CREDIT FRAME WORK

For the Papers offered during I, II, III, IV, V, VI Semesters

(As Approved in the BOS meeting held on 12th July 2024 for batch 2024-25)

COURSE STRUCTURE

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
I	I	1	Essentials and Applications of Mathematical, Physical and ChemicalSciences	3+2	4
		2	Advances in Mathematical, Physical andChemical Sciences	3+2	4
	II	3	Concepts in Material science	3	3
			Concepts in Material science Practical Course	2	1
		4	Science of Materials in Daily Life	3	3
			Science of Materials in Daily Life Practical Course	2	1
			Minor: Mathematics	5	4
			Community Service Project (CSP)	24	4
II	III	5	Crystallography and crystal structures	3	3
			Crystallography and crystal structures Practical Course	2	1
		6	Thermodynamics and kinematics of materials	3	3
			Thermodynamics and kinematics of materials PracticalCourse	2	1
		7	Mechanical Properties of Materials	3	3
			Mechanical Properties of Materials Practical Course	2	1
		8	Electrical and Magnetic Properties of Materials	3	3
			Electrical and Magnetic Properties of Materials Practicalcourse	2	1
			Minor: Mathematics	4	4
	IV	9	Characterization Techniques in Material Science	3	3
			Characterization Techniques in Material Science PracticalCourse	2	1
		10	Polymer Science	3	3
			Polymer Science Practical Course	2	1
		11	Ceramics and Composite Materials	3	3
			Ceramics and Composite Materials Practical Course	2	1
			Minor1: Mathematics		
			Minor 2: Mathematics		
			On Job Training (OJT)	24	4

B.Sc (Honours) with Single Major

Semester	Major* (4 Cr)			Minor (4 Cr)			AECC (3 Cr)			Multi Disny' (2 Cr)			Skill Enhancement Courses (2Cr)			OOTC			Env. Edn (2 Cr)			Total		
	C	H	Cr	C	H	Cr	C	H	Cr	C	H	Cr	C	H	Cr	C	H	Cr	C	H	Cr	C	H	Cr
Sem 1	2*	10	8				2	8	6	1	2	2	2	6	4							7	26	20
Sem 2	2	10	8	1	3+2	4	2	8	6				2	6	4							7	29	22
Community Service Project of 180 hours with 4 Credits. Student is eligible for Exit Option-1 with the award of Certificate in respective discipline																								
Sem 3	4	12+8	16	1	3+2	4				1	2	2	1	2	2							7	29	24
Sem 4	3	9+6	12	2	6+4	8				1	2	2	1	2	2							7	29	24
Short-Term Internship/Apprenticeship/OJT of 180 hours with 4 Credits. Student is eligible for Exit Option-2 with the award of Diploma in respective major with minor																								
Sem 5	4	12+8	16	2	6+4	8													1	2	2	7	32	26
Sem 6	**Semester Internship/Apprenticeship/OJT with 12 Credits. Student is eligible for Exit Option-3 with the award of Degree in respective major with minor**																							
																			IKS#					
Sem 7	3	9+6	12										2*	6+4	8	1	2	2	1	2	0	6	29	22
Sem 8	3	9+6	12										2*	6+4	8	1	2	2	1	2	0	6	29	22
	21		84	6		24	4		12	3	6	6	#	32	28	2	4	4	2	4	0	47		**160**

20 Additional Credits for 10 month mandatory Internship/OJT/Apprenticeship

C Courses **H Hours** **Cr Credits** **OOTC** **Open Online Transdisciplinary**

IKS# **Indian Knowledge Systems - Audit Course**

Government College (Autonomous) Rajahmundry

Curriculum 2024-25

Version: 1.0

COURSES OFERED IN THE PROGRAM

S.No	SEM	COURSE CODE	COURSE TYPE	TITLE OF THE COURSE	CIA	SEE	Hours / Week			
							L	T	P	C
1	I	124901	MAJOR	Essentials and Applications of Mathematical, Physical and Chemical Sciences	50	50	3	-	2	4
		124902	MAJOR	Advances in Mathematical, Physical and Chemical Sciences	50	50	3	-	2	4
2	II	224901	MAJOR	Concepts in Material science	50	50	3	-	-	3
			MAJOR	Concepts in Material science Practical Course	--	50	-	-	2	1
		224902	MAJOR	Science of Materials in Daily Life	50	50	3	-	-	3
			MAJOR	Science of Materials in Daily Life Practical Course	--	50	-	-	2	1
			MINOR	Mathematics						
3	III	324901	MAJOR	Crystallography and crystal structures	50	50	3	-	-	3
				Crystallography and crystal structures Practical Course	--	50	-	-	2	1
		324902	MAJOR	Thermodynamics and kinematics of materials	50	50	3	-	-	3
				Thermodynamics and kinematics of materials PracticalCourse	--	50	-	-	2	1
		324903	MAJOR	Mechanical Properties of Materials	50	50	3	-	-	3
				Mechanical Properties of Materials Practical Course	--	50	-	-	2	1
		324904	MAJOR	Electrical and Magnetic Properties of Materials	50	50	3	-	-	3
				Electrical and Magnetic Properties of Materials Practicalcourse	--	50	-	-	2	1

			MINOR	Mathematics						
4	**IV**	**424901**	**MAJOR**	Characterization Techniques in Material Science	**50**	**50**	**3**	**-**	**-**	**3**
				Characterization Techniques in Material Science Practical Course	**--**	**50**	**-**	**-**	**2**	**1**
		424902	**MAJOR**	Polymer Science	**50**	**50**	**3**	**-**	**-**	**3**
				Polymer Science Practical Course	**--**	**50**	**-**	**-**	**2**	**1**
			MAJOR	Ceramics and Composite Materials						
				Ceramics and Composite Materials Practical Course						
			MINOR	Minor1: Mathematics						
			MINOR	Minor 2: Mathematics						

Scheme of Valuation

GOVERNMENT COLLEGE(A), RAJAHMUNDRY: DEPARTMENT OF PHYSICS

For all Semester End Examinations

(As Approved in the BOS meeting held on 12/07/2024for batch 2024-25)

SEMESTER END THEORY EXAMINATIONS

SCHEME OF EVALUATION

Examination	No.of Marks	Remarks
Semester end examination	50	Model of examination patternfurnished below
Internal examination	50	Pedagogy methods like Quiz, classroom seminar, Assignment orCase study, Test, puzzles, viva andfew more innovative methods Followed by individual lecturer

MODEL OF SEMESTER END EXAMINATION QUESTION PAPER [THEORY]

PART	DESCRIPTION	MARKS
A	Essay type questions- Five questions to be asked withinternal choice in each question (A or B) from each unit. Student has to answer five questions choosing one (A or B) from each question. Each question Carries 7 marks.	5x7= 35
B	Short answer type questions -Eight questions are to be asked (4 theories + 4 numerical). Student has to answer any five questions.Each question carries 3 marks	5x3= 15
	TOTALMARKS	50

Time: 2.30 Hours **Max.Marks:50**

TYPE OF QUESTION	MARKS	SCHEME
PART-A Essay Questions	Each question carries 7 Marks **5x7 = 35 M**	**Answer all questions** 1. (A)&(B)-From Unit I 2. (A)&(B)–From Unit II 3. (A)&(B)-From Unit III 4. (A)&(B)-From Unit IV 5. (A)&(B)-From Unit V
Short Answer Questions	**5x3= 15 M**	**Answer any 5 out of 8 questions** • 4 Theoretical Questions • Not more than one question from Each unit. • 4 Numerical Questions • Not more than one question From each unit. • At least one theoretical/ numerical to be asked • From each unit.

SEMESTER END PACTICAL EXAMINATIONS

EVALUATION SCHEME

S.No	Description	Marks
1	FORMULA	05
2	TABULAR FORM & READINGS	10
3	CALCULATIONS & RESULT (Including Graph)	15
4	PRECAUTIONS & UNITS	05
5	VIVA VOCE	05
6	RECORD**	10
7	**TOTAL**	**50**
INTERNAL PRACTICAL EXAM FOR ODD SEM: 50M EXTERNAL PRACTICAL EXAM F OR EVEN SEM: 50M TOTAL: 100 M		

**Award of marks for number of practical recorded in the Record

05 PRACTICALS and above	-	10
04 PRACTICALS	-	08
03 PRACTICALS	-	06
02 PRACTICALS	-	05
LESSTHAN02	-	00

AP STATE COUNCIL OF HIGHER EDUCATION

B.Sc. Materials Science

SYLLABUS UNDER CBCS (w.e.f. 2023-24)

B.Sc. Materials Science (Single Major)

SEM-I

Course 1. ESSENTIALS AND APPLICATIONS OF MATHEMATICAL, PHYSICAL & CHEMICAL SCIENCES

Course 2. ADVANCES OF MATHEMATICAL, PHYSICAL & CHEMICAL SCIENCES

SEM-II

Course 3. CONCEPTS IN MATERIALS SCIENCE

Course 4. SCIENCE OF MATERIALS IN DAILY LIFE

SEM-III

Course 5. CRYSTALLOGRAPHY AND CRYSTAL STRUCTURES (MINOR)

Course 6. THERMODYNAMICS AND KINETICS OF MATERIALS

Course 7. MECHANICAL PROPERTIES OF MATERIALS

Course 8. ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS

SEM-IV

Course 9. CHARACTERIZATION TECHNIQUES IN MATERIAL SCIENCE (MINOR)

Course 10. POLYMER SCIENCE (MINOR)

Course 11. CERAMICS AND COMPOSITE MATERIALS

SEM-V

Course 12. NANOMATERIALS AND NANOTECHNOLOGY

Course 13. BIOMATERIALS

Course 14. ELECTRONIC MATERIALS

Course 15. MATERIALS FOR ENERGY APPLICATIONS

SEM-VI

Internship

Note: All the above 15 courses are majors for Materials Science single major students. Among 15, the 6 courses that are marked as minor will be offered to other single major students.

SEM- I

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
I	I	1	Essentials and Applications of Mathematical, Physical and ChemicalSciences	3+2	4
		2	Advances in Mathematical, Physical andChemical Sciences	3+2	4

	Government College (Autonomous) Rajahmundry	Program & Semester I B.Sc., (I SEM)			
Course Code 124901	ESSENTIALS AND APPLICATIONS OF MATHEMATICAL, PHYSICALAND CHEMICAL SCIENCES				
Teaching	Hours Allocated: 60 (**Theory**)	L	T	P	C
Pre-requisites:	Trigonometric ratios, vector multiplication, Laws of motion, Basics of thermodynamics, kepler‟s laws, Inverse square law, Periodic table, classification matter	3	0	2	4

Course Objective:

The objective of this course is to provide students with a comprehensive understanding of theessential concepts and applications of mathematical, physical, and chemical sciences. The course aims to develop students' critical thinking, problem-solving, and analytical skills in these areas, enabling them to apply scientific principles to real-world situations.

Learning outcomes:

	On Completion of the course, the students will be able to-	Cognitive Domain
CO1	Apply critical thinking skills to solve complex problems involving complex numbers, trigonometric ratios, vectors, and statistical measures.	Understanding & Application
CO2	To Explain the basic principles and concepts underlying a broad range of fundamental areas of physics and to Connect their knowledge of physicsto everyday situations	Application
CO3	To Explain the basic principles and concepts underlying a broad range offundamental areas of chemistry and to Connect their knowledge of chemistry to daily life.	Understanding, Application
CO4	Understand the interplay and connections between mathematics, physics,and chemistry in various applications. Recognize how mathematical models and physical and chemical principles can be used to explain and predict phenomena in different contexts.	understanding , Applications
CO5	To explore the history and evolution of the Internet and to gain an understanding of network security concepts, including threats, vulnerabilities, and countermeasures	Application

SYLLABUS:

COURSE 1: ESSENTIALS AND APPLICATIONS OF MATHEMATICAL,PHYSICAL ANDCHEMICAL SCIENCES

UNIT I: ESSENTIALS OF MATHEMATICS:

Complex Numbers: Introduction of the new symbol i – General form of a complex number – Modulus-Amplitude form and conversions

Trigonometric Ratios: Trigonometric Ratios and their relations – Problems on calculation of angles

Vectors: Definition of vector addition – Cartesian form – Scalar and vector product and problems

Statistical Measures: Mean, Median, Mode of a data and problems

UNIT II: ESSENTIALS OF PHYSICS:

Definition and Scope of Physics- Measurements and Units - Motion of objects: Newtonian Mechanics and relativistic mechanics perspective - Laws of Thermodynamics and Significance- Acoustic waves and electromagnetic waves- Electric and Magnetic fields and their interactions- Behavior of atomic and nuclear particles- Wave-particle duality, the uncertainty principle- Theories and understanding of universe

UNIT III: ESSENTIALS OF CHEMISTRY:

Definition and Scope of Chemistry- Importance of Chemistry in daily life -Branches of chemistry and significance- Periodic Table- Electronic Configuration, chemical changes, classification of matter, Biomolecules- carbohydrates, proteins, fats and vitamins.

UNIT IV: APPLICATIONS OF MATHEMATICS, PHYSICS & CHEMISTRY:

Applications of Mathematics in Physics & Chemistry: Calculus, Differential Equations & Complex Analysis

Application of Physics in Industry and Technology: Electronics and Semiconductor Industry, Robotics and Automation, Automotive and Aerospace Industries, Quality Control and Instrumentation, Environmental Monitoring and Sustainable Technologies.

Application of Chemistry in Industry and Technology: Chemical Manufacturing, Pharmaceuticals and Drug Discovery, Materials Science, Food and Beverage Industry.

UNIT V: ESSENTIALS OF COMPUTER SCIENCE:

Milestones of computer evolution - Internet, history, Internet Service Providers, Types of Networks, IP, Domain Name Services, applications.

Ethical and social implications: Network and security concepts- Information Assurance Fundamentals, Cryptography-Symmetric and Asymmetric, Malware, Firewalls, Fraud Techniques- Privacy and Data Protection

Recommended books:

1. Functions of one complex variable by John.B.Conway, Springer- Verlag.
2. Elementary Trigonometry by H.S.Hall and S.R.Knight
3. Vector Algebra by A.R.Vasishtha, Krishna Prakashan Media(P)Ltd.
4. Basic Statistics by B.L.Agarwal, New age international Publishers
5. University Physics with Modern Physics by Hugh D. Young and Roger A. Freedman
6. Fundamentals of Physics by David Halliday, Robert Resnick, and Jearl Walker
7. Physics for Scientists and Engineers with Modern Physics" by Raymond A. Serway and John W. Jewett Jr.
8. Physics for Technology and Engineering" by John Bird
9. Chemistry in daily life by Kirpal Singh
10. Chemistry of bio molecules byS. P. Bhutan
11. Fundamentals of Computers by V. RajaRaman
12. Cyber Security Essentials by James Graham, Richard Howard, Ryan Olson

vv CO-PO Mapping:

(1: Slight [Low];2: Moderate [Medium]; 3: Substantial [High], '-' : No Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	1	2	2	3	1	2	1	1	3	2	3	2	2	3	2
CO2	2	1	2	1	2	2	1	2	2	2	2	2	2	1	2	2
CO3	2	1	2	2	3	2	1	2	2	2	2	3	2	1	3	2
CO4	3	2	2	2	3	3	1	3	3	2	2	3	2	1	3	3
CO5	2	1	2	3	2	2	2	2	2	1	2	2	3	2	2	2

STUDENT ACTIVITIES

UNIT I: ESSENTIALS OF MATHEMATICS:

1: Complex Number Exploration

Provide students with a set of complex numbers in both rectangular and polar forms. They will plot the complex numbers on the complex plane and identify their properties

2: Trigonometric Ratios Problem Solving
Give students a set of problems that require the calculation of trigonometric ratios and theirrelations.
Students will solve the problems using the appropriate trigonometric functions (sine, cosine,tangent, etc.) and trigonometric identities.

3: Vector Operations and Applications
Provide students with a set of vectors in Cartesian form.
Students will perform vector addition and subtraction operations to find the resultant vectors.They will also calculate the scalar and vector products of given vectors.

4: Statistical Measures and Data Analysis
Give students a dataset containing numerical values.
Students will calculate the mean, median, and mode of the data, as well as other statisticalmeasures if appropriate (e.g., range, standard deviation).
They will interpret the results and analyze the central tendencies and distribution of the data.

UNIT II: ESSENTIALS OF PHYSICS:

1. Concept Mapping

Divide students into groups and assign each group one of the topics.
Students will create a concept map illustrating the key concepts, relationships, andapplications related to their assigned topic.
Encourage students to use visual elements, arrows, and labels to represent connections andinterdependencies between concepts.

2. Laboratory Experiment

Select a laboratory experiment related to one of the topics, such as motion of objects orelectric and magnetic fields.
Provide the necessary materials, instructions, and safety guidelines for conducting theexperiment.
Students will work in small groups to carry out the experiment, collect data, and analyze theresults.
After the experiment, students will write a lab report summarizing their findings, observations, and conclusions.

UNIT III: ESSENTIALS OF CHEMISTRY

1: Chemistry in Daily Life Presentation

Divide students into groups and assign each group a specific aspect of daily life where chemistry plays a significant role, such as food and nutrition, household products, medicine,orenvironmental issues.

Students will research and create a presentation (e.g., PowerPoint, poster, or video) thatshowcases the importance of chemistry in their assigned aspect.

2: Periodic Table Exploration

Provide students with a copy of the periodic table.

Students will explore the periodic table and its significance in organizing elements based ontheir properties.
They will identify and analyze trends in atomic structure, such as electronic configuration,atomic size, and ionization energy.

3: Chemical Changes and Classification of Matter

Provide students with various substances and chemical reactions, such as mixing acids andbases or observing a combustion reaction.
Students will observe and describe the chemical changes that occur, including changes incolor, temperature, or the formation of new substances.

4: Biomolecules Investigation

Assign each student or group a specific biomolecule category, such as carbohydrates, proteins,fats, or vitamins.
Students will research and gather information about their assigned biomolecule category, including its structure, functions, sources, and importance in the human body.

They can create informative posters or presentations to present their findings to the class.

UNIT IV: APPLICATIONS OF MATHEMATICS, PHYSICS & CHEMISTRY

1: Interdisciplinary Case Studies

Divide students into small groups and provide them with interdisciplinary case studies thatinvolve the interdisciplinary application of mathematics, physics, and chemistry.

Each case study should present a real-world problem or scenario that requires the I ntegrationof concepts from all three disciplines.

2: Design and Innovation Project

Challenge students to design and develop a practical solution or innovation that integratesmathematics, physics, and chemistry principles.

Students can choose a specific problem or area of interest, such as renewable energy,environmental conservation, or materials science.

3: Laboratory Experiments

Assign student's laboratory experiments that demonstrate the practical applications of mathematics, physics, and chemistry.

Examples include investigating the relationship between concentration and reaction rate,analyzing the behavior of electrical circuits, or measuring the properties of materials.

.4: Mathematical Modeling

Present students with real-world problems that require mathematical modeling and analysis.

UNIT V: ESSENTIALS OF COMPUTER SCIENCE:

1. Identifying the attributes of network (Topology, service provider, IP address and bandwidth
2. your college network) and prepare a report covering network architecture.
3. Identify the types of malwares and required firewalls to provide security.
4. Latest Fraud techniques used by hackers.

	Government College (Autonomous) Rajahmundry	Program & Semester I B.Sc. (I SEM)			
Course 2 **124902**	ADVANCES OF MATHEMATICAL, PHYSICALAND CHEMICAL SCIENCES				
Teaching	Hours Allocated:60 (**Theory**)	L	T	P	C
Pre-requisites:	Basic knowledge of geometry, matrices, law of conservation of energy, Number system etc.	3	0	2	4

Course Objective:

The objective of this course is to provide students with an in-depth understanding of the recent advances and cutting-edge research in mathematical, physical, and chemical sciences. The course aims to broaden students' knowledge beyond the foundational concepts and expose them to the latest developments in thesedisciplines, fostering critical thinking, research skills, and the ability to contribute to scientific advancements.

Learning outcomes:

	On Completion of the course, the students will be able to-	Cognitive Domain
CO1	Explore the applications of mathematics in various fields of physics and chemistry, to understand how mathematical concepts are used tomodel and solve real-world problems.	Understanding & Application
CO2	To Explain the basic principles and concepts underlying a broad rangeof fundamental areas of physics and to Connect their knowledge of physics to everyday situations.	Application
CO3	Understand the different sources of renewable energy and their generation processes and advances in Nanomaterials and their properties, with a focus on quantum dots. To study the emerging fieldof quantum communication and its potential applications. To gain an understanding of the principles of biophysics in studying biological systems. Explore the properties and applications of shape memory materials.	**Understanding , Application**
CO4	Understand the principles and techniques used in computer-aided drugdesign and drug delivery systems, to understand the fabrication techniques and working principles of Nano sensors. Explore the effectsof chemical pollutants on ecosystems and human health.	**understanding , Application**
CO5	Understand the interplay and connections between mathematics, physics, and chemistry in various advanced applications. Recognize how mathematical models and physical and chemical principles can beused to explain and predict phenomena in different contexts.	**Application**

SYLLABUS :

UNIT I: ADVANCES IN BASICS MATHEMATICS

Straight Lines: Different forms – Reduction of general equation into various forms – Pointof intersection of two straight lines

Limits and Differentiation: Standard limits – Derivative of a function –Problems on product rule and quotient rule

Integration: Integration as a reverse process of differentiation – Basic methods of integration

Matrices: Types of matrices – Scalar multiple of a matrix – Multiplication of matrices – Transpose of a matrix and determinants

UNIT II: ADVANCES IN PHYSICS:

Renewable energy: Generation, energy storage, and energy-efficient materials and devices. **Recent advances in the field of nanotechnology**: Quantum dots, Quantum Communication- recent advances in biophysics- recent advances in medical physics- Shape Memory Materials.

UNIT III: ADVANCES IN CHEMISTRY:

Computer aided drug design and delivery, nano sensors, Chemical Biology, impact of chemical pollutants on ecosystems and human health, Dye removal - Catalysis method

UNIT IV: ADVANCED APPLICATIONS OF MATHEMATICS, PHYSICS &CHEMISTRY

- **Mathematical Modelling applications in physics and chemistry**
- **Application of Renewable energy**: Grid Integration and Smart Grids,
- **Application of nanotechnology**: Nanomedicine,
- **Application of biophysics**: Biophysical Imaging, Biomechanics, Neurophysics,
- **Application of medical physics**: Radiation Therapy, Nuclear medicine

Solid waste management, Environmental remediation- Green Technology, Water treatment.

UNIT V: Advanced Applications of computer Science

Number System-Binary, Octal, decimal, and Hexadecimal, Signals-Analog, Digital, Modem, Codec, Multiplexing, Transmission media, error detection and correction- Parity check and CRC, Networking devices- Repeater, hub, bridge, switch, router, gateway.

Recommended books:

1. Coordinate Geometry by S.L.Lony, Arihant Publications
2. Calculus by Thomas and Finny, Pearson Publications
3. Matrices byA.R.Vasishtha and A.K.Vasishtha, Krishna Prakashan Media(P)Ltd.
4. "Renewable Energy: Power for a Sustainable Future" by Godfrey Boyle
5. "Energy Storage: A Nontechnical Guide" by Richard Baxter
6. "Nanotechnology: Principles and Applications" by Sulabha K. Kulkarni and Raghvendra A.Bohara
7. "Biophysics: An Introduction" by Rodney Cotterill
8. "Medical Physics: Imaging" by James G. Webster
9. "Shape Memory Alloys: Properties and Applications" by Dimitris C. Lagoudas
10. Nano materials and applications by M.N.Borah
11. Environmental Chemistry by Anil.K.D.E.
12. Digital Logic Design by Morris Mano
13. Data Communication & Networking by Bahrouz Forouzan.

CO-PO Mapping:

(1: Slight [Low]; 2: Moderate [Medium]; 3: Substantial [High], '-' : No Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	2	3	3	3	1	2	2	3	2	3	2	3	2	2
CO2	3	2	3	3	2	3	3	1	3	3	3	2	1	3	1	3
CO3	2	3	2	3	2	3	2	2	2	3	2	2	3	2	2	1
CO4	3	2	3	2	2	2	3	3	1	1	3	1	2	2	2	3
CO5	3	2	3	2	2	2	3	3	1	1	3	1	2	3	2	2

STUDENT ACTIVITIES

UNIT I: ADVANCES IN BASIC MATHEMATICS

1: Straight Lines Exploration

Provide students with a set of equations representing straight lines in different forms, such as slope-intercept form, point-slope form, or general form.

Students will explore the properties and characteristics of straight lines, including their slopes, intercepts,and point of intersection.

2: Limits and Differentiation Problem Solving

Students will apply the concept of limits to solve various problems using standard limits.

Encourage students to interpret the results and make connections to real-world applications,

such as analyzingrates of change or optimizing functions.

3: Integration Exploration

Students will explore the concept of integration as a reverse process of differentiation and apply basic methodsof integration, such as the product rule, substitution method,or integration by parts.

Students can discuss the significance of integration in various fields, such as physics and chemistry

4: Matrices Manipulation

Students will perform operations on matrices, including scalar multiplication, matrix multiplication, andmatrix transpose.

Students can apply their knowledge of matrices to real-world applications, such as solving systems ofequations or representing transformations in geometry.

UNIT II: ADVANCES IN PHYSICS:

1: Case Studies

Provide students with real-world case studies related to renewable energy, nanotechnology, biophysics,medical physics, or shape memory materials.

Students will analyze the case studies, identify the challenges or problems presented, and proposeinnovative solutions based on the recent advances in the respective field.

They will consider factors such as energy generation, energy storage, efficiency, sustainability, materials design, biomedical applications, or technological advancements.

2: Experimental Design

Assign students to design and conduct experiments related to one of the topics: renewable energy, nanotechnology, biophysics, medical physics, or shape memory materials.

They will identify a specific research question or problem to investigate and design an experimentaccordingly.

Students will collect and analyze data, interpret the results, and draw conclusions based on their findings.They will discuss the implications of their experimental results in the context of recent advances in the field.

3: Group Discussion and Debate

Organize a group discussion or debate session where students will discuss the ethical, social, and environmental implications of the recent advances in renewable energy, nanotechnology, biophysics, medical physics, and shape memory materials.

Assign student's specific roles, such as proponent, opponent, or moderator, and provide them with key points and arguments to support their positions.

UNIT III: ADVANCES IN CHEMISTRY:

1. Experimental Design and Simulation

In small groups, students will design experiments or simulations related to the assigned topic.

For example, in the context of computer-aided drug design, students could design a virtual screeningexperiment to identify potential drug candidates for a specific disease target.

For nano sensors, students could design an experiment to demonstrate the sensitivity and selectivityof nano sensors in detecting specific analytes.
Chemical biology-related activities could involve designing experiments to study enzyme-substrateinteractions or molecular interactions in biological systems.
Students will perform their experiments or simulations, collect data, analyze the results, and drawconclusions based on their findings.

2. Case Studies and Discussion

Provide students with real-world case studies related to the impact of chemical pollutants oneco systemsand human health.
Students will analyze the case studies, identify the sources and effects of chemical pollutants, and proposemitigation strategies to minimize their impact.

Encourage discussions on the ethical and environmental considerations when dealing withchemical pollutants.
For the dye removal using the catalysis method, students can explore case studies wherecatalytic processes are used to degrade or remove dyes from wastewater.

Students will discuss the principles of catalysis, the advantages and limitations of thecatalysis method, and its applications in environmental remediation.

3: Group Project

Assign students to work in groups to develop a project related to one of the topics.
The project could involve designing a computer-aided drug delivery system, developing a nano sensor
for aspecific application, or proposing strategies to mitigate the impact of chemical pollutants on ecosystems. Students will develop a detailed project plan, conduct experiments or simulations, analyze data,and present their findings and recommendations.
Encourage creativity, critical thinking, and collaboration throughout the project.

UNIT IV: ADVANCED APPLICATIONS OF MATHEMATICS, PHYSICS &CHEMISTRY

1: Mathematical Modelling Experiment

Provide students with a mathematical modelling experiment related to one of the topics. For example, in the context of renewable energy, students can develop a mathematical model to optimize the placement and configuration of solar panels in a solar farm.
Students will work in teams to design and conduct the experiment, collect data, and analyze the results using mathematical models and statistical techniques.
They will discuss the accuracy and limitations of their model, propose improvements, and

interpret the implications of their findings in the context of renewable energy or the specific applicationarea.

2: Case Studies and Group Discussions

Assign students to analyze case studies related to the applications of mathematical modeling nanotechnology, biophysics, medical physics, solid waste management, environmental remediation, orwater treatment.
Students will discuss the mathematical models and computational methods used in the case studies,analyze the outcomes, and evaluate the effectiveness of the modelling approach.
Encourage group discussions on the challenges, ethical considerations, and potential advancements in the field.

Students will present their findings and engage in critical discussions on the advantages and limitations ofmathematical modelling in solving complex problems in these areas.

3. Group Project

Assign students to work in groups to develop a group project that integrates mathematical modelling withone of the application areas: renewable energy, nanotechnology, biophysics, medical physics, solid waste management, environmental remediation, or water treatment.

The project could involve developing a mathematical model to optimize the delivery of radiation therapy in medical physics or designing a mathematical model to optimize waste management practices.Students will plan and execute their project, apply mathematical modelling techniques, analyze the results, and present their findings and recommendations. Encourage creativity, critical thinking, and collaboration throughout the project.

UNIT V: Advanced Applications of computer Science

Students must be able to convert numbers from other number system to binary number systems

1. Identify the networking media used for your college network
2. Identify all the networking devices used in your college premises.


SEM - 2

DEPARTMENT OF PHYSICS,
Government College
RAJAHMUNDRY-AP-533103

Course Code	Title of the Course (SEM-2)	L	T	P	C
Material science	**Concepts in Materials Science**	3	0	0	3
Prerequisites	Crystalline amorphous materials				

Course Objectives:

1. Understand basic science behind material properties
2. Strong emphasis on applications to materials
3. Design, make and test materials

Course Outcomes:

On Completion of the course, the students will be able to-	
CO1	Understands crystal symmetry, miller indices etc
CO2	Calculate coordination number
CO3	Distinguish between various defects
CO4	Learn about the lattice vibrations
CO5	Solve problems based on lattice vibrations and Band theory of solids

Syllabus - Concepts in Materials Science

UNIT –I (9 Hrs)

Crystal Bonding: Crystal bonding, ionic crystal, potential and lattice energy of ionic crystals, madelung constant, covalent bonding, Vander wall bonding, hydrogen bond and metallic bond, formation of energy bands in solids - distinction between metals, insulators and semiconductors.

Activity Proposed: Case study on types of bonds
Evaluation Method: Assignment

UNIT –II (9 Hrs)

Translational vectors; Lattice and Basis; Unit cell; Bravais lattices; Lattice constants, Crystal planes; Miller indices; Symmetric operations; Point groups; Packing fraction; Simple cubic structures; Body centered cubic structure, Face centered cubic structure; Hexagonal close packed structure; NaCl, CsCl, Diamond and ZnS structures

Activity Proposed: Development of model crystal structures
Evaluation Method: Demonstration and

Unit-III (9 hrs)

Point defects: Impurities; Vacancies - Frenkel and Schottky intrinsic vacancies; Equilibrium concentration of defects; Ionic conductivity in alkali halides; Color centers: Classification- F, F', V centers-Production of color centers

Line defects: Edge and Screw dislocations; Burger vector;

Plane defects: Stacking faults; Grain boundaries – Low angle grain boundaries

Activity Proposed: Presentation on various defects
Evaluation Method: Content, Way of explanation, body language

Unit IV (9 hrs)

Formation of Crystals: Crystal growth – Velocity of growth, Theories of growth, Mechanism of growth, Twinning – Growth twins, Deformation twins, Transformation twins, Growth in the solid state – Recrystallization, Martensite transformation.

Activity Proposed: Student mini projects
Evaluation Method: Viva

Unit V (9 hrs)

Structure analysis and Transformations in crystals: Atomic scattering factor. Laue conditions for diffraction and Bragg's law - Geometrical structure factor – Laue method, Powder XRD Method, Applications of XRD.

Activity Proposed: Student mini projects
Evaluation Method: Viva

Text Books:

1. R. L. Singhal, Solid State Physics, Kedarnath Ramnath - Publisher
2. S.O. Pillai, Solid State Physics, Wiley Easter Ltd.(1994)
3. Gupta, Kumar, Sharma, Solid State Physics
4. Stephen Elliott and S.R. Elliot, The Physics and Chemistry of Solids, Wiley, 1st Edn (1998)
5. Malik Wahid U. Et. Al, Selected topics in inorganic chemistry, S. Chand & Co., Ltd. (2009)
6. C.Kittle, Introduction to Solid State Physics, Wiley, 7th Edition (1995)
7. M.A.Wahab, Solid State Physics: Structure and Properties of Materials, Alpha Science International Ltd., (2005)
8. The Structure and Properties of Materials-Vol.I-IV -Rose, Shepard and Wulff (Wiley Eastern, 1987)
9. The Solid State of Matter. Libretexts. https://chem.libretexts.org/@go/page/38214
10. Solids. Libretexts. https://chem.libretexts.org/@go/page/6373 .

(1: Slight [Low]; 2: Moderate [Medium]; 3: Substantial [High], 4: No Correlation

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	3	1	2	2	3	2	3	2
CO2	3	2	3	3	2	3	3	1	3	3	3	2	1
CO3	2	3	2	3	2	3	2	2	2	3	2	2	3
CO4	3	2	3	2	2	2	3	3	1	1	3	1	2
CO5	3	2	3	2	2	2	3	3	1	1	3	1	2

Course Code	Title of the Course (SEM -2)	L	T	P	C
	Concepts in Materials Science	0	0	2	1
Prerequisites	Lattice, Crystal structure				

Objectives:

1. Students have hands on experience on preparation of materials
2. Able to understand atom arrangements in space lattice
3. Able to analyse the crystal structures

List of Experiments/Syllabus:

Minimum 6 experiments has to be done out of 9

1. Drawing crystal structures in XCrysden/VIESTA/High Score Plus software.
2. Powder XRD analysis of NaCl, CsCl crystal structures
3. d-spacing analysis of XRD data for SC.
4. d-spacing analysis of XRD data for BCC.
5. d-spacing analysis of XRD data for FCC.
6. Crystal growth of CuSO4.
7. Determination of Madelung constant using programme.
8. To study bravais lattice with the help of models
9. To analyse the properties of various types of plastics

Reference books:

1. https://users.metu.edu.tr/chem355/assets/6-355%20Viscosity.pdf
2. https://www.wctmgurgaon.com/pdf/chemistry%20lab%20manual..pdf

GOVERNMENT COLLEGE (A) :: RAJAMAHENDRAVARAM
DEPARTMENT OF PHYSICS
B.Sc. Materials Science (Single Major)
SYLLABUS - Semester-II
PRACTICAL COURSE 3: Concepts in Materials Science

STUDENT ACTIVITIES

Periodic table of elements is key to understanding and mastering concepts. To know the arrangement of elements, properties and the role of each elements plays in the world around us periodic table making activity was organised. Department of physics assigned an activity of periodic table making in innovative way to for I BSc students from August 2023-2024.

- Students were divided in to groups and made them to show the periodic table in their innovative way.
- Through this group activity student were able to communicate with them and try to make their own ways to present it as a best chart of periodic table.
- Through the activity students were engaged themselves in the study of periodic table with their atomic number and mass.
- With the proper analysis of the nature of the elements the students used colour combinations for the elements with similar properties.
- All the charts were well appreciated by the faculty for their effect to explain the difference in the elements with their metallic nature, conductance, outer electronic configurations, uses etc.

Course Code	Title of the Course	L	T	P	C
	SCIENCE OF MATERIALS IN DAILY LIFE	3	0	0	3
Prerequisites	Classification of materials				

Course Objectives:

1. Helps to understand the relationship between different types of materials with the properties.
2. Understanding the structure-property correlation in materials
3. Various synthesis techniques of materials

Course Outcomes:

On Completion of the course, the students will be able to-	
CO1	understands why materials behave the way they do
CO2	It equips them with all the basics required for a deeper understanding of the properties of metals, semiconductors and insulators
CO3	Learn various synthesis methods
CO4	Learn various characterization techniques
CO5	Understand various applications of materials

Syllabus - **SCIENCE OF MATERIALS IN DAILY LIFE**

UNIT -I (10 hrs)

Conductors: Metals, Alloys, Semiconductors- Definition, elementary ideas of electrical properties, optical properties, mechanical properties, thermal properties. Specific examples of metals- Copper, Aluminium, Iron, Gold, Silver. Uses of metals. Drawbacks of metals. Alloys- advantages of alloying. Examples-Brass, Bronze, Steel, Stainless steel, Gold alloys, silver alloys and their uses. Semiconductors: Elemental semiconductors- Silicon, Germanium. Doping- n-type and p-type semiconductors, p-n junctions

Activity Proposed: Classification of metals and alloys
Evaluation Method: Study report

UNIT –II (10 hrs)

Polymers and composites: Plastics- Introduction, Types of plastics, Rubber- Types of rubber, Vulcanization of rubber. Fibers- Different types of natural and synthetic fibers. Resins, Adhesives and polymer coatings. Physical, chemical, mechanical properties and applications of polymers. Recycling of polymers. Composites- Introduction, types, Wood, Concrete, FRP and some advanced composites. Properties and applications.

Activity Proposed: Preparation of polymers
Evaluation Method: Lab report

Unit-III: (9 hrs)

Ceramics: Ceramics- Introduction, classification, raw materials, fabrication methods, properties and applications, Types of ceramics- oxide and non-oxide ceramics, Allotropes of carbon- graphite, diamond and fullerene, Primary refractory materials.

Activity Proposed: preparation of models
Evaluation Method: Demonstration

Unit IV: (7 hrs)

Glasses: Introduction, raw materials, manufacture of glass, properties and applications, Types of glasses, properties and Applications, Photochromic and photosensitive glasses.

Activity Proposed: Preparation of Glasses
Evaluation Method: Lab report

Unit V: (9 hrs)

Nanomaterials: Origin of nanotechnology, Properties of nano-materials, Quantum confinement, Surface to Volume ratio, Top down and Bottom-up methods, Methods of preparation - Ball milling, Sol-Gel, PVD, CVD, Characterization – XRD, SEM, TEM.

Activity Proposed: Presentation on synthesis of nano materials
Evaluation Method: Content, Demonstration

Text Books:

1. Materials Science and Engineering – V Raghavan (Prentice Hall India, 1993)
2. Introduction to Solids – A J Dekker (McMillan India, 1981)
3. Plastics-How Structure determines properties- G Gruenwald (Hanser)
4. Materials Science- Nagpal (Khanna, Delhi)
5. Polymer Science –V R Gowarikar, N V Viswanath, Jayadev Sridhar (Wiley Eastern, 1987)
6. Composite Materials-Engineering & Science – F L Mathews & R D Rawlings (Chapman & Hall, 1990)
7. Introduction to Ceramics – W D Kingery, H K Bower and U R Uhlman (John Wiley, 1960)
8. Glasses and vitreous state – J Zarzycki (Cambridge University Press, 1982)
9. Nanoscale Materials – (Ed) L.M. Liz-Marzan and P.V.Kamat, (Kluwer, 2003)
10. Understanding Materials Science- R E Hummel (II Ed) (Springer)
11. Nanostructured Materials and Nanotechnology, (Ed) H.S.Nalwa, (Academic, 2002).
12. The Science of the World Around Us, Solid State Sciences Committee, (National Research Council, 2007)
13. The Physics of Materials: How Science Improves Our Lives, Solid State Sciences Committee, (National Research Council, 1997)
14. Solids and Modern Materials. Libretexts. https://chem.libretexts.org/@go/page/84923
15. Examination of a Manufactured Article. University of Cambridge. LibreTexts. https://eng.libretexts.org/@go/page/31610

(1: Slight [Low];2: Moderate [Medium]; 3: Substantial [High], 4: No Correlation

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	3	1	2	2	3	2	3	2
CO2	3	2	3	3	2	3	3	1	3	3	3	2	1
CO3	2	3	2	3	2	3	2	2	2	3	2	2	3
CO4	3	2	3	2	2	2	3	3	1	1	3	1	2
CO5	3	2	3	2	2	2	3	3	1	1	3	1	2

GOVERNMENT COLLEGE (A) :: RAJAMAHENDRAVARAM
DEPARTMENT OF PHYSICS
B.Sc. Materials Science Single Major
SYLLABUS (w.e.f. 2024-25)
Semester-II
PRACTICAL COURSE 4: Science of Materials in Daily Life

STUDENT ACTIVITIES

Materials used in daily life is key to understanding and mastering concepts. To know the arrangement of materials, properties and the role of each material plays wide understanding and easy to remember in the world around us **materials table making activity** was organised. Department of physics assigned an activity of materials table making in innovative way to for I BSc students from August 2023-2024.

- Students were divided in to groups and made them to show the materials table in their innovative way.
- Through these group activity students were able to communicate with them and try to make their own ways to present it as a best chart of materials table.
- Through the activity students were engaged themselves in the study of various materials used in daily life.
- With the proper analysis of the nature of the elements the students used colour combinations for the elements with similar properties.
- All the charts were well appreciated by the faculty for their effect to explanation.

Course Code	Title of the Course	L	T	P	C
	Science of materials in daily life	0	0	2	1
Prerequisites	Classification of materials				

Objectives:

1. Students have hands on experience on preparation of materials
2. Able to understand the preparation techniques of various materials
3. Able to prepare materials

Minimum of 6 experiments has to be done out of 8

List of Experiments/Syllabus

1. Electrical Resistivity of conducting wires
2. Preparation of Urea formaldehyde resin
3. Preparation of Phenol formaldehyde resin
4. Preparation of Borate based glasses
5. Preparation of Silicate based glasses
6. To determine the Viscosity and molecular weight of the polymer using viscometer
7. Preparation of Zinc Oxide nano material by precipitation method
8. Energy band gap of semiconductors


III SEM

GOVERNMENT COLLEGE (A) :: RAJAMAHENDRAVARAM

DEPARTMENT OF PHYSICS

AP STATE COUNCIL OF HIGHER EDUCATION

SYLLABUS UNDER CBCS (w.e.f. 2023-24)

B.Sc. Materials Science (Single Major)

COURSE STRUCTURE UNDER

Year	Semester	Course	Title of the Course	Minor	Marks	No. of Hrs/ Week	No. of Credits
II	III	5	Crystallography and Crystal Structures	Minor	50	3	3
	III	6	Thermodynamics and Kinetics of Materials		50	3	3
	III	7	Mechanical Properties of Materials		50	3	3
	III	8	Electrical and Magnetic Properties of Materials		50	3	3
	IV	9	Characterization Techniques in Material Science	Minor	50	3	3
	IV	10	Polymer Science	Minor	50	3	3
	IV	11	Ceramics and Composite Materials		50	3	3

SEM-III	Course Code	Title of the Course	L	T	P	C
	5	CRYSTALLOGRAPHY AND CRYSTAL STRUCTURES	3	0	0	3
	Prerequisites					

Course Objectives:

To understand the concepts on materials failure and fracture analysis of materials and to design new materials that can withstand catastrophic failures in different environments, and also a fundamental understanding of electrical, magnetic and optical properties of materials and to apply those fundamentals for selecting and developing materials for different engineering applications.

Course Outcomes:

On Completion of the course, the students will be able to-	
CO1	Understand the fundamental concepts of crystallography and crystal structures.
CO2	Apply X-ray diffraction techniques to analyze crystal structures.
CO3	Identify and characterize various types of crystal defects.
CO4	Use electron and neutron diffraction methods to study material properties.
CO5	Interpret and analyze phase transitions in crystalline materials.

Syllabus

UNIT -I (9 hrs)

Fundamentals of Crystallography: Crystal Systems and Lattice Types - Symmetry Elements and Operations - Miller Indices and Planes - Crystal Defects: Point Defects, Dislocations - Quasicrystals and Amorphous Solids

Activity Proposed: Classification of Crystal systems and defects
Evaluation Method: Study report

UNIT –II (9 hrs)

X-ray Diffraction: Principles of X-ray Generation - Bragg's Law and Diffraction Patterns - X-ray Diffraction Techniques: Powder and Single Crystal Methods - Analysis of Crystal Structures - Applications of X-ray Diffraction

Activity Proposed: Applications of X-Ray diffraction
Evaluation Method: Assignment

Unit-III: (9 hrs)

Electron and Neutron Diffraction: Basics of Electron Diffraction - Comparison with X-ray Diffraction - Neutron Diffraction: Principles and Techniques - Applications in Material Science - Case Studies

Activity Proposed: preparation of models
Evaluation Method: Demonstration

Unit IV: (9 hrs)

Defects in Crystals: Types of Defects: Point, Line, Planar - Role of Defects in Material Properties - Techniques for Studying Defects - Impact on Mechanical and Electrical Properties - Grain Boundaries and Their Effects

Activity Proposed: Preparation of Glasses
Evaluation Method: Lab report

Unit V: (9 hrs)

Advanced Topics in Crystallography: Reciprocal Lattice and Ewald Sphere - Fourier Analysis and Structure Factors - Crystal Growth and Epitaxy - Modern Crystallographic Techniques - Current Research and Applications

Activity Proposed: Presentation on synthesis of nanomaterials
Evaluation Method: Content, Demonstration

Text Books:

"Introduction to Solid State Physics" by Charles Kittel

Reference books:

1. Elements of X-ray Diffraction by B.D. Cullity and S.R. Stock
2. Introduction to Solid State Physics by Charles Kittel
3. Fundamentals of Crystallography by C. Giacovazzo
4. X-Ray Diffraction: A Practical Approach by C.S. Barrett and T.B. Massalski
5. Crystallography: An Introduction by Walter Borchardt-Ott

Web Links:

CO-PO Mapping:

(1: Slight [Low]; 2: Moderate [Medium]; 3: Substantial [High], 4: No Correlation

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	3	1	2	2	3	2	3	2
CO2	3	2	3	3	2	3	3	1	3	3	3	2	1
CO3	2	3	2	3	2	3	2	2	2	3	2	2	3
CO4	3	2	3	2	2	2	3	3	1	1	3	1	2
CO5	3	2	3	2	2	2	3	3	1	1	3	1	2

	Course Code	Title of the Course	L	T	P	C
SEM-III	5	**Crystallography and Crystal Structures**	0	0	2	1
	Prerequisites					

Objectives:

Students have hands on experience on preparation of materials
Able to understand the preparation techniques of various materials
Able to prepare materials

Minimum of 6 experiments has to be done out of 8

List of Experiments/Syllabus

1. X-ray Diffraction (XRD)
Technique: XRD involves directing X-rays at a crystalline material and analyzing the diffraction pattern to determine lattice parameters and crystal structure.
Equipment: X-ray diffractometer.
2. Powder Diffraction
-Technique: Used to identify crystalline phases in powdered samples by analyzing the diffraction pattern.
Equipment: Powder X-ray diffractometer.
3. Scherrer Equation
Technique: Determines crystallite size from the broadening of XRD peaks.
4. Optical Microscopy
Technique: Uses visible light and lenses to magnify small features in materials.
Equipment: Optical microscope.
5. Symmetry Elements in Crystals
Technique: Uses models or diagrams to study symmetry operations (rotation, reflection, inversion) in crystals.
Equipment: Crystal models or computer software.
6. Electron Diffraction
Technique: Uses electrons to probe the crystal structure, providing high-resolution information.
Equipment: Transmission electron microscope (TEM).
7. Laue Method
Technique: Uses a single crystal and X-rays to determine crystal orientation by analyzing Laue patterns.
Equipment: X-ray diffractometer with Laue attachment.
8. XRD of Polycrystalline Samples
Technique: Analysis of XRD patterns to study polycrystalline materials.
Equipment: X-ray diffractometer.
9. Differential Scanning Calorimetry (DSC)
Technique: Measures heat flow associated with phase transitions in materials.
Equipment: DSC apparatus.
10. Single Crystal Growth
Technique: Slow evaporation or other methods to grow single crystals.
Equipment: Controlled environment chamber.

SEM-III	Course Code	Title of the Course	L	T	P	C
	6	**Thermodynamics and Kinetics of Materials**	3	0	0	3
	Prerequisites					

Course Objectives:

1. To study the basics of mechanical properties of materials.
2. The course deals with the crystal imperfections, diffusion in solids, elastic behaviour of

Course Outcomes:

On Completion of the course, the students will be able to-	
CO 1	Understand the principles of thermodynamics and their application to materials science.
CO 2	Interpret and construct phase diagrams for unary and binary systems.
CO 3	Analyze the kinetics of diffusion and phase transformations in materials.
CO 4	Apply statistical thermodynamics to understand material behavior.
CO 5	Utilize thermodynamic and kinetic principles to solve material science problems.

Syllabus

Unit I 9 hours

Thermodynamic Principles: Laws of Thermodynamics - State Functions: Internal Energy, Enthalpy, Entropy - Gibbs Free Energy and Chemical Potential - Thermodynamic Equilibrium - Applications in Material Science

Activity Proposed: Classification of metals and alloys
Evaluation Method: Study report

Unit II **9** hours

Phase Diagrams: Unary Phase Diagrams - Binary Phase Diagrams and Lever Rule - Ternary Phase Diagrams - Eutectic and Peritectic Reactions - Phase Transformations

Activity Proposed: Classification of metals and alloys
Evaluation Method: Study report

Unit III **9** hours

Statistical Thermodynamics: Basics of Statistical Mechanics - Distribution Functions: Maxwell-Boltzmann, Fermi-Dirac, Bose-Einstein - Partition Function and Thermodynamic Properties - Applications to Solids and Gases - Thermodynamic Models

Activity Proposed: Classification of metals and alloys
Evaluation Method: Study report

Unit IV **9** hours

Kinetics of Materials: Diffusion: Fick's Laws, Mechanisms - Nucleation and Growth Kinetics - Solid-State Reactions - Rate Theories: Arrhenius Equation, Transition State Theory - Applications in Material Processing

Activity Proposed: Classification of metals and alloys
Evaluation Method: Study report

Unit V **9** hours

Thermodynamics and Kinetics in Advanced Materials: Thermodynamics of Surfaces and Interfaces - Phase Field Modeling - Kinetics in Nanomaterials - Thermodynamics in Biological Materials - Case Studies and Current Research

Activity Proposed: Classification of metals and alloys
Evaluation Method: Study report

Text Books:

"Thermodynamics in Materials Science" by Robert DeHoff

Reference books:

1. Thermodynamics in Materials Science by Robert DeHoff
2. Introduction to the Thermodynamics of Materials by David R. Gaskell
3. Phase Transformations in Metals and Alloys by David A. Porter and Kenneth E. Easterling
4. Physical Chemistry of Metals by L.S. Darken and R.W. Gurry
5. Kinetics of Materials by Robert W. Balluffi, Samuel M. Allen, and W.C. Carter

Web Links:

CO-PO Mapping:

(1: Slight [Low]; 2: Moderate [Medium]; 3: Substantial [High], 4: No Correlation

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	3	1	2	2	3	2	3	2
CO2	3	2	3	3	2	3	3	1	3	3	3	2	1
CO3	2	3	2	3	2	3	2	2	2	3	2	2	3
CO4	3	2	3	2	2	2	3	3	1	1	3	1	2
CO5	3	2	3	2	2	2	3	3	1	1	3	1	2

SEM-III	Course Code	Title of the Course	L	T	P	C
	6	**Thermodynamics and Kinetics of Materials**	0	0	2	1
	Prerequisites					

Objectives:

Students have hands on experience on preparation of materials
Able to understand the preparation techniques of various materials
Able to prepare materials

Minimum of 6 experiments has to be done out of 8

List of Experiments/Syllabus

1. Calorimetry Technique: Measures heat absorbed or released during a chemical reaction or phase transition. Equipment: Calorimeter.
2. Cooling Curves Technique: Measures temperature over time to determine phase diagrams. Equipment: Thermocouples, data logger.
3. Diffusion Couple Method Technique: Studies diffusion between two materials in contact. Equipment: High-temperature furnace.
4. Steady-State Thermal Conductivity Technique: Measures thermal conductivity by applying a steady heat flow. Equipment: Thermal conductivity apparatus.
5. Arrhenius Plot Technique: Determines activation energy by plotting reaction rate against temperature. Equipment: Temperature-controlled reaction setup.
6. Oxidation Kinetics Technique: Studies the rate of oxidation at high temperatures. Equipment: High-temperature furnace, balance.
7. DSC for Enthalpy Change Technique: Measures heat flow during phase transitions to determine enthalpy changes. Equipment: DSC apparatus.
8. Optical Microscopy of Solidification Microstructures Technique: Observes microstructures formed during solidification. Equipment: Optical microscope.
9. Precipitation Hardening Technique: Studies the effect of heat treatment on alloy hardness. Equipment: Furnace, hardness tester.
10. Electrochemical Cell for Gibbs Free Energy
    Technique: Uses electrochemical measurements to determine Gibbs free energy changes.
    Equipment: Electrochemical cell, potentiostat.

SEM-III	Course Code	Title of the Course	L	T	P	C
	7	**Mechanical Properties of Materials**	3	0	0	3
	Prerequisites					

Course Objectives:

1. To study the basics of properties of nanomaterials.
2. The course deals with the crystal imperfections, diffusion in solids, elastic behaviour of materials, plastic deformation and fracture, etc.
3. Students should be able to classify various types of defects in the materials and their connection with elastic/plastic deformations and various mechanical properties of materials.
4. This would help students in the selection of materials for various applications during their career.

Course Outcomes:

On Completion of the course, the students will be able to-	
CO 1	Understand the stress-strain behavior of materials and their mechanical properties.
CO 2	Conduct mechanical tests to determine material properties such as hardness, toughness, and fatigue.
CO 3	Analyze the effects of microstructural changes on mechanical properties.
CO 4	Apply principles of fracture mechanics to predict material failure.
CO 5	Understand the mechanisms of material strengthening and apply them to improve material performance.

Syllabus

UNIT-I **(9 hrs)**

Introduction to Mechanical Properties: Stress and Strain Relationships - Elastic Deformation: Young's Modulus, Poisson's Ratio - Plastic Deformation: Yield Strength, Hardening - True Stress and True Strain - Mechanical Testing Methods

Activity Proposed:
Evaluation Method: Study report

UNIT-II **(9 hrs)**

Fracture Mechanics: Types of Fracture: Ductile and Brittle - Fracture Toughness and Crack Propagation - Fatigue: S-N Curves, Fatigue Life - Creep: Creep Curves, Creep Mechanisms - Failure Analysis

Activity Proposed:
Evaluation Method: Study report

UNITS-III **(9 hrs)**

Strengthening Mechanisms: Work Hardening and Cold Working - Grain Boundary Strengthening: Hall-Petch Relationship - Solid Solution Strengthening - Precipitation and Age Hardening - Case Studies in Strengthening Techniques

Activity Proposed:
Evaluation Method: Study report

UNIT-IV **(9 hrs)**

Mechanical Properties of Specific Materials: Metals: Ferrous and Non-Ferrous Alloys - Ceramics: Brittle Behavior, Toughening Mechanisms - Polymers: Viscoelasticity, Deformation Behavior - Composites: Fiber and Matrix Materials - Biomaterials: Mechanical Properties and Applications

Activity Proposed:
Evaluation Method: Study report

UNIT-V **(9 hrs)**

Applications and Case Studies: Mechanical Properties in Design - Structural Materials in Aerospace and Automotive Industries - Wear and Tear in Industrial Applications - Biomechanics: Implants and Prosthetics - Future Trends and Research Directions

Activity Proposed:
Evaluation Method: Study report

Text Books:

"Mechanical Behavior of Materials" by Norman E. Dowling

Reference books:

1. "Mechanical Behavior of Materials" by Norman E. Dowling
2. "Mechanical Metallurgy" by George E. Dieter
3. "Mechanical Properties of Solid Polymers" by I.M. Ward and J. Sweeney
4. "Deformation and Fracture Mechanics of Engineering Materials" by Richard W. Hertzberg
5. "Mechanical Properties of Materials" by William D. Callister and David G. Rethwisch

Web Links:

CO-PO Mapping:

(1: Slight [Low]; 2: Moderate [Medium]; 3: Substantial [High], 4: No Correlation

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	3	1	2	2	3	2	3	2
CO2	3	2	3	2	2	3	3	1	3	3	3	2	2
CO3	2	3	2	3	2	3	2	2	2	3	2	2	3
CO4	2	2	1	2	2	2	3	3	3	1	3	2	2
CO5	3	2	3	2	2	2	3	3	1	2	2	1	1

SEM-III	Course Code	Title of the Course	L	T	P	C
	7	**Mechanical Properties of Materials**	0	0	2	1
	Prerequisites					

Objectives:

Students have hands on experience on preparation of materials
Able to understand the preparation techniques of various materials
Able to prepare materials

Minimum of 6 experiments has to be done out of 8, and recorded

List of Experiments/Syllabus

1. Tensile Testing
Technique: Measures the response of a material to uniaxial tension.
Equipment: Universal testing machine.
2. Hardness Testing
Technique: Measures resistance to indentation.
Equipment: Rockwell or Vickers hardness tester.
3. Impact Testing
Technique: Measures the materials ability to absorb energy during fracture.
Equipment: Charpy or Izod impact tester.
4. Creep Testing
Technique: Measures deformation under constant stress at elevated temperatures.
Equipment: Creep testing machine.
5. Fatigue Testing
Technique: Determines the materials fatigue life by applying cyclic loads.
Equipment: Fatigue testing machine.
6. Bending Test
Technique: Measures Young's modulus and flexural strength.
Equipment: Bending test fixture on a universal testing machine.
7. Fracture Toughness Testing
Technique: Measures the resistance to crack propagation.
Equipment: Compact tension specimen, universal testing machine.
8. Microstructural Analysis
Technique: Observes changes in microstructure after deformation.
Equipment: Optical or electron microscope.
9. Work Hardening
Technique: Studies increase in hardness due to plastic deformation.
Equipment: Hardness tester.
10. Poisson's Ratio Measurement
Technique: Uses strain gauges to measure lateral and axial strains.
Equipment: Strain gauges, data acquisition system.

SEM-III	Course Code	Title of the Course	L	T	P	C
	8	**Electrical and Magnetic Properties of Materials**	3	0	0	3
	Prerequisites					

Course Objectives:

This course aims to provide the basic concepts of heat and dynamics of a substance under various thermodynamics conditions as a sound background in thermodynamics is necessary for understanding materials. The nature of bonding, energy and structure of various metal complexes based on coordination principles are also imparted.

Course Outcomes:

On Completion of the course, the students will be able to-	
CO1	Understand the electrical properties of conductors, semiconductors, and insulators.
CO2	Analyze the magnetic properties of materials and their applications.
CO3	Measure and interpret the dielectric properties of materials.
CO4	Understand the principles of superconductivity and its applications.
CO5	Apply knowledge of electrical and magnetic properties to material design and selection.

Syllabus

Unit 1 **9 hours**

Fundamentals of Electrical Properties: Conductivity and Resistivity - Ohm's Law and Electrical Circuits - Band Theory of Solids - Intrinsic and Extrinsic Semiconductors - Temperature Dependence of Conductivity

Unit II **9 hours**

Semiconductor Physics: p-n Junctions and Diodes - Transistors: Bipolar Junction and Field-Effect Transistors - Semiconductor Devices: LEDs, Photovoltaics - Carrier Generation and Recombination - Doping Techniques and Applications

Unit III **9 hours**

Magnetic Properties: Basic Concepts: Magnetic Moments, Susceptibility - Types of Magnetism: Diamagnetism, Paramagnetism, Ferromagnetism - Magnetic Domains and Hysteresis - Magnetic Materials: Soft and Hard Magnets - Applications: Data Storage, Transformers, Magnetic Sensors

Unit IV **9 hours**

Dielectric Properties: Polarization Mechanisms: Electronic, Ionic, Orientation - Dielectric Constant and Loss - Ferroelectric and Piezoelectric Materials - Dielectric Materials in Capacitors - Applications in Electronics and Communication

Unit V **9 hours**

Superconductivity and Advanced Topics: Basics of Superconductivity - Type I and Type II Superconductors - BCS Theory - Applications of Superconductors: MRI, Power Cables - Emerging Trends in Electrical and Magnetic Materials

Text Books:

"Electronic Properties of Materials" by Rolf E. Hummel

Reference books:

1. "Electronic Properties of Materials" by Rolf E. Hummel
2. "Solid State Physics" by S.O. Pillai
3. "Introduction to Magnetic Materials" by B.D. Cullity and C.D. Graham
4. "Electrical Properties of Materials" by L. Solymar and D. Walsh
5. "Magnetic Materials: Fundamentals and Applications" by Nicola A. Spaldin

Web Links:

CO-PO Mapping:

(1: Slight [Low]; 2: Moderate [Medium]; 3: Substantial [High], 4: No Correlation

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	3	1	2	2	2	3	3	2
CO2	3	2	3	3	2	3	3	1	3	3	3	2	3
CO3	2	3	3	4	2	4	2	2	2	2	2	3	1
CO4	3	2	3	2	2	2	3	3	1	3	3	2	3
CO5	3	2	3	2	2	2	3	3	1	3	3	2	3

SEM-III	Course Code	Title of the Course	L	T	P	C
	8	**Electrical and Magnetic Properties of Materials**	0	0	2	1
	Prerequisites					

Objectives:

Students have hands on experience on preparation of materials
Able to understand the preparation techniques of various materials
Able to prepare materials

Minimum of 6 experiments has to be done out of 8

List of Experiments/Syllabus

1. Four-Probe Method
   Technique: Measures electrical conductivity.
   Equipment: Four-probe setup, voltmeter, ammeter.
2. Hall Effect
   Technique: Studies the properties of semiconductors.
   Equipment: Hall effect setup, magnetic field source.
3. Capacitance Method
   Technique: Measures dielectric constant.
   Equipment: LCR meter, parallel plate capacitor setup.
4. P-E Hysteresis Loop
   Technique: Studies ferroelectric materials.
   Equipment: Ferroelectric hysteresis loop tracer.
5. Gouy Balance Method
   Techniq: Measures magnetic susceptibility.
   Equipment: Gouy balance.
6. Curie Temperature Measurement
   Technique: Determines the temperature at which ferromagnetic materials become paramagnetic.
   Equipment: Furnace, magnetic balance.
7. B-H Curve Tracer
   Technique: Measures magnetic hysteresis loop.
   Equipment: B-H curve tracer.
8. Resistivity Measurement
   Technique: Measures the electrical resistivity of semiconductor wafers.
   Equipment: Four-probe setup or van der Pauw method.
9. Superconducting Transition Temperature
   Technique: Measures resistivity to find the superconducting transition temperature.
   Equipment: Cryostat, resistivity measurement setup.
10. Thermoelectric Power Measurement
    Technique: Measures the Seebeck coefficient.
    Equipment: Thermoelectric power measurement setup.

SEM IV

SEM-IV	Course Code	Title of the Course	L	T	P	C
	9	**Characterization Techniques in Material Science**	3	0	0	3
	Prerequisites					

CO 1	Understand the principles and applications of various material characterization techniques.
CO 2	Use optical and electron microscopy to study the microstructure of materials.
CO 3	Apply spectroscopic techniques to analyze the chemical composition and structure of materials.
CO 4	Utilize thermal analysis methods to study material properties and transitions.
CO 5	Interpret and analyze data obtained from advanced characterization techniques.

Unit-I (9 hrs)

Optical Microscopy: Principles of Light Microscopy - Sample Preparation Techniques - Bright Field and Dark Field Microscopy - Phase Contrast and Polarized Light Microscopy - Applications in Material Analysis

Unit-II (9 hrs)

Electron Microscopy: Scanning Electron Microscopy (SEM) - Transmission Electron Microscopy (TEM) - Electron Diffraction Techniques - Sample Preparation for Electron Microscopy - Advanced Electron Microscopy Techniques

UNITS-III (9 hrs)

Spectroscopy Techniques: X-ray Spectroscopy: XPS, EDS - Raman Spectroscopy and Infrared Spectroscopy - UV-Vis Spectroscopy - Nuclear Magnetic Resonance (NMR) Spectroscopy - Applications in Material Science

UNITS-IV (9 hrs)

Thermal Analysis Techniques: Differential Scanning Calorimetry (DSC) - Thermogravimetric Analysis (TGA) - Differential Thermal Analysis (DTA) - Dynamic Mechanical Analysis (DMA) - Applications and Case Studies

UNITS-V (9 hrs)

Advanced Characterization Methods: Atomic Force Microscopy (AFM) - Scanning Tunneling Microscopy (STM) - X-ray Tomography -Surface Plasmon Resonance (SPR) - Current Trends and Innovations in Material Characterization

Text Books:

"Characterization of Materials" by Elton N. Kaufmann

Reference books:

1. "Characterization of Materials; by Elton N. Kaufmann
2. "Materials Characterization: Introduction to Microscopic and Spectroscopic Methods; by Yang Leng
3. "Handbook of Materials Characterization; by Surender Kumar Sharma
4. "Fundamentals of Materials Science and Engineering: An Integrated Approach; by William D. Callister and David G. Rethwisch
5. "Elements of X-ray Diffraction; by B.D. Cullity and S.R. Stock

Web Links:

CO-PO Mapping:

(1: Slight [Low]; 2: Moderate [Medium]; 3: Substantial [High], 4: No Correlation

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	3	3	3	1	2	2	2	3	3	2
CO 2	3	2	3	3	2	3	3	1	3	3	3	2	3
CO 3	2	3	2	3	2	3	2	2	2	2	2	3	2
CO 4	3	2	3	2	2	2	3	3	1	1	3	2	3
CO 5	3	2	3	2	2	2	3	3	1	3	3	2	3

SEM-IV	Course Code	Title of the Course	L	T	P	C
	9	**Characterization Techniques in Material Science**	0	0	2	1
	Prerequisites					

Objectives:

Students have hands on experience on preparation of materials
Able to understand the preparation techniques of various materials
Able to prepare materials

Minimum of 6 experiments has to be done out of 8

List of Experiments/Syllabus

1. Optical Microscopy
Technique: Uses visible light to study the microstructure of metals and alloys.
Equipment: Optical microscope.
2. SEM Imaging
Technique: Uses electrons to create high-resolution images of surfaces.
Equipment: Scanning electron microscope (SEM).
3. X-ray Diffraction (XRD)
Technique: Determines the crystal structure and phases present in materials.
Equipment: X-ray diffractometer.
4. Energy Dispersive Spectroscopy (EDS)
Technique: Analyzes the elemental composition of materials.
Equipment: EDS detector on SEM.
5. Raman Spectroscopy
Technique: Uses Raman scattering to study molecular vibrations.
Equipment: Raman spectrometer.
6. FTIR Spectroscopy
Technique: Identifies chemical bonds and functional groups in materials.
Equipment: Fourier transform infrared (FTIR) spectrometer.
7. Thermogravimetric Analysis (TGA): Measures weight changes as a function of temperature.
Equipment: TGA apparatus.
8. Differential Scanning Calorimetry (DSC)
Technique: Measures heat flow associated with material transitions.
Equipment: DSC apparatus.
9. UV-Vis Spectroscopy
Technique: Measures absorbance and transmittance of UV and visible light.
Equipment: UV-Vis spectrophotometer.
10. Atomic Force Microscopy (AFM)
Technique: Measures surface topography at the nanoscale.
Equipment: AFM apparatus.

SEM-IV	Course Code	B.Sc. Material Science Single Major Title of the Course	L	T	P	C
	10	**Polymer Science**	3	0	0	3
	Prerequisites					

CO 1	Understand the basic concepts and types of polymers.
CO 2	Synthesize and characterize polymers using various methods.
CO 3	Analyze the thermal and mechanical properties of polymers.
CO 4	Understand the applications of polymers in different fields.
CO 5	Apply knowledge of polymer science to solve practical problems in material science.

Unit I (9 hours)

Basics of Polymer Science: Introduction to Polymers - Types of Polymers: Thermoplastics, Thermosets, Elastomers - Polymerization Mechanisms: Addition, Condensation - Molecular Weight and Distribution - Polymer Nomenclature and Classification

Unit II (9 hours)

Polymer Structure and Properties: Crystallinity in Polymers - Amorphous and Semi-Crystalline Polymers - Glass Transition Temperature - Mechanical Properties: Tensile, Impact, Hardness - Thermal Properties: Tm, Tg, Degradation

Unit III (9 hours)

Polymer Processing and Fabrication: Techniques: Extrusion, Injection Molding, Blow Molding - Film and Fiber Formation - Compounding and Blending - Additives and Reinforcements - Recycling and Sustainability

Unit IV (9 hours)

Advanced Polymer Systems: Conductive Polymers - Biodegradable Polymers - Polymer Nanocomposites - Smart Polymers and Hydrogels - Applications in Electronics, Medicine, and Packaging

Unit V (9 hours)

Characterization and Testing of Polymers: Spectroscopic Methods: FTIR, NMR, UV-Vis - Thermal Analysis: DSC, TGA - Mechanical Testing: Tensile, Impact - Rheology and Viscosity Measurements - Case Studies and Applications

Text Books:

"Polymer Science and Technology" by Joel R. Fried

Reference books:

1. Polymer Science and Technology; by Joel R. Fried
2. Introduction to Polymers; by Robert J. Young and Peter A. Lovell
3. Textbook of Polymer Science; by Fred W. Billmeyer Jr.
4. Principles of Polymer Chemistry; by Paul J. Flory
5. Polymer Chemistry: An Introduction; by Malcolm P. Stevens

Web Links:

CO-PO Mapping:

(1: Slight [Low]; 2: Moderate [Medium]; 3: Substantial [High], 4: No Correlation

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	3	1	2	2	2	3	3	2
CO2	3	2	3	3	2	3	3	1	3	3	3	2	3
CO3	2	3	2	3	2	3	2	2	2	2	2	3	2
CO4	3	2	3	2	2	2	3	3	1	1	3	2	3
CO5	3	2	3	2	2	2	3	3	1	3	3	2	3

SEM-IV	Course Code	Title of the Course	L	T	P	C
	9	**Polymer Science**	0	0	2	1
	Prerequisites					

Objectives:

Students have hands on experience on preparation of materials
Able to understand the preparation techniques of various materials
Able to prepare materials

Minimum of 6 experiments has to be done out of 8

List of Experiments/Syllabus

1. Polymerization
Technique: Synthesis of polymers by various polymerization methods.
Equipment: Reaction setup, initiators.
2. Viscometry
Technique: Measures the viscosity of polymer solutions to determine molecular weight.
Equipment: Viscometer.
3. DSC for Polymers
Technique: Measures thermal transitions such as Tg and Tm.
Equipment: DSC apparatus.
4. Mechanical Testing of Polymers
Technique: Determines tensile strength, elongation, and Young's modulus of polymers.
Equipment: Universal testing machine.
5. Glass Transition Temperature (Tg)
Technique: Measures the glass transition temperature of polymers.
Equipment: Differential scanning calorimeter (DSC).
6. FTIR Analysis
Technique: Identifies chemical bonds and functional groups in polymer samples.
Equipment: Fourier transform infrared (FTIR) spectrometer.
7. X-ray Diffraction (XRD)
Technique Studies the crystallinity and structure of polymers.
Equipment: X-ray diffractometer.
8. Thermogravimetric Analysis (TGA)
Technique: Measures weight loss due to degradation of polymers as a function of temperature.
Equipment: TGA apparatus.
9. Polymer Blends
Technique: Preparation and characterization of polymer blends.
Equipment: Mixing equipment, characterization tools (DSC, FTIR, etc.).
10. Dynamic Mechanical Analysis (DMA)
Technique: Measures viscoelastic properties of polymers.
Equipment: DMA apparatus.

B.Sc. Material Science Single Major

	Course Code	Title of the Course	L	T	P	C
SEM-IV	11	**Ceramics and Composite Materials**	3	0	0	3
	Prerequisites					

CO 1	Understand the structure and properties of ceramic materials.
CO 2	Synthesize and process ceramic and composite materials.
CO 3	Analyze the mechanical and thermal properties of ceramics and composites.
CO 4	Understand the applications and advantages of using ceramics and composites in various industries.
CO 5	Apply knowledge of ceramics and composites to material design and selection.

Unit 1 (9 hours)

Fundamentals of Ceramic Materials: Introduction to Ceramics - Crystal Structures of Ceramics - Properties of Ceramics: Mechanical, Thermal, Electrical - Processing and Sintering of Ceramics - Applications in Industry

Unit 2 (9 hours)

Types of Ceramics and Their Properties: Traditional Ceramics: Clay, Silicates, Glasses - Advanced Ceramics: Oxides, Carbides, Nitrides - Bio ceramics: Hydroxyapatite, Zirconia - Electro ceramics: Dielectrics, Ferroelectrics, Piezo electrics - Case Studies and Applications

Unit 3 (9 hours)

Introduction to Composite Materials: Definition and Classification - Matrix and Reinforcement Materials - Fabrication Methods: Hand Lay-Up, Filament Winding, Pultrusion - Mechanical Properties of Composites - Applications in Aerospace, Automotive, and Construction

Unit 4 (9 hours)

Types of Composites: Fiber-Reinforced Composites - Particle-Reinforced Composites - Structural Composites: Laminates, Sandwich Panels - Nanocomposites - Environmental and Cost Considerations

Unit 5 (9 hours)

Characterization and Testing of Ceramics and Composites: Mechanical Testing: Hardness, Strength, Toughness - Thermal and Electrical Testing - Microscopy: Optical, Electron - Non-Destructive Testing: Ultrasonics, X-ray - Applications and Current Research

Text Books:

"Ceramics: Mechanical Properties, Failure Behaviour, Materials Selection" by Dietrich Munz and Theo Fett

Reference books:

1. Introduction to Ceramics; by W.D. Kingery, H.K. Bowen, and D.R. Uhlmann
2. Fundamentals of Ceramics; by Michel W. Barsoum
3. Engineering Materials: Properties and Selection; by Kenneth G. Budinski and Michael K. Budinski
4. Composite Materials: Science and Engineering; by Krishan K. Chawla
5. Ceramic Materials: Science and Engineering; by C. Barry Carter and M. Grant Norton

Web Links:

CO-PO Mapping:

(1: Slight [Low]; 2: Moderate [Medium]; 3: Substantial [High], 4: No Correlation

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	3	1	2	2	2	3	3	2
CO2	3	2	3	3	2	3	3	1	3	3	3	2	3
CO3	2	3	3	4	2	4	2	2	2	2	2	3	1
CO4	3	2	3	2	2	2	3	3	1	3	3	2	3
CO5	3	2	3	2	2	2	3	3	1	3	3	2	3

SEM-IV	Course Code	Title of the Course	L	T	P	C
	9	Ceramics and Composite Materials	0	0	2	1
	Prerequisites					

Objectives:

Students have hands on experience on preparation of materials
Able to understand the preparation techniques of various materials
Able to prepare materials

Minimum of 6 experiments has to be done out of 8

List of Experiments/Syllabus

1**. Sol-Gel Synthesis**
Technique: Synthesis of ceramics using the sol-gel method.
Equipment: Reaction setup, precursor materials.

2. Density and Porosity Measurement
Technique: Measures the density and porosity of ceramic materials.
Equipment: Pycnometer, porosimeter.

3. Bending Test
Technique: Measures the flexural strength of ceramic materials.
Equipment: Universal testing machine with bending test fixture.

4. Optical Microscopy
Technique: Studies the microstructure of ceramics.
Equipment: Optical microscope.

5. Thermal Analysis (DSC and TGA)
Technique: Measures thermal properties and stability of ceramics.
Equipment: DSC and TGA apparatus.

6. Composite Fabrication
Technique: Fabrication of composite materials using hand lay-up method.
Equipment: Molds, reinforcing fibers, matrix material.

7. Tensile Testing of Composites
Technique: Measures the tensile strength of composite materials.
Equipment: Universal testing machine.

8. Fracture Behavior
Technique: Studies the fracture behavior of composites.
Equipment: Universal testing machine, microscopy.

9. Fiber-Matrix Interface
Technique: Analyzes the interface between fiber and matrix in composites.
Equipment: Optical or electron microscope.

10. Thermal Conductivity
Technique: Measures the thermal conductivity of composites.
Equipment: Thermal conductivity measurement setup.