of Science (Undergraduate) – Materials Science

Semester -I

Course Code	US01MAMTS01	Title of the Course	Atomic Structure and Related Properties of Materials
Total Credits of the Course	04 (3 T + 1 P)	Hours per Week	03 + 02

Course Objectives:	1. To understand atomic structure, molecular stability, and material interactions. 2. To explore electrical, thermal, magnetic, and mechanical properties of materials.

Course Content		
Unit	Description	Weightage (%)
1	**Fundamental of Materials:** Principles behind the formation of atomic particles, Atoms, and Molecules, Stability to atoms, Basic criteria for the formation of particles and molecules, Underlying factors that influence these processes, Types of interactions and the interaction energies, Including different bonding types and their bond energies, Molecular stability and strength, Interactions between molecules, Role of non-bonded interactions and is role in molecular stability and properties of materials. Band gap and its effect on material properties: The concept of the band gap and its types, Valence band, Conduction band.	25
2	**Electrical Properties of Materials:** Understanding the concept and factors affecting electrical conductivity, Role of electrons and phonons in electrical conductivity, Thermal properties of materials: Explanation of thermal vibrations and their role in heat transfer, Parameters responsible for good and moderate thermal conductivity in materials, Magnetic properties of materials: Magnetic conductivity, Basic criteria for magnetic conductivity, Key parameters influencing magnetic conductivity in materials.	25
3	**Mechanical Properties of Materials:** Stress and Strain – Types of stress (tensile, compressive, shear), Strain, and stress-strain curve, Elastic and plastic Deformation – Hooke's law, Young's modulus, Yield strength and Strain hardening, Toughness and ductility – Impact resistance, Charpy and Izod tests, Brittle vs. Ductile behaviour, Hardness and Wear – Hardness testing methods (Brinell, Vickers, Rockwell), Types of wear (Adhesive, Abrasive, Fatigue), Fatigue and Creep – Fatigue failure, S-N curves, Creep mechanism.	25

4	**Practical:** -Study of intermolecular forces using surface tension measurement. -Temperature dependence of electrical resistance in a metal and semiconductor. -Study of thermal properties of materials (Lee's Disc and Searle's Experiment). -Measuring magnetic permeability of a material. -Effect of temperature on magnetic strength. -Stress-Strain Test using a Rubber (Tensile & Compressive). -Impact testing of glass.	25

Teaching Learning Methodology	Direct Teaching through Chalk-Walk and Talk ICT enabled teaching Question-Answer Problem-solving activities Concept Mapping Teaching with demonstration Group discussion/ Panel/Presentation

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1	Internal Examination	50 %
2	External Examination	50 %

1	Understand atomic structure and molecular interactions that govern material formation and stability.
2	Analyze the role of band gap and electronic structure in determining material properties.
3	Explain electrical, thermal, and magnetic properties and their dependence on material composition and conditions.
4	Evaluate mechanical properties such as stress-strain behaviour, toughness, hardness, and fracture mechanics.
5	Apply fundamental material science principles to real-world applications and problem-solving in materials engineering.

Suggested References:	
1	Materials Science and Engineering – William D. Callister Jr. and David G. Rethwisch
2	Introduction to Solid State Physics – Charles Kittel
3	Solid State Physics – Neil W. Ashcroft and N. David Mermin
4	Materials Science for Engineers – James F. Shackelford
5	Mechanical Properties of Solid Materials – D. H. Allen
6	Introduction to the Thermodynamics of Materials – David R. Gaskell

On-line resources to be used if available as reference material
https://learncheme.com/screencasts/materials-science/
https://www.matweb.com/
https://nptel.ac.in/courses/112108148

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Semester -I

Course Code	US01MAMTS02	Title of the Course	Concepts of Physics – 1
Total Credits of the Course	04 (3 T + 1 P)	Hours per Week	03 + 02

Course Objectives:	1. Learn the fundamental principles of acoustics, lasers, and optics, their theoretical foundations and practical applications. 2. Enable students to apply theoretical principles, such as Sabine's formula, Einstein coefficients, and interference and diffraction phenomena, to solve numerical and conceptual problems. 3. Expose students to experimental methods, such as the measurement of sound absorption coefficients, detection of ultrasonic waves, and interferometric techniques, to understand data collection and analysis. 4. Learn the methods of using various gauges and measurement techniques with applications. 5. Determine different properties of optical equipment and components like resolving power, refractive indices, laser parameters like wavelength and beam width. 6. Learn about applications of diffraction gratings, prisms, interferometers, transducers. 7. Learn and apply the numerical methods for analysis of experimental observations.

Course Content		
Unit	Description	Weightage (%)
1	**Acoustics:** Introduction, Historical development in the field, Basic requirements of an acoustically good hall, Reverberation and reverberation time, Sabine's formula for reverberation time, Sound absorption, Room averaged sound absorption coefficient, Measurement of absorption coefficient, Factors affecting the acoustics of buildings, Requisites for good acoustics, Decibel scale, Acoustic quieting, Aspects of acoustic quieting, Methods of quieting, Quieting for specific observers, Mufflers, Soundproofing, Airborne soundproofing, Structure-borne soundproofing. Examples based on the theoretical principles.	25
2	**Optics:** Basics of Interference, Importance of coherence in interference, Amplitude division and wavefront division interference, Different types of interferometers – Newton, Michelson, Mach-Zehender etc, Interferometry and its applications – wavelength, refractive index and distance, Holography and applications. Basics of diffraction, Resolving power of optical instruments, limit of resolution, Rayleigh and Abbe criterion, limit of resolution of the eye, Resolving power of – a Telescope,	25

	microscope, grating and prism.	
3	**Lasers:** Introduction, The historical development of light sources and lasers, Attenuation of light in an optical medium, Thermal equilibrium; Interaction of light with matter, Einstein coefficients and their relations, Light amplification; Meeting the three requirements, Components of laser, Lasing action, Principal pumping schemes, Role of resonant cavity, Modes of the laser beam, Transverse modes, Types of lasers – gas, dye, solid state and semi-conductor, Laser beam characteristics – Intensity, coherence and directionality. Examples based on the theoretical principles.	25
4	**Practicals:** - Use of Vernier Callipers, Micrometre Screw Gauge, Traveling Microscope, multimeters etc.: Measurement Techniques and Applications. - Errors in observation: Types, sources, and elimination techniques. - Slit width determination using a laser beam and diffraction: Methodology and Applications. - Divergence properties of ordinary and laser light: Principle, analysis and Comparison. - Resolving power of prism: Principles and calculation. - Resolving Power of Telescope: Experiment and inference. - Newton Interferometer: Determination of refractive indices of transparent liquids. - Application of diffraction grating: Wavelength determination of given unknown Source.	25

Teaching Learning Methodology	Direct Teaching through Chalk-Walk and Talk ICT enabled teaching Question-Answer Problem-solving activities Concept Mapping Teaching with demonstration Group discussion/ Panel/Presentation

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1	Internal Examination	50 %
2	External Examination	50 %

Course Outcomes: Having completed this course, the learner will be able to	
1	Explain the key concepts of acoustics, including reverberation time, Sabine's formula, and sound absorption, and their impact on designing acoustically effective spaces.
2	Articulate the working principles of lasers, including light amplification, lasing action, and laser beam characteristics (intensity, coherence, directionality).
3	Understand the fundamentals of interference and diffraction, including the role of coherence, types of interferometers, and resolving power of optical instruments.
4	Interpret the behavior of laser systems, including the role of resonant cavities and pumping schemes, and analyze laser types and their applications.
5	Learn numerical methods for analysing experimental observations.
6	Determine different properties of optical equipment and components like resolving power and refractive indices.

Suggested References:	
1	Principles of Engineering Physics 1 Md. N. Khan, S. Panigrahi Cambridge University Press 2016.
2	A textbook of optics N. Subrahmanyam, Brijlal, M. N. Avadhanulu, S. Chand (Reprint 2018).
3	Elements of Properties of Matter D. S. Matur S Chand & Co., New Delhi (Reprint 2018).
4	Engineering Physics R K Gaur and S L Gupta Dhanpat Rai Publications (P) Ltd., New Delhi (Reprint 2016)
5	A Textbook of Optics D N Vasudeva Atma Ram & Sons, Delhi (20th Edition) .
6	Engineering Physics K Rajagopal PHI Learning, New Delhi (Third Printing 2009)
7	Optics E. Hecht, A. R. Ganesan, Pearson (2019).
8	University Practical Physics D. C. Tayal Himalaya Publishing House. 2000.
9	Advanced Practical Physics for students B L Worsnop and H T Flint Methuen and Co. Ltd., London (1951).
10	B.Sc. Practical Physics C L Arora S. Chand & Co. Ltd., New Delhi (2018).
11	Advanced Practical Physics M S Chauhan and S P Singh Pragati Prakashan, Meerut (1984).
12	Advanced Practical Physics S L Gupta and V Kumar Pragati Prakashan, Meerut (1998)
13	B.Sc. Practical Physics Harnam Singh and Dr. P.S. Hemne S. Chand & Co. Ltd., New Delhi (2000).

On-line resources to be used if available as reference material
NPTEL – Architectural Acoustics, IIT Kharagpur https://archive.nptel.ac.in/noc/courses/noc21/SEM2/noc21-ar06
NPTEL – Applied Optics, IIT Roorkee https://www.nptel.ac.in/courses/115107131
OpenStax – Physics: Interference, Diffraction and Coherence https://openstax.org/books/physics/pages/17-section-summary
Physics LibreTexts – Acoustics https://phys.libretexts.org/Bookshelves/Waves_and_Acoustics/Acoustics

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Semester -I

Course Code	US01MIMTS01	Title of the Course	Fundamentals of Chemistry-1
Total Credits of the Course	04 (3 T + 1 P)	Hours per Week	03 + 02

Course Objectives:	1. An introduction to chemistry as a scientific discipline and its relevance in everyday life. 2. An overview of the historical development and broad scope of chemistry as a central science. 3. Fundamental concepts from major branches of chemistry—organic, inorganic, analytical, and physical chemistry—to build a strong conceptual base for advanced studies.

Course Content		
Unit	Description	Weightage (%)
1	**Periodic properties:** The periodic table: Introduction to the periodic table and classification of elements, types of elements including representative, transition, inner-transition elements, and noble gases. Shielding effect and effective nuclear charge: Trends in shielding and effective nuclear charge across periods and down groups. Ionization energy (IE): Definition, factors affecting ionization energy and electron configuration. Periodic trends in ionization energies, ionization energy values, ionization energies of isoelectronic species, order of second ionization energies. Ionization potential and electrode potential. Electron affinity (EA): Electron affinity and ionization energy, second electron affinity (EA_2), factors affecting electron affinity. Trends in electron affinity values across the periodic table, EA values among different groups of elements. Electronegativity: Definition and significance in chemical bonding. Electronegativity scales, factors affecting electronegativity, its role in chemical reactivity and bond character. Electronegativity of s- and p-block elements. Electronegativity to predict molecular polarity, bond type, and reactivity. Numerical applications and problem solving: Calculation of shielding effect and effective nuclear charge, ionization energies, electron affinities, and electronegativity scales in chemical analysis.	25
2	**Ionic equilibria in aqueous solutions:** Acids and Bases: Definitions and acid-base theories. Strength of Acids and Bases: Strong and weak acids and bases. Degree of ionization and dissociation constants (Ka and Kb). Effect of concentration and temperature on acid-base strength. Interrelationship among Ka, Kb, and the ionic product of water (Kw). pH Scale and Related Concepts: Definitions and calculations of pH, pOH, and pKw. Temperature dependence of pKw. The pH in chemical systems. Self-Ionization of Water: Water auto-ionization and Kw. Acid-base equilibrium and pH calculations. Hydrolysis of Salts: Hydrolysis of salts of strong acid with weak base, weak acid with strong/weak base. Hydrolysis constant Kh,	25

	dissociation constants Ka and Kb. Buffer Solutions: Definition and Buffer action henderson–Hasselbalch equation. Buffer capacity. Acid–Base Indicators: Acid-base indicators and their selection in titration. Color change and pH ranges. Solubility/ Precipitation Equilibria: Ksp, Common ion effect. Selective precipitation in qualitative inorganic analysis. Numerical problems on pH and pOH, ionization constants, hydrolysis equilibrium, and solubility product problems.	
3	**Alkanes, alkenes, alkynes:** Introduction to Hydrocarbons: Their Classification and characteristics. Physical properties of alkanes, alkenes, and alkynes. IUPAC nomenclature of alkanes, alkenes, and alkynes. Alkanes: Methods of preparation: From alkenes by catalytic hydrogenation, reduction of alkyl halides, the Grignard reagent, Corey–House synthesis, and the Wurtz reaction. Halogenation mechanism: Free radical chain mechanism with orientation and selectivity in halogenation of n-propane, n-butane, isopentane, isobutane, n-pentane, and 2,3-dimethylbutane. Alkenes: Preparation methods: Dehydrohalogenation of alkyl halides via E2 mechanism with detailed steps and evidence; dehydration of alcohols through the E1 mechanism involving carbocation rearrangements. Reactions and mechanisms: Electrophilic addition and rearrangement reactions, halogen addition, halohydrin formation, free radical additions, hydroxylation reactions, and ozonolysis with emphasis on mechanistic understanding and application-based problem-solving. Alkynes Preparation methods: Dehydrohalogenation of alkyl di-halides and alkylation of metal acetylides with primary alkyl halides. Reactions and properties: Hydration reactions of alkynes, acidity of terminal alkynes and stability of their conjugate bases, along with modern analytical techniques and spectral identification of alkynes.	25
4	**Practicals:** **Introduction to the chemical laboratory** - Familiarization with standard laboratory setup, proper handling, and use of everyday glassware, chemicals, and reagents. - Understanding the properties and safe usage of organic and inorganic solvents. - Introduction to bench reagents and side reagents commonly used in chemical experiments. - Emphasis on essential safety practices, identifying toxic and hazardous substances, and implementing appropriate safety precautions to ensure a secure laboratory environment. **Volumetric Analysis Practicals** Each practical exercise involves the preparation of a standard solution of the titrant followed by titration to determine the concentration of the analyte. These experiments emphasize accuracy in measurement, understanding stoichiometry, and interpreting titration curves. - Preparation of solution of primary standards. - Standardization of secondary standards using primary standards. - Standardization of Hydrochloric Acid (HCl) using standardized NaOH solution. - Acid-base titration of Hydrochloric Acid (HCl) with Sodium Carbonate (Na_2CO_3). - Titration of Oxalic Acid with Sodium Hydroxide (NaOH). - Titration of Hydrochloric Acid (HCl) with Sodium Bicarbonate ($NaHCO_3$). - Titration of Succinic Acid with Potassium Hydroxide (KOH). - Titration of Oxalic Acid with Potassium Hydroxide (KOH). - Titration of a mixed base system (NaOH + $NaHCO_3$) with Hydrochloric Acid (HCl). - Titration of a mixed base system (NaOH + $NaHCO_3$) with Sulfuric Acid (H_2SO_4).	25

Teaching Learning Methodology	Hands-on training through practical laboratory sessions, reinforced by conceptual understanding delivered in the classroom. The teaching approach is designed to be challenging, engaging, and inclusive, accommodating diverse learning styles. Key instructional methods include: Laboratory-based practical sessions focused on skill development in volumetric analysis. Interactive classroom teaching supported by blackboard, PowerPoint presentations, and audio-visual aids. Use of e-resources and online platforms for supplementary learning. Seminars, workshops, and model-based demonstrations to encourage collaborative and applied learning. This blended methodology ensures that students not only understand the theoretical basis of volumetric techniques but also gain the practical competence required for real-world chemical analysis.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1	Internal Examination	50 %
2	External Examination	50 %

Course Outcomes: Having completed this course, the learner will be able to	
1	Demonstrate hands-on proficiency in volumetric analysis techniques, including the accurate handling and usage of laboratory instruments such as burettes and pipettes.
2	Enhance their practical laboratory skills through systematic preparation, standardization, and execution of titration-based experiments.
3	Develop precision, accuracy, and confidence in chemical experimentation and data interpretation.
4	Apply acquired skills in real-world chemical analysis and further experimental chemistry courses.

Suggested References:	
1	Vogel, A. I. Vogel's Textbook of Quantitative Chemical Analysis, 6th Edition, Pearson Education.
2	Clayden, J., Greeves, N., Warren, S. Organic Chemistry, 2nd Edition, Oxford University Press.
3	Atkins, P. and de Paula, J. Atkins' Physical Chemistry, 11th Edition, Oxford University Press.
4	Shriver, D.F., Atkins, P.W., Langford, C.H. Inorganic Chemistry, 5th Edition, Oxford University Press.
5	Huheey, J. E., Keiter, E. A., Keiter, R. L. Inorganic Chemistry: Principles of Structure and Reactivity, 4th Edition, Pearson.
6	Skoog, D.A., West, D.M., Holler, F.J., Crouch, S.R. Fundamentals of Analytical Chemistry, 9th Edition, Cengage Learning.
7	Morrison, R.T. & Boyd, R.N. Organic Chemistry, 7th Edition, Pearson Education.
8	Lehninger, A.L., Nelson, D.L., Cox, M.M. Principles of Biochemistry, 7th Edition, W.H. Freeman and Company.
9	Mendham, J., Denney, R.C., Barnes, J.D., & Thomas, M.J.K. Vogel's Textbook of Quantitative Chemical Analysis, 6th Edition, Pearson Education.

	(A classic and comprehensive guide for quantitative analysis with a strong focus on titrimetric methods.)
10	Pandey, O.P., Bajpai, D.N., & Giri, S. Practical Chemistry, S. Chand Publishing. (Covers basic to advanced practical experiments with clear procedures and theoretical background.)
11	Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press. (Useful for understanding analytical techniques and laboratory handling skills relevant to real-world applications.)

On-line resources to be used if available as reference material
Google Books, INFLIBNET, NPTEL, Virtual Labs (MHRD), ScienceDirect, PubChem, ChemSpider.
Google Books, INFLIBNET, Google Scholar, Virtual Labs (MHRD), NPTEL

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Semester -I

Course Code	US01MDMTS01	Title of the Course	Basic Computing and Productivity Tools
Total Credits of the Course	04 (3 T + 1 P)	Hours per Week	03 + 02

Course Objectives:	1. Understand basic computing concepts, computer architecture, operating systems, and internet fundamentals. 2. Develop digital literacy, including use of academic tools, cybersecurity, and generative AI awareness. 3. Gain skills in MS Office and Google Workspace for document, spreadsheet, and presentation tasks. 4. Learn basic Python programming concepts and write simple interdisciplinary programs. 5. Apply learning through practical tasks in document creation, data handling, presentations, Python coding, and online tools.

Course Content		
Unit	Description	Weightage (%)
1	**Fundamentals of Computing and Digital Literacy:** Introduction to computers: evolution, classification, applications in daily life and academics. Basic architecture: hardware (CPU, memory, input/output devices) and software (system vs application software). Operating Systems: introduction to Windows/Linux, file and folder management. Internet basics: web browsers, search engines, URLs, emails, cloud storage (Google Drive, OneDrive). Cybersecurity: passwords, phishing, malware, ethical internet use. Digital tools for academia: online collaboration tools (Google Docs, Google Forms), academic search engines (Google Scholar, NDLI), and e-libraries. Introduction to generative AI and Generative AI and Its Applications in education, writing assistance, image generation, content creation, Ethical considerations: misinformation, authorship, and responsible use.	25

2	**Office Productivity Tools:** Word Processing (MS Word/Google Docs): Formatting text, inserting tables/images, page layout, references, and basic templates for academic documents. Spreadsheet Tools (MS Excel/Google Sheets): Cell referencing, formulas (SUM, AVERAGE, IF), sorting and filtering data, charts and graphs, basic data analysis for tabular data. Presentation Tools (MS PowerPoint/Google Slides): Slide design, inserting visuals and charts, using transitions/animations, designing mini presentations for seminars or reports.	25
3	**Introduction to Programming using Python:** Programming concepts: need for coding, applications across disciplines. Writing your first Python program: input/output, variables, data types. Conditional statements (if, else, elif) and loops (for, while). Lists and simple operations, basic functions and modular coding. Problem-solving examples from interdisciplinary	25
4	**Practical:** -Creating, editing, and formatting a document in Word or Google Docs. -Developing an academic report or project summary using productivity tools. -Using Excel/Sheets to record, compute, and visualize data (e.g., attendance, marks, expenses). -Designing a slide academic presentation. -Writing small Python programs using loops, conditionals, and functions. -Creating and distributing a survey using Google Forms.	25

Teaching Learning Methodology	Direct Teaching through Chalk-Walk and Talk ICT enabled teaching Question-Answer Problem-solving activities Concept Mapping Teaching with demonstration Group discussion/ Panel/Presentation

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1	Internal Examination	50 %
2	External Examination	50 %

Course Outcomes: Upon completion of this course, students will be able to:	
1	Describe the basic architecture of a computer, differentiate between hardware and software, explain the role of operating systems, and demonstrate safe and ethical internet usage including cybersecurity awareness.
2	Utilize digital tools such as search engines, cloud storage, academic databases, and collaboration platforms (Google Docs, Forms) for academic and research purposes.
3	Explain the concept of generative AI, identify its applications in education and content creation, and discuss ethical concerns including misinformation and responsible use.
4	Create, format, and edit academic documents using word processing software (MS Word / Google Docs) with proper layout, tables, images, and references.
5	Use spreadsheet tools (MS Excel / Google Sheets) to organize data, apply formulas (SUM, AVERAGE, IF), sort and filter data, and generate charts for basic data analysis.
6	Design effective slide-based presentations (MS PowerPoint / Google Slides) incorporating visuals, charts, transitions, and animations for seminars or academic reports.
7	Write, execute, and debug simple Python programs involving input/output, variables, data types,

	conditional statements, loops, lists, and basic functions.
8	Integrate multiple productivity tools (word processor, spreadsheet, presentation, online forms) and Python programming to solve simple interdisciplinary problems relevant to biological sciences.

Suggested References:	
1	P. K. Sinha and P. Sinha, Computer Fundamentals and Office Automation, 4th ed. New Delhi, India: BPB Publications, 2022.
2	R. Bangia, Learning Microsoft Office, 3rd ed. New Delhi, India: Khanna Publishing, 2020.
3	D. McFedries, Teach Yourself VISUALLY Google Workspace, Hoboken, NJ: Wiley
4	E. Mollick and L. Mollick, Practical AI for Teachers and Students. Philadelphia, PA: Wharton Interactive, 2023. [Online]. Available: https://practical.chat
5	S. S. Shukla, Python Programming: A Practical Approach, 1st ed. New Delhi, India: BPB Publications, 2020.
6	P. Sharma, Python for Beginners, 1st ed. New Delhi, India: Dreamtech Press, 2021.

On-line resources to be used if available as reference material
Online resources related to the topics

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Semester -I

Course Code	US01AEMTS01	Title of the Course	Functional English-1
Total Credits of the Course	02 (T)	Hours per Week	02

Course Objectives:	1. To introduce students to the fundamentals of functional English. 2. To enhance students' verbal and non-verbal communication skills. 3. To develop basic writing skills suitable for academic and professional contexts. 4. To improve students' reading comprehension abilities. 5. To apply functional English in practical scenarios through role-plays and discussions.

Course Content		
Unit	Description	Weightage (%)
1	**Introduction to Functional English** Vocabulary (Homophones, Homonyms, Phrasal Verbs, & Word Formation) Basics of Grammar (Tenses, Sequence of Tenses, Modal Auxiliaries, Prepositions, Linking words) Common Grammatical Errors	50
2	**Communication Skills** Meaning, Objectives and Process of Verbal Communication Listening – Qualities of an Active Listener, Note-Taking (Use of relevant audios/videos is recommended) Speaking – Qualities of a Good Speech and Speaker, Various Speeches (Welcome/Farewell, Vote of Thanks) during Technical and Non-Technical Events Reading Comprehension – Practice in Reading Comprehension using relevant scientific passages Writing – Paragraph Writing	50
	Assessment Methods Continuous assessment through presentations, group discussions, assignments, quizzes, and class participation Mid-semester and end-semester examinations Practical assessments through presentations, group projects, and role-plays	

Teaching Learning Methodology	Direct Teaching through Chalk-Walk and Talk ICT enabled teaching Question-Answer Problem-solving activities Concept Mapping Teaching with demonstration Group discussion/ Panel/Presentation

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1	Internal Examination	50 %
2	External Examination	50 %

Course Outcomes: Upon completion of this course, students will be able to:	
1	Students will be able to differentiate between academic and functional English.
2	Students will improve their listening and speaking skills for effective communication.
3	Students will be able to write clear and coherent sentences and paragraphs.
4	Students will develop the ability to comprehend and analyse written texts.
5	Students will demonstrate practical application of functional English in real-life situations.

Suggested References:	
1	Effective Communication Skills for Scientific and Technical Professionals by Harry Chambers
2	English for Everyone: Phrasal Verbs by Thomas Booth, Ben Ffrancon Davies, Peter Dainty, et al
3	English for Everyone: Idioms by Thomas Booth, Jenny Wilson
4	Oxford English Grammar Course (Advanced) by Michael Swan, Catherine Walter
5	Communication Skills by Parul Popat & Kaushal Kotadia
6	Listen to Me, Listen to You: A Step-by-Step Guide to Communication Skills Training by Mandy Kotzman, Anne Kotzman
7	Note Taking Made Easy: Strategies for Helping All Students Take Effective Notes by Deana Hippie
8	Functional English Grammar: An Introduction for Second Language Teachers by Graham Lock (Cambridge Language Education)
9	Practical English Grammar (4th ed.) by A.V. Martinet & A.J.A. Thomason (Oxford University Press, Delhi)
10	Active Listening Techniques: 30 Practical Tools to Hone Your Communication Skills by Nixsali Leonardo LCSW

On-line resources to be used if available as reference material
1. https://readtheory.org/ 2. https://www.bbc.co.uk/learningenglish/ 3. https://www.khanacademy.org/humanities/grammar 4. https://www.quill.org/

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Semester -I

Course Code	US01SEMTS01	Title of the Course	Basic Experiments of Materials
Total Credits of the Course	02	Hours per Week	04

Course Objectives:	1. Understand the measurement of refractive index, density, and mechanical properties of materials 2. Analyze the effect of temperature and light on electrical and material properties 3. Understanding of fundamental physics laws, including Ampère's Law, Hooke's Law,

Course Content		
Unit	Description	Weightage (%)
1	Determination of Refractive Index of Different Liquids Using Optical Methods	100
2	Density Measurement of Liquids and Solids Using Archimedes' Principle	
3	Temperature Dependence of Electrical Resistance in Copper Wire	
4	Experimental Verification of Ampère's Law Using a Current-Carrying Coil	
5	Measurement of Young's Modulus and Validation of Hooke's Law in Materials	
6	Effect of Temperature and Monochromatic Light on Material Properties	
7	Poisson's ratio for Rubber	

Teaching Learning Methodology	Hands-on Experience Direct teaching through chalk-walk and talk ICT enabled teaching Question-answer Problem-solving activities Concept mapping Teaching with demonstration Group discussion/ Panel/Presentation

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1	Internal Examination	50 %
2	External Examination	50 %

Course Outcomes: Having completed this course, the learner will be able to	
1	Students will develop hands-on skills in measuring physical properties of materials such as refractive index, density, and electrical resistance using standard laboratory methods.
2	Students will understand and interpret the effects of temperature, light, and mechanical stress on various material properties, including elasticity and resistance.

3	Students will experimentally validate theoretical concepts like Ampère's law, Hooke's law, and Poisson's ratio, enhancing their ability to correlate practical results with physical laws.

Suggested References:	
1	Materials Science for Engineers – James F. Shackelford
2	Fundamentals of Materials Science and Engineering– William D. Callister Jr
3	Introduction to Engineering Materials-G. T. Murray

On-line resources to be used if available as reference material
https://pubs.aip.org/aip/rsi/article/4/4/231/303670/A-Simple-Method-of-Determining-the-Refractive
https://www.scribd.com/doc/294394861/Refractive-Index-of-Different-Liquids-Using-Hollow-Prism
https://nptel.ac.in/translation

SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar, Gujarat

Reaccredited with 'A' Grade by NAAC (CGPA 3.11)

Syllabus with effect from the Academic Year 2026-2027

Bachelor of Science (Undergraduate) – Materials Science

Semester -I

Course Code	US01IKMTS01	Title of the Course	Foundations of Indian Knowledge Systems
Total Credits of the Course	02 (T)	Hours per Week	02

Course Objectives:	1. To introduce students to the rich heritage of Indian Knowledge Systems (IKS) and their relevance in contemporary scientific inquiry. 2. To explore the contributions of ancient Indian scholars in mathematics, astronomy, metallurgy, medicine, and physics. 3. To develop an understanding of holistic health principles from Ayurveda and their connection to modern biological sciences. 4. To hig1hlight the scientific principles underlying ancient Indian practices in acoustics, environmental sustainability, and material science. 5. To foster an appreciation for interdisciplinary approaches integrating traditional knowledge with modern biological research.

Course Content		
Unit	Description	Weightage (%)
1	**Introduction to IKS and Scientific Inquiry in Ancient India:** (i) Definition and Scope of IKS Overview of Indian Knowledge Systems: Meaning and Scope. Distinction between traditional knowledge and modern scientific frameworks. (ii) Major Knowledge Traditions of India The Vedas, Upanishads, and the Gita: Their relevance today. Six Darshanas (schools of philosophy) – Nyaya, Vaisheshika, Samkhya, Yoga, Mimamsa, Vedanta – and their approach to knowledge. (iii) Ancient Indian Mathematicians Aryabhata: Aryabhatiya, concept of zero, place value system, trigonometry. Brahmagupta: Brahmasphutasiddhanta, rules for zero, quadratic equations. (iv) Astronomy and Space Science in Ancient India Surya Siddhanta: planetary motions, time calculation (yugas), eclipses. Contributions to cosmology and calendar systems.	50
2	**Scientific and Technological Developments in Classical India:** (i) Metallurgy and Material Science Iron Pillar of Delhi: corrosion resistance, metallurgical techniques. Wootz Steel: production methods, global influence (Damascus steel). (ii) Ayurveda and Holistic Health Charaka Samhita: concepts of Tridosha (Vata, Pitta, Kapha), digestion, metabolism (Agni), immunity (Ojas). Sushruta Samhita: surgical techniques, anatomy, classification of diseases, herbal	50

	remedies. Relevance to modern biology: personalized medicine, microbiome, psychoneuroimmunology. (iii) Acoustic Science in Sanskrit Phonetics Panini's Ashtadhyayi: grammatical framework, phonological rules. Shiksha: phonetics, articulation, sound production, resonance. Scientific basis of Sanskrit phonemes and their effects on speech and cognition. (iv) Principles of Physics in Ancient India Concept of sound (Shabda): propagation, frequency, vibration. Concept of ether (Akasha): as a medium for sound and energy transfer. Ancient ideas on energy transfer and dynamics in Vaisheshika school. (v) Ancient Indian Environmental Wisdom Ecological consciousness in Indian traditions: reverence for nature (trees, rivers, animals). Water conservation: stepwells (baolis), ancient irrigation systems, rainwater harvesting. Sustainable agriculture: organic farming practices, crop rotation, use of natural fertilizers in ancient India. Relevance to contemporary environmental issues and sustainability science.	

Teaching Learning Methodology	Classroom lectures, case studies, Group discussions

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1	Internal Examination	50 %
2	External Examination	50 %

Course Outcomes: Upon completion of this course, students will be able to:	
1	Define the scope of Indian Knowledge Systems and explain the major knowledge traditions including Vedas, Upanishads, Gita, and the six Darshanas.
2	Describe the contributions of ancient Indian mathematicians (Aryabhata, Brahmagupta) and astronomers (Surya Siddhanta) to global science.
3	Explain the scientific principles behind ancient Indian metallurgy (Iron Pillar, Wootz Steel) and their relevance to material science.
4	Describe the holistic health principles of Ayurveda from Charaka and Sushruta Samhitas and relate them to modern biological and medical sciences.
5	Explain the acoustic science underlying Sanskrit phonetics (Panini's Ashtadhyayi, Shiksha) and the ancient Indian concepts of sound, ether, and energy transfer.
6	Discuss the ecological wisdom in Indian traditions including water conservation, sustainable agriculture, and environmental ethics, and relate them to contemporary environmental challenges.

Suggested References:	
1	AICTE, Indian Knowledge Systems (IKS) Handbook, AICTE Publications, 2022, Ch. 1 (pp. 1-25).
2	B. Mahadevan et al., Introduction to Indian Knowledge System: Concepts and Applications, PHI Learning, 2022.
3	Kapil Kapoor and Avadesh Kumar Singh, Knowledge Traditions and Practices of India, Vol. 1, Pearson Education India, 2005 (Sections on Vedas and Darshanas).
4	S. Radhakrishnan (Ed.), The Principal Upanishads, HarperCollins Publishers India, 1994 (Selections).
5	Various authors, Bhagavad Gita (Translations with commentaries, select chapters).
6	Pbhutibhushan Datta and Avadhesh Narayan Singh, History of Hindu Mathematics, Asia Publishing House, 1962 (Chapters related to Aryabhata and Brahmagupta).
7	Bharati Krishna Tirtha, Vedic Mathematics, Motilal Banarsidass Publishers, 1965 (Introduction and select chapters, focus on historical context).
8	S. Balachandra Rao, Indian Astronomy: An Introduction, Universities Press, 2000 (Chapters on Surya Siddhanta).
9	D.M. Bose, S.N. Sen, and B.V. Subbarayappa, A Concise History of Science in India, Indian National Science Academy, 1971 (Chapter on Astronomy).
10	Dharampal, Indian Science and Technology in the Eighteenth Century: Some Contemporary European Accounts, Academy of Gandhian Studies, 1971 (Chapter on Metallurgy).
11	P.V. Sharma, Caraka Samhita: A Scientific Synopsis, Chaukhambha Orientalia, 2001 (Select chapters).
12	P. K. Mukhopadhyay, Vedic Knowledge and Science, New Age Books, 2004 (Chapter on Phonetics).
13	Debiprasad Chattopadhyaya, History of Science in India, K.P. Bagchi & Company, 1982 (Relevant sections).
14	R. N. Iyengar, Sustainable Practices in Ancient Indian Science and Technology, Indian National Academy of Engineering, 2015.
15	R. Narayan, Indian Environmental Ethics, D.K. Printworld, 2009.