

**GOVERNMENT COLLEGE (A), RAJAHMUNDRY**

DEPARTMENT OF PHYSICS-2025-26

**COURSE-1: MATHEMATICAL FOUNDATION FOR MATERIAL SCIENCE**

QUESTION BANK

**UNIT-1 : Vector Calculus**

**Essay Questions**

Sl. No.	Question	BT	CLO	PLO	PI
1	State and prove the divergence of a vector field.	BT4	CLO2	PLO1, PLO2	1.1.2, 2.2.1
2	State and prove the curl of a vector field.	BT4	CLO2	PLO1, PLO2	1.1.2, 2.2.1
3	State and prove Stokes' theorem of vector calculus.	BT5	CLO3	PLO1, PLO3	2.3.1, 3.3.4
4	State and prove Gauss theorem of vector calculus.	BT5	CLO3	PLO1, PLO3	2.3.1, 3.3.4

**Short Answer Questions**

5	Write the physical significance of gradient of a scalar field.	BT2	CLO1	PLO1	1.1.1
6	Find the value of constant (c) for which the vector $A=(x+3y) i+(y-3z) j+(x+cz) k$ is solenoidal.	BT3	CLO2	PLO2	1.3.2, 2.1.2
7	Show that $A= e^x [ -yz i + z j + y k ]$ is irrotational.	BT3	CLO2	PLO2	1.3.2, 2.3.1
8	Write a short note on scalar field and vector field with examples.	BT2	CLO1	PLO1	1.1.1, 1.2.1
9	Write the physical significance of divergence of a vector field.	BT2	CLO1	PLO1	1.1.2
10	Write the physical significance of curl of a vector field.	BT2	CLO1	PLO1	1.1.2

**UNIT-2 : Linear Algebra**

**Essay Questions**

Sl. No.	Question	BT	CLO	PLO	PI
11	Determine the Eigen values and Eigen vectors of the matrix $A = \begin{pmatrix} 4 & 2 & 1 \\ & 2 & 3 \end{pmatrix}$	BT4	CLO2	PLO2	2.2.1, 2.3.1
12	Determine the Eigen values and Eigen vectors of the matrix $A = \begin{pmatrix} 4 & 1 & 1 & 1 \\ 1 & 4 & 1 & 1 \\ 1 & 1 & 4 & 1 \\ 1 & 1 & 1 & 4 \end{pmatrix}$	BT4	CLO3	PLO2, PLO3	2.2.1, 3.3.3
13	Solve the linear equations using matrices: $2x+3y=8, 4x+y=10$	BT3	CLO2	PLO2	1.3.2, 2.1.2
14	By using Matrices, Find tension force in ropes, where mass hangs with ropes in equilibrium. Rope 1: makes an angle $30^\circ$ with horizontal. Rope 2: makes an angle $45^\circ$ with horizontal. Weight of the object is 100N	BT4	CLO3	PLO2, PLO3	2.2.1, 3.3.1

### Short Answer Questions

Sl. No.	Question	BT	CLO	PLO	PI
15	Check whether the given matrix is orthogonal or not.	BT3	CLO2	PLO2	1.3.2

$$A = \begin{bmatrix} 12 & 12 & 0 & -12 & 12 & 0 & 0 & 0 & 1 \end{bmatrix}$$

16	Check whether the given matrix is Hermitian or not.	BT3	CLO2	PLO2	1.3.2
----	---	-----	------	------	-------

$$A = \begin{bmatrix} 4 & 6+8i & 2-7i & 6-8i & 1 & 5+i & 2+6i & 5-i & 3 \end{bmatrix}$$

17	Find the inverse of the given matrix.	BT3	CLO2	PLO2	1.3.2
----	---------------------------------------	-----	------	------	-------

$$A = \begin{bmatrix} 1 & 3 & 3 & 1 & 4 & 3 & 1 & 3 & 4 \end{bmatrix}$$

### UNIT-3 : Complex Numbers

#### Essay Questions

Sl. No.	Question	BT	CLO	PLO	PI
18	Derive the expression for impedance of a series LCR circuit using phasor concept.	BT4	CLO3	PLO1, PLO2	1.1.2, 2.2.1
19	Explain the concepts "modulus" and "argument" of a complex number with an example.	BT2	CLO1	PLO1	1.1.1

### Short Answer Questions

Sl. No.	Question	BT	CLO	PLO	PI
20	Simplify $Z = 6+8i-3i$	BT3	CLO2	PLO2	1.3.2
21	Represent the complex number $Z = 1 + i/\sqrt{3}$ in polar form.	BT3	CLO2	PLO2	1.3.2
22	Represent the complex number $Z = -1-i$ in polar form.	BT3	CLO2	PLO2	1.3.2
23	If Voltage $V = 4+3i$ and current $I = 2-i$ , find power (P).	BT3	CLO2	PLO2	1.3.2, 2.3.1

### UNIT-4 : Probability

#### Essay Questions

Sl. No.	Question	BT	CLO	PLO	PI
24	State Bayes' Theorem. Solve the following problem using Bayes' Theorem: In 2025 there will be three candidates for the position of Principal – Dr. Chatterji, Dr. Ayangar and Dr. Singh, whose chances of appointment are in the ratio 4:2:3 respectively. The probability that Dr. Chatterji, if selected, would introduce co-education in the college is 0.3. The corresponding probabilities for Dr. Ayangar and Dr. Singh are 0.5 and 0.8 respectively. (i) What is the probability that there will be co-education in the college? (ii) If there is co-education in the college in 2025, what is the probability that Dr. Ayangar is the Principal?	BT4	CLO3	PLO2, PLO3	2.2.1, 2.3.1
25	State Binomial Distribution. Solve the following problem using Binomial Distribution: A and B play a game in which their chances of winning are in the ratio 3:2. Find A's chance of winning at least three games out of the five games played.	BT4	CLO3	PLO2, PLO3	2.2.1, 2.3.1
26	State Poisson Distribution. Solve the following problem using Poisson Distribution: An insurance company insures 4,000 people against loss of both eyes in a car accident. Based on previous data, it is assumed that on an average 10 persons in 1,00,000 meet with such accidents per year. Find the probability that more than 3 of the insured will collect on their policy in a given year.	BT4	CLO3	PLO2, PLO3	2.2.1, 2.3.1

### Short Answer Questions

Sl. No.	Question	BT	CLO	PLO	PI
27	Write a short note on sample space and probability theory.	BT2	CLO1	PLO1	1.1.1
28	Write a short note on discrete and continuous random variables.	BT2	CLO1	PLO1	1.1.1
29	If two dice are thrown at a time, what is the probability that the sum of the digits on the faces of the two dice is 9?	BT3	CLO2	PLO2	1.3.2, 2.1.2

### UNIT-5 : Fourier Series

#### Essay Questions

Sl. No.	Question	BT	CLO	PLO	PI
30	State and explain Fourier Theorem. Evaluate Fourier coefficients.	BT4	CLO3	PLO1, PLO2	1.1.2, 2.2.1
31	State Fourier Theorem and analyse the square wave using Fourier Theorem.	BT4	CLO3	PLO1, PLO3	2.2.1, 3.3.3
32	State Fourier Theorem and analyse the saw tooth wave using Fourier Theorem.	BT4	CLO3	PLO1, PLO3	2.2.1, 3.3.3
33	State Fourier Theorem and analyse the triangular wave using Fourier Theorem.	BT4	CLO3	PLO1, PLO3	2.2.1, 3.3.3

### Short Answer Questions

34	Explain briefly the importance of Fourier analysis.	BT2	CLO1	PLO1	1.1.2
35	Write a short note on periodic functions.	BT2	CLO1	PLO1	1.1.1
36	Explain the graphical understanding of sine and cosine functions.	BT2	CLO1	PLO1	1.1.1

**GOVERNMENT COLLEGE (AUTONOMOUS), RAJAHMUNDRY**  
**DEPARTMENT OF PHYSICS**

**Question Bank**

**Programme:** B.Sc. (Material Science)  
**Course:** Mechanics & Properties of Matter

**Semester:** I  
**Academic Year:** 2025–26

**UNIT – I: Mechanics of Particles (9 Hrs)**

**Essay Questions**

Question	CLO	PLO	BL	PI
Derive the equation of motion for a variable mass system and obtain the equation of a rocket in free space.	3	1, 2	4	1.1.2, 1.3.2, 2.2.1
Explain the principles of conservation of energy and momentum. Illustrate their applications in particle collisions.	3	1	3	1.1.2, 1.2.2
Discuss collisions in two dimensions. Derive the expressions for scattering angle and final velocities.	4	1, 2	4	1.3.2, 2.3.1
Define impact parameter and scattering cross-section. Derive the relation between impact parameter.	3	1	3	1.1.2, 1.3.2
Explain Rutherford scattering. Derive the Rutherford scattering formula and discuss its significance.	4	1, 2	4	1.3.2, 2.3.3

**Short Questions**

Question	CLO	PLO	BL	PI
State Newton's second law and give two examples of its applications.	2	1	2	1.1.2
What is a variable mass system? Give one example.	1	1	1	1.1.1
Distinguish between elastic and inelastic collisions.	2	1	2	1.1.2
Define impact parameter.	1	1	1	1.1.1
What is scattering cross-section?	1	1	1	1.1.1

**UNIT – II: Central Forces and Planetary Motion (9 Hrs)**

**Essay Questions**

Question	CLO	PLO	BL	PI
Define central forces. Explain their characteristics with examples.	2	1	2	1.1.2
Discuss why all central forces are conservative. Show that the force is the negative gradient of potential energy.	4	1, 2	4	2.2.1
Derive the equations of motion of a particle under a central force.	3	1	3	1.3.2
Derive Kepler's laws of planetary motion.	3	1	3	1.3.2
Explain the motion of satellites. Derive expressions for escape velocity and orbital velocity.	3	1	3	1.2.2, 1.3.2
What are geostationary satellites? Explain their working and applications.	2	1	2	1.2.1

### Short Questions

Question	CLO	PLO	BL	PI
Define central force and give two examples.	1	1	1	1.1.1
What is a conservative force?	1	1	1	1.1.1
State Kepler's three laws of planetary motion.	1	1	1	1.1.1
Write the expression for escape velocity.	2	1	2	1.1.2
What do you mean by orbital velocity?	2	1	2	1.1.2

### UNIT – III: Elasticity – Basics and Applications (9 Hrs)

#### Essay Questions

Question	CLO	PLO	BL	PI
Define stress and strain. Explain the different types of stress and strain.	2	1	2	1.1.2
State Hooke's law. Define Young's modulus, bulk modulus, and shear modulus. Deduce relation between Y, N & K.	3	1	3	1.3.2
Explain the physical meaning and significance of Poisson's ratio.	2	1	2	1.1.2
Derive an expression for the elastic energy stored in a stretched wire.	3	1	3	1.3.2
Discuss the theory of twisting a cylinder and derive the expression for the twisting couple.	3	1	3	1.3.2

#### Short Questions

Question	CLO	PLO	BL	PI
Define stress.	1	1	1	1.1.1
Define strain.	1	1	1	1.1.1
What is Hooke's law?	1	1	1	1.1.1
What is Poisson's ratio?	1	1	1	1.1.1

### UNIT – IV: Bending of Beams and Torsion (9 Hrs)

#### Essay Questions

Question	CLO	PLO	BL	PI
Explain the different types of loads acting on a beam.	2	1	2	1.1.2
Discuss the theory of cantilever bending and mention its applications.	3	1	3	1.3.2
Derive the expression for depression at the free end of a cantilever beam.	3	1	3	1.3.2
Explain uniform bending. Derive the formula for depression and discuss applications.	4	1, 2	4	2.2.2
Explain the principle and working of a torsional pendulum.	2	1	2	1.1.2

**UNIT – V: Fluid Mechanics (9 Hrs)****Essay Questions**

Question	CLO	PLO	BL	PI
Explain the properties and classification of fluids. Distinguish between ideal and real fluids.	CLO-2	PLO1	BT2	1.1.2
Discuss streamline and turbulent flow. Explain Reynolds number.	CLO-2	PLO1	BT2	1.1.2
Derive equation of continuity and explain its applications.	CLO-3	PLO1	BT3	1.3.2
State and derive Bernoulli's theorem and explain its applications.	CLO-3	PLO1	BT3	1.2.2
Explain viscosity and Poiseuille's law.	CLO-2	PLO1	BT2	1.1.2

**Blue print****SCHEME FOR SEMESTER END THEORY EXAMINATION (SEE) – (Major1 /Major-2)****EXTERNAL (50)**

TYPE OF QUESTION	MARKS	SCHEME
<b>PART-A</b> Essay Questions	Each question carries 7 Marks	<b>Answer all the questions</b>  <b>5x7 = 35 M</b>  Theoretical Questions, Maximum 2 questions from Each unit with internal choice
<b>PART-B</b> Short Answer Questions	Each question carries 3 Marks	<b>Answer any 5 out of 8 questions</b>  <b>5x3= 15 M</b>  <ul style="list-style-type: none"> <li>• Minimum 1 question from Each unit.</li> <li>• 2 questions from Unit II, IV &amp; V</li> </ul>

GOVERNMENT COLLEGE (AUTONOMOUS), RAJAHMUNDRY  
 (Accredited by NAAC "A+" Grade)  
 DEPARTMENT OF COMPUTER SCIENCE  
 I B.Sc\B.Com\B.A Honours  
 Semester-I  
 FUNDAMENTALS OF ARTIFICIAL INTELIGENCE  
 CIE- I Question Bank  
 UNIT – I:

**Essay Questions (7 Marks Each)**

Q.No	Question	BT	CLO	PLO	PI Code(s)
1	Describe the history of artificial intelligence	BT2	CLO1	PLO1	1.2.1
2	Differentiate between narrow AI, general AI, and super AI, with examples	BT4	CLO2	PLO2	2.1.1
3	Discuss how artificial intelligence works, including its components (data, algorithms, learning) and the process of machine learning	BT2	CLO2	PLO1	1.2.1
4	Explain the types of learning in AI (supervised, unsupervised, reinforcement) with real-life examples and advantages/limitations	BT3	CLO3	PLO2	2.1.1

**Multiple Choice Questions**

1. What is a key characteristic of intelligent behavior?
  - a) Repeating tasks without change
  - b) Learning from experience
  - c) Ignoring patterns
  - d) Memorizing facts
2. Which period marks the birth of artificial intelligence?
  - a) 16th–19th Century
  - b) Early 20th Century
  - c) 2000s–Present
  - d) 1950s–1960s
3. Narrow AI is also known as:
  - a) Artificial General Intelligence
  - b) Artificial Superintelligence
  - c) Artificial Human Intelligence
  - d) Artificial Narrow Intelligence
4. In AI, data is comparable to:

a) Tools in a kitchen

b) The chef

c) Instructions in a recipe

d) Ingredients in a recipe

5. Supervised learning is like:

a) Learning by exploring without guidance

b) Learning without data

c) Learning by trial and error

d) Learning from a teacher with labeled examples

6. Which industry uses AI for personalized shopping experiences?

a) Healthcare

b) Finance

c) Agriculture

d) Retail

7. Knowledge engineering involves:

a) Generating images

b) Building robots

c) Collecting and structuring knowledge for AI

d) Processing natural language

8. Machine learning is a subset of:

a) Robotics

b) Natural language processing

c) Artificial intelligence

d) Computer vision

9. Deep learning is inspired by:

a) Chemical reactions

b) Human brain's neural networks

c) Mechanical gears

d) Animal behavior

10. NLP stands for:

a) Natural Learning Process

b) Network Language Protocol

c) Neural Language Processing

d) Natural Language Processing

UNIT – II :

Essay Questions (7 Marks Each)

Q.No	Question	BT	CLO	PLO	PI Code(s)
1	Discuss the applications of AI in healthcare	BT2	CLO2	PLO1	1.2.1
2	Explain how AI is used in finance for fraud detection, personalized banking, algorithmic trading, and credit scoring, with benefits and challenges	BT3	CLO3	PLO2	2.1.1
3	Describe AI applications in retail	BT2	CLO2	PLO1	1.2.1
4	Discuss AI in agriculture	BT2	CLO2	PLO1	1.2.1

**Multiple Choice Questions**

AI in healthcare is used for:

- a) Building houses
- b) Cooking recipes
- c) Playing music
- d) Early disease detection

Fraud detection in finance uses AI to:

- a) Design cards
- b) Count coins
- c) Print money
- d) Analyze transaction patterns

Personalized shopping in retail involves:

- a) AI recommendations based on user behavior
- b) No suggestions
- c) Manual suggestions
- d) Random items

AI in education supports:

- a) No learning

b) Personalized learning plans

c) Fixed plans

d) Only group learning

Precision farming in agriculture uses AI for:

a) Manual labor

b) Ignoring data

c) Wasting resources

d) Optimizing resource use

Predictive maintenance in manufacturing:

a) Prevents breakdowns using data

b) Replaces machines

c) Causes breakdowns

d) Ignores data

Autonomous vehicles use AI for:

a) Self-driving and navigation

b) Swimming

c) Manual driving

d) Flying

A challenge of AI in healthcare is:

a) Too cheap

b) Always accurate

c) Ethical considerations like privacy

d) No challenges

Dynamic pricing in retail adjusts:

a) No prices

b) Random prices

c) Prices based on demand

d) Fixed prices

AI in transportation helps with:

a) No management

b) Traffic management in smart cities

c) Increasing traffic

d) Ignoring traffic

**I.B.Sc. Material Science**  
**Semester II Course:**  
**Major 3: WAVES AND OPTICS - Question Bank**

**UNIT-I**

**LONG ANSWER (ESSAY) QUESTIONS**

Q.No	Question	CLO	PLO	BTL	PI Code
1	Derive the differential equation of a simple harmonic oscillator and obtain its solution. Discuss its physical characteristics.	CLO2	PLO1	BTL-2	1.1.2
2	Explain damped harmonic oscillations. Derive expressions for logarithmic decrement, relaxation time, and quality factor.	CLO3	PLO2	BTL-3	2.2.1
3	Obtain the solution of the differential equation for forced oscillations and discuss resonance.	CLO4	PLO3	BTL-4	3.3.3

**SHORT ANSWER QUESTIONS**

Q.No	Question	CLO	PLO	BTL	PI Code
1	Define simple harmonic motion with examples.	CLO1	PLO1	BTL-1	1.1.1
2	What is logarithmic decrement?	CLO2	PLO1	BTL-1	1.1.1
3	Define the quality factor of an oscillator.	CLO2	PLO2	BTL-2	2.1.1
4	What is resonance in forced oscillations?	CLO3	PLO2	BTL-2	2.2.1

**UNIT-II**

**LONG ANSWER (ESSAY) QUESTIONS**

Q.No	Question	CLO	PLO	BTL	PI Code
1	Derive the equation for the velocity of transverse waves along a stretched string.	CLO3	PLO1	BTL-3	1.3.2
2	Discuss longitudinal vibrations in bars and obtain solutions.	CLO3	PLO2	BTL-3	2.2.1
3	Explain the working principle of a tuning fork with necessary theory.	CLO4	PLO3	BTL-	3.3.1

**SHORT ANSWER QUESTIONS**

Q.No	Question	CLO	PLO	BTL	PI Code
1	Write the three laws of transverse waves?	CLO1	PLO1	BTL-1	1.1.1
2	Write the wave equation for longitudinal vibrations.	CLO2	PLO1	BTL-2	1.1.2
3	Mention the boundary conditions for a bar fixed at both ends.	CLO4	PLO2	BTL-3	2.2.1
4	State any three applications of vibrating strings.	CLO5	PLO1	BTL-1	1.2.1

**UNIT-III:**

## LONG ANSWER (ESSAY) QUESTIONS

Q.No	Question	CLO	PLO	BTL	PI Code
1	Explain the principle of superposition and conditions for interference of light.	CLO2	PLO1	BTL-2	1.1.2
2	Describe Fresnel's biprism experiment and explain how wavelength of light is determined.	CLO3	PLO2	BTL-3	2.2.1
3	Explain Newton's rings experiment and derive the expression for wavelength determination.	CLO4	PLO3	BTL-4	3.3.4

## SHORT ANSWER QUESTIONS

Q.No	Question	CLO	PLO	BTL	PI Code
1	What is coherence?	CLO1	PLO1	BTL-1	1.1.1
2	What causes colors in thin films?	CLO2	PLO2	BTL-2	2.1.1
3	Define fringe width.	CLO2	PLO1	BTL-2	1.1.2
4	Write the applications of interference.	CLO5	PLO1	BTL-1	1.2.1

## UNIT-IV:

### LONG ANSWER (ESSAY) QUESTIONS

Q.No	Question	CLO	PLO	BTL	PI Code
1	Distinguish between Fresnel and Fraunhofer diffraction.	CLO4	PLO3	BTL-4	3.3.3
2	Explain Fraunhofer diffraction due to a single slit with necessary theory.	CLO3	PLO2	BTL-3	2.2.1
3	Explain the construction and working of a zone plate.	CLO4	PLO3	BTL-4	3.3.4

### SHORT ANSWER QUESTIONS

Q.No	Question	CLO	PLO	BTL	PI Code
1	What is diffraction?	CLO1	PLO1	BTL-1	1.1.1
2	Define half period zone.	CLO2	PLO1	BTL-2	1.1.2
3	What is a zone plate?	CLO2	PLO2	BTL-2	2.1.1
4	State one difference between interference and diffraction.	CLO4	PLO3	BTL-4	3.3.3

## UNIT-V:

### LONG ANSWER (ESSAY) QUESTIONS

Q.No	Question	CLO	PLO	BTL	PI Code
1	Explain various methods of polarization of light.	CLO2	PLO1	BTL- <sub>2</sub>	1.1.2
2	Describe the construction and working of Nicol prism with suitable diagrams.	CLO3	PLO2	BTL- <sub>3</sub>	2.2.1
3	Describe Nicol prism as a polarizer and analyzer.	CLO4	PLO3	BTL- <sub>4</sub>	3.3.4

### SHORT ANSWER QUESTIONS

Q.No	Question	CLO	PLO	BTL	PI Code
1	State Malus law.	CLO2	PLO1	BTL-2	1.1.2
2	What is a quarter wave plate?	CLO2	PLO1	BTL-2	1.1.2
3	Explain Brewster's law and its significance.	CLO3	PLO2	BTL-3	2.2.1
4	Mention the applications of polarized light.	CLO5	PLO1	BTL-1	1.2.1

**III SEMESTER**  
**I.BSc--MATERIALS SCIENCE**  
**MAJOR 5: CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE**  
**QUESTION BANK**

**ESSAY QUESTIONS**

**UNIT-1**

1. Describe the Bravais Lattices in 3-Dimensional crystal with neat diagrams? **(BL-1 &2)**
2. State crystal defect? Explain the point defect and line defect in the crystal? **(BL-1 2)**
3. Derive the expression for interplaner spacing in the crystal? **(BL-2)**

**UNIT-2**

1. State and explain Bragg's Law? Mention its physical significance? **(BL-1, BL2 & BL-3)**
2. Explain the Laue equations of a 3-Dimensional crystal and derive Bragg's law from Laue equations? **(BL-1, BL2 & BL-3)**
3. Describe the powder diffraction method to determine the crystal s

**UNIT-3**

1. State principles of electron diffraction? Explain LEED technique to study crystal surface? **(BL-1 &BL-2)**
2. Explain the neutron diffraction to study the magnetic properties of the crystal? **(BL-1 &BL-2)**
3. Differences and similarities between X-ray diffraction and electron diffraction?**(BL-2)**

**UNIT-4**

1. Explain the role of defects on electrical and thermal properties of crystals? **(BL-3)**
2. Explain the working of Scanning Electron Microscope (SEM)? **(BL-1 &BL-2)**
3. Explain the working of Transmission Electron Microscope (TEM)? **(BL-1 &BL-2)**

**UNIT-5**

1. Describe the construction of Ewald Sphere and its applications? **(BL-3)**
2. Discuss the principles of crystal growth? Describe any one method of crystal growth? **(BL-1 &BL-2)**

**SHORT QUESTIONS**

**UNIT-1**

1. State crystal lattice and basis? **(BL-1)**
2. State unit cell and primitive cell? **(BL-1)**

3. Determine the miller indices of a crystal plane, if the intercepts of the plane are  $1a$ ,  $2a$  and  $3a$  with  $x$ ,  $y$  and  $z$  axis where  $a$  is lattice constant? **(BL-3)**

#### **UNIT-2**

1. Write a short note on the properties of X-rays? **(BL-2)**
2. Briefly explain about continuous and characteristic X-rays? **(BL-2)**
3. Write a short note on applications of X-ray diffraction? **(BL-3)**

#### **UNIT-3**

1. State applications and limitations of electron diffraction? **(BL-3)**
2. Principles of electron diffraction? **(BL-1)**

#### **UNIT-4**

1. Briefly explain the interaction of neutrons with matter? **(BL-2)**
2. Write a short note on creep and fatigue? **(BL-2)**
3. Briefly explain structure and energy of grain boundary? **(BL-1 & BL-2)**

#### **UNIT-5**

1. State and explain reciprocal lattice? **(BL-1 & BL-2)**
2. Write a short note on interpretation of electron density maps? **(BL-3)**
3. Discuss the principles of crystal growth? **(BL-1)**
4. Discuss the applications of crystal growth in semiconductor industry? **(BL-3)**

**III SEMESTER B.Sc (Hons) Material Science  
(2023-2024 admitted batch of students)  
Course: 6 Thermodynamics and Kinetics of Materials  
Question bank**

**UNIT 1 Thermodynamic Principles**

**Essay Questions**

Q.No.	Question	BTL	CLO	PLO	PI Code
1	Explain Carnot cycle and derive the expression for efficiency	BL3	CLO2	PLO1, PLO2	1.2.2, 2.2.1
2	Explain how the thermodynamic principles are used understanding the properties of materials, particularly in alloys and phase change	BL3	CLO3	PLO1, PLO3	1.2.2, 3.2.1
3	Explain the concepts of internal energy, work, and heat. Discuss the First Law of Thermodynamics.	BL2	CLO2	PLO1	1.1.2
4	Explain the concept of entropy and its significance in the second law of thermodynamics. Discuss how entropy relates to the spontaneity of processes and provide examples of spontaneous and non-spontaneous processes in nature	BL3–BL4	CLO4	PLO2, PLO3	2.3.1, 3.3.4
5	Explain Gibbs free energy and chemical potential in detail.	BL4	CLO4	PLO2, PLO3	2.3.1, 3.3.3

**Short Answer Questions**

1	Write short notes on Specific heats and calorimetry	BL2	CLO2	PLO1	1.1.2
2	Explain Entropy and its physical meaning.	BL2	CLO2	PLO1	1.1.2
3	Define a closed system in thermodynamics. How does it differ from an open system?	BL3	CLO1	PLO1	1.1.2
4	Define the terms Thermodynamics, System, Surroundings, State and Process	BL1	CLO1	PLO1	1.1.1

**UNIT 2 Phase Diagrams**

**Essay Questions**

1	How do you interpret a unary phase diagram for water? What phases are present at different temperatures?	BL3	CLO2	PLO1, PLO2	1.2.2, 2.2.1
2	Explain binary phase diagram with example.	BL3	CLO2	PLO1, PLO2	1.2.2, 2.2.1
3	Explain ternary phase diagram with example.	BL3–BL4	CLO3	PLO2, PLO3	2.3.1, 3.2.1

**Short Answer Questions**

1	Explain Lever rule and tie-line rule	BL3	CLO3	PLO2	2.2.1
2	Explain Peritectic and monotectic reactions	BL2	CLO1	PLO1	1.1.2
3	Explain Nucleation and growth in phase transformations	BL2	CLO4	PLO1	1.1.2

**Unit 3: Statistical Thermodynamics**

### Essay Questions

1	Compare and contrast Maxwell–Boltzmann, Fermi–Dirac, and Bose–Einstein statistics	BL4	CLO2	PLO2, PLO3	2.3.1, 3.2.1
2	Discuss the significance of the Boltzmann distribution in statistical mechanics. How does it relate microstates to macro states, and what implications does it have for understanding thermodynamic systems?	BL4	CLO4	PLO2, PLO3	2.3.1, 3.3.4
3	What are the applications of statistical mechanics in material science?	BL3	CLO3	PLO1,	1.2.2,

### Short Answer Questions

1	Define a Macro state and explain how it differs from a Microstate	BL2 (Understand)	CLO1	PLO1	1.1.2
2	How is entropy defined in the context of statistical mechanics?	BL2 (Understand)	CLO1	PLO1	1.1.2
3	What is the significance of the concept of degeneracy in statistical mechanics?	BL2 (Understand)	CLO1	PLO1	1.1.2

## UNIT4: Kinetics of Materials

### Essay Questions

1	What is Fick's First Law of Diffusion, and Kirkendall effect?	BL3 (Apply)	CLO2	PLO1, PLO2	1.2.2, 2.2.1
2	Explain kinetic models and reaction mechanisms.	BL4 (Analyze)	CLO3	PLO2, PLO3	2.3.1, 3.2.1
3	What are some common methods for synthesizing nanomaterials?	BL3 (Apply)	CLO4	PLO1, PLO3	1.2.2, 3.2.1

### Short Answer Questions

Q. No.	Question	BT	CLO	PLO	PI Code
1	Define the Kirkendall effect and its significance in materials science	BL2	CLO2	PLO1	1.1.2
2	Explain sintering and densification	BL2	CLO1	PLO1	1.1.2
3	Explain homogeneous and heterogeneous nucleation	BL2	CLO1	PLO1	1.1.2
4	What are the main differences between interstitial and vacancy diffusion mechanisms?	BL3	CLO3	PLO2	2.2.1

## Unit 5: Essay Questions

1	Explain the thermodynamics of biomolecules.	BL3 (App)	CLO1	PLO1, 3	1.2.2, 3.2.1
2	Explain the synthesis and growth of nanomaterials.	BL3 (App)	CLO2	PLO1, 3	1.2.2, 3.2.1
3	Discuss the significance of surface energy and surface tension in materials science	BL4 (Ana)	CLO3	PLO2, 4	2.3.1, 4.1.1

### Short Answer Questions

1	What is the difference between surface energy and surface tension?	BL2	CLO3	PLO1	1.1.2
2	Explain the thermodynamics of nanomaterials.	BL2	CLO2	PLO1	1.1.2
3	Write the applications of thermodynamics in biotechnology.	BL3	CLO4	PLO3	3.2.1

**DEPARTMENT OF PHYSICS**  
**II B.Sc, MATERIAL SCIENCE (HONS) – SEM III**  
**(COURSE-7): MECHANICAL PROPERTIES OF MATERIALS**  
**QUESTION BANK**

**Unit 1: Introduction to Mechanical Properties**

**Essay Questions (7 marks)**

1. Explain the concept of Hooke's law and its application in elastic deformation. (BL2: understanding)
2. What is Young's modulus? Explain its significance in determining material stiffness. (BL2: understanding)
3. Explain what yield strength is and how it influences the design of mechanical components. (BL2: understanding)
4. Explain the significance of true stress and true strain in plastic deformation. (BL2: understanding)

**Short Answer Questions (3 marks)**

1. Define stress and strain. (BL1: remembering)
2. What is the difference between elastic and plastic deformation? (BL1: remembering)
3. State Hooke's law. (BL1: remembering)
4. Define yield strength. (BL1: remembering)
5. What is work hardening? (BL2: understanding)

**Unit 2: Fracture Mechanics**

**Essay Questions (7 marks)**

1. Define ductile fracture and describe its characteristics. (BL1: remembering)
2. What is fatigue? Explain how it affects the longevity of materials. (BL2: understanding)
3. Describe the basic form of an S-N curve and its relevance in predicting fatigue life. (BL2: understanding)
4. Explain the creep mechanisms and how they affect the mechanical properties of materials at high temperatures. (BL3: applying)
5. Describe the methods used in failure analysis to identify the cause of material failure. (BL3: applying)

**Short Answer Questions (3 marks)**

1. Define brittle fracture. (BL1: remembering)
2. What is fracture toughness? (BL2: understanding)
3. What is an S-N curve? (BL2: understanding)

4. What is failure analysis? (BL1: remembering)
5. Name two factors that affect fatigue strength. (BL2: understanding)

### **Unit 3: Strengthening Mechanisms**

#### **Essay Questions (7 marks)**

1. Define work hardening and explain how it strengthens materials. (BL2: understanding)
2. Explain the Hall-Petch relationship and its role in grain boundary strengthening. (BL2: understanding)
3. What is solid solution strengthening? Describe how it enhances material properties. (BL2: understanding)
4. Explain the significance of controlling grain size in the mechanical properties of materials. (BL2: understanding)
5. Explain the basic heat treatment process for precipitation hardening in Al-Cu alloys. (BL3: applying)

#### **Short Answer Questions (3 marks)**

1. What is cold working? (BL1: remembering)
2. What factors affect solid solution strengthening? (BL2: understanding)
3. Name two examples of alloys that undergo precipitation hardening. (BL1: remembering)
4. What is the effect of grain size on material strength? (BL2: understanding)
5. What are the key differences between work hardening and precipitation hardening? (BL4: analyzing)

### **Unit 4: Mechanical Properties of Specific Materials**

#### **Essay Questions (7 marks)**

1. Compare the mechanical properties of ferrous and non-ferrous alloys. (BL3: applying)
2. Explain the brittle behavior of ceramics and its implications for their use in engineering applications. (BL2: understanding)
3. What is viscoelastic behavior in polymers? Describe how it affects the mechanical performance of plastics. (BL2: understanding)
4. Explain the role of biomaterials in medical implants and their key mechanical properties. (BL2: understanding)

#### **Short Answer Questions (3 marks)**

1. What are fiber-reinforced composites? (BL1: remembering)
2. Name two toughening mechanisms used in ceramics. (BL2: understanding)
3. What is the significance of matrix materials in composites? (BL2: understanding)
4. What are the primary applications of titanium alloys in aerospace? (BL2: understanding)
5. Name two polymers used in biomedical applications. (BL1: remembering)

## **Unit 5: Applications and Case Studies**

### **Essay Questions (7 marks)**

1. What role do mechanical properties play in material selection for engineering design? (BL2: understanding)
2. Describe the importance of lightweight materials in automotive and aerospace industries. (BL2: understanding)
3. Explain the mechanical properties that make materials suitable for biomedical implants. (BL2: understanding)
4. Describe the process of material selection for a high-performance component in the aerospace industry. (BL3: applying)
5. Compare the wear and tear mechanisms encountered in different industrial environments. (BL3: applying)

### **Short Answer Questions (3 marks)**

1. Why are mechanical properties crucial in material selection? (BL2: understanding)
2. Name two design criteria for selecting materials in aerospace applications. (BL1: remembering)
3. Define wear and tear in industrial applications. (BL2: understanding)
4. Name two wear-resistant materials used in industry. (BL1: remembering)
5. What are the mechanical requirements of prosthetics? (BL2: understanding)
6. What is nanomechanics? (BL2: understanding)
7. Name two materials used in automotive applications. (BL1: remembering)

**II B.Sc. Materials Science –SEMESTER-III**  
**COURSE\_8 Electrical and Mechanical Properties of Materials**  
**Question Bank**

**Unit 1: Fundamentals of Electrical Properties**

**Essay Questions:**

1. Explain the differences between conductors, semiconductors, and insulators based on their band structure. (Level 2: Understand)
2. Describe the concept of intrinsic and extrinsic semiconductors. Explain the role of doping in modifying the electrical properties of semiconductors. (Level 3: Apply)
3. Discuss the free electron theory of electrical conductivity in metals. How does Matthiessen's rule help explain the influence of temperature and impurities on Conductivity? (Level 3: Apply)

**Short Answer Questions:**

1. What is the temperature dependence of electrical conductivity in metals and Semiconductors? (Level 2: Understand)
2. Briefly explain how electron and hole mobility affect the conductivity of semiconductors. (Level 2: Understand)
3. Define Matthiessen's rule and explain its significance in understanding the conductivity of metals. (Level 1: Remember)

**Unit 2: Semiconductor Materials and Devices**

**Essay Questions:**

1. Explain the difference between intrinsic and extrinsic semiconductors. How does doping affect the electrical properties of semiconductors? (Level 2: Understand)
2. Discuss the formation of a p-n junction and describe its current-voltage characteristics. (Level 3: Apply)
3. Explain construction and working of photovoltaic cell (Solar Cell)

**Short Answer Questions:**

1. What are the electrical properties of pure (intrinsic) semiconductors? (Level 1: Remember)
2. How do diodes function as rectifiers in electronic circuits? (Level 2: Understand)
3. Define the basic structure and operation of a BJT. (Level 2: Understand)
4. Explain working of LED? Give two examples of their applications. (Level 1: Remember)

**Unit 3: Dielectric Materials and Applications**

**Essay Questions:**

1. Explain the different mechanisms of polarization in dielectric materials. How do these

mechanisms vary with frequency? (Level 2: Understand)

2. Discuss the concept of dielectric constant and dielectric loss. Explain their significance in determining material performance in capacitors. (Level 3: Apply)
3. Explain piezoelectric effect. Write some applications. (Level: Apply)

**Short Answer Questions:**

1. What is dielectric relaxation and why is it important? (Level 2: Understand)
2. How does temperature affect the dielectric properties of materials? (Level 2: Understand)
3. Explain the measurement of dielectric constant.
4. Define piezoelectric effect and mention one of its uses. (Level 1: Remember)

**Unit 4: Magnetic Materials and Applications**

**Essay Questions:**

1. Compare the magnetic properties of diamagnetic, paramagnetic, and ferromagnetic materials. (Level 2: Understand)
2. Discuss the concept of magnetic hysteresis. Explain the significance of the hysteresis loop in designing magnetic storage media and transformers. (Level 3: Apply)
3. Explain the domain theory of ferromagnetism and describe the process of magnetization in materials. (Level 3: Apply)

**Short Answer Questions:**

1. What is magnetic susceptibility and how is it measured? (Level 1: Remember)
2. Explain the difference between hard and soft magnetic materials. (Level 2: Understand)
3. What are Curie and Neel temperatures? Why are they important for magnetic materials? (Level 1: Remember)

**Unit 5: Emerging Trends in Electronic Materials**

**Essay Questions:**

1. Discuss the basics quantum dots and nanowires and how they are used in advanced electronic devices? (Level 3: Apply)
2. Explain the structure and operation of organic light-emitting diodes (OLEDs). How do they differ from traditional LEDs in terms of materials and applications? (Level 3: Apply)
3. Explain thermoelectricity and discuss the importance of thermoelectric materials for energy harvesting (Level 4: Analyze)

**Short Answer Questions:**

1. What are the key features of conducting polymers? (Level 1: Remember)
2. What are quantum dots? Mention one of their applications. (Level 2: Understand)
3. Define spintronics and explain its potential application in future electronic devices. (Level 2: Understand)

**GOVERNMENT COLLEGE (A) :: RAJAMAHENDRAVARAM**  
**DEPARTMENT OF PHYSICS**  
**II B.Sc. Material Science SEMESTER-IV**  
**(w.e.f. 2023-24)**  
**COURSE 9: Characterization Techniques in Material Science**  
**Question Bank**

---

**Unit 1**

Q. No	Question	Marks	BTL	CLO	PLO	PI
<b>Essay Questions</b>						
1.	Explain the basic components of an optical microscope. Discuss the factors that determine magnification and the physical limits of resolution.	7	2	2	1	1.1.2
2.	Compare Bright Field and Dark Field microscopy. Describe the techniques used for contrast enhancement and their practical applications in material science.	7	4	3	2	2.2.1
3.	Discuss the role of optical microscopy in material analysis, specifically for identifying grain boundaries, phase distributions, and defect identification.	7	2	2	1	1.2.2
<b>Short Questions</b>						
4.	Define "Birefringence" and explain how polarized light microscopy is used to study birefringent materials.	3	1	1	1	1.1.1
5.	State the fundamental principle of Phase Contrast microscopy and name one application in polymer science.	3	1	1	1	1.1.1
6.	Calculate the total magnification of a microscope if the objective lens is 40x and the eyepiece is 10x.	3	3	2	1	1.3.2
7.	Identify two main differences between a Bright Field image and a Dark Field image of the same specimen.	3	4	3	2	2.3.2

**Unit 2:**

**Essay Questions**

- |    |  |   |   |   |   |       |
|----|--|---|---|---|---|-------|
| 1. | Explain the fundamental principles and working of Scanning Electron Microscopy (SEM). Discuss its specific applications in surface morphology analysis.            | 7 | 2 | 2 | 1 | 1.1.2 |
| 2. | Describe the principles of Transmission Electron Microscopy (TEM). Elaborate on imaging and diffraction modes used for crystallography and defect analysis.        | 7 | 2 | 2 | 1 | 1.1.2 |
| 3. | Compare and contrast the sample preparation techniques for SEM and TEM. Include details on coating techniques and cryo-preparation methods for biological samples. | 7 | 4 | 3 | 2 | 2.2.1 |

**Short Questions**

- |   |               |
|---|---------------|
| 4. Define the principle of High-resolution TEM (HRTEM) and its significance in material science.  | 3 1 1 1 1.1.1 |
| 5. What is selected area electron diffraction (SAED) and how is it used in material analysis?     | 3 2 2 1 1.1.2 |
| 6. List the primary differences between SEM and STEM (Scanning Transmission Electron Microscopy). | 3 4 2 2 2.3.2 |

### Unit 3:

#### Essay Questions (7 Marks each)

- |  |               |
|--|---------------|
| 1. Explain the principles of Fourier Transform Infrared (FTIR) spectroscopy. Discuss its specific applications in functional group identification and polymer analysis.    | 7 2 2 1 1.1.2 |
| 2. Explain the principle of Raman spectroscopy and its applications in material identification   | 7 4 3 2 2.2.1 |
| 3. Elaborate on the principles of Nuclear Magnetic Resonance (NMR) spectroscopy. Explain the significance of chemical shift and spin-spin coupling in structural analysis. | 7 2 2 1 1.1.2 |

#### Short Questions (3 Marks each)

- |  |               |
|--|---------------|
| 4. Write any three applications of Raman scattering.   | 3 1 1 1 1.1.1 |
| 5. Illustrate how UV-Vis spectroscopy is used for the determination of the energy band gap in materials.         | 3 3 2 1 1.2.2 |
| 6. Identify the main components of a Raman spectrometer and explain their basic functions.                       | 3 1 1 1 1.1.1 |
| 7. Differentiate between Infrared absorption and Raman scattering in terms of the molecular changes they detect. | 3 4 3 2 2.3.2 |

### Unit 4:

#### Essay Questions (7 Marks each)

- |   |               |
|---|---------------|
| 1. Describe the principles and operation of Differential Scanning Calorimetry (DSC). Explain how it is used to measure thermal transitions such as T <sub>g</sub> and T <sub>m</sub> in polymers. | 7 2 2 1 1.1.2 |
| 2. Discuss the principles of Thermogravimetric Analysis (TGA). How is it used to determine material stability and composition through weight loss measurements?                                   | 7 2 2 1 1.1.2 |
| 3. Compare Differential Thermal Analysis (DTA) with DSC. Discuss their specific applications in phase transition analysis and research.   | 7 4 3 2 2.2.1 |

#### Short Questions (3 Marks each)

- |   |               |
|---|---------------|
| 4. Define "Thermal Degradation" and explain its significance in the quality control of composite materials.                         | 3 1 1 1 1.1.1 |
| 5. Identify the components of a TGA instrument and explain the role of the microbalance in the setup.                               | 3 1 1 1 1.1.1 |
| 6. Predict the expected weight loss behavior in a TGA curve for a hydrated salt as it is heated from room temperature to 500°C.     | 3 3 2 1 1.2.2 |
| 7. In a DSC experiment, differentiate between an endothermic and an exothermic peak with examples of physical transitions for each. | 3 4 3 2 2.3.2 |

### Unit 5

#### Essay Questions (7 Marks each)

1. Explain the fundamental principles of Atomic Force Microscopy (AFM). Discuss the differences between contact, tapping, and non-contact imaging modes. 7 2 2 1 1.1.2
2. Describe the principles of X-ray Computed Tomography (CT). Elaborate on its applications in non-destructive testing and 3D imaging of materials. 7 2 2 1 1.1.2
3. Analyze the significance of *in-situ* and *operando* characterization techniques in modern material research. How does the integration of multiple methods enhance material analysis? 7 5 5 3 3.3.4

**Short Questions (3 Marks each)**

4. Define the principle of Scanning Tunneling Microscopy (STM) and explain how tunneling current is used for surface imaging. 3 1 1 1 1.1.1
5. What is Surface Plasmon Resonance (SPR)? Name two major applications of SPR in the field of biosensing. 3 1 1 1 1.1.1
6. Identify the key differences between AFM and STM in terms of the physical principles they utilize for topography. 3 4 3 2 2.3.2

**GOVERNMENT COLLEGE (A) :: RAJAMAHENDRAVARAM**  
**DEPARTMENT OF PHYSICS**  
**II B.Sc. Material Science SEMESTER-IV**  
**(w.e.f. 2023-24)**  
**COURSE 10: Polymer science**  
**QUESTION BANK**

**UNIT 1: Basics of Polymer Science**

**Essay Questions**

Q.No	Question	BL	CLO	PLO	PI Code
1	Define polymers and discuss their classification	BL2	CLO1	PLO1	1.1.2
2	Explain the historical development and significance of polymers in modern applications	BL2	CLO1	PLO1	1.2.1
3	Describe the mechanisms of addition (chain-growth) and condensation (step-growth) polymerization, with examples	BL2	CLO1	PLO2	2.1.2

**Short Answer Questions**

1	Differentiate between thermoplastics and thermosets	BL2	CLO1	PLO1	1.1.2
2	Define homopolymers and copolymers, providing examples of each	BL2	CLO1	PLO1	1.1.2
3	What is meant by polymer nomenclature? Give one example of systematic naming of a polymer	BL1	CLO1	PLO1	1.1.1
4	Explain the terms number average and weight average molecular weight	BL2	CLO1	PLO2	2.2.1

**UNIT 2:**

**Essay Questions**

1	Explain crystallinity in polymers. Discuss the structure and properties of amorphous and semi-crystalline polymers.	BL4	CLO2	PLO3	3.1.1
2	Define glass transition temperature (T <sub>g</sub> ) and melting temperature (T <sub>m</sub> ). Explain their significance in polymers.	BL4	CLO2	PLO2	2.2.2
3	Describe the mechanical properties of polymers and the factors influencing them.	BL4	CLO2	PLO3	3.3.3

**Short Answer Questions**

1	What is crystallinity in polymers? Mention any two methods used to measure it.	BL2	CLO2	PLO2	2.3.1
2	Differentiate between amorphous and semi-crystalline polymers.	BL2	CLO2	PLO2	2.2.1
3	Define glass transition temperature (T <sub>g</sub> ) and state its importance	BL2	CLO2	PLO1	1.1.2
4	What is thermal degradation of polymers? Mention one factor affecting it.	BL2	CLO2	PLO2	2.1.1

**UNIT 3:**

**Essay Questions**

- |   |                     |
|---|---------------------|
| 1 Explain the extrusion process used in polymer processing                        | BL2 CLO3 PLO1 1.2.2 |
| 2 Describe injection molding and blow molding techniques in detail                | BL2 CLO3 PLO2 2.2.1 |
| 3 Discuss polymer compounding and blending. in Polymer Processing and Fabrication | BL3 CLO3 PLO3 3.2.1 |

### Short Answer Questions

- |  |                      |
|--|----------------------|
| 1 Define polymer additives. Give two examples  | BL2 CLO3 PLO1 1.2.1  |
| 2 What is meant by polymer recycling? State one challenge associated with it               | BL2 CLO3 PLO10 7.2.1 |
| 3 What are reinforcement materials in polymers, and how do they affect polymer properties? | BL3 CLO3 PLO3 3.3.1  |

### UNIT 4:

#### Essay Questions

- |  |                      |
|--|----------------------|
| 1 Explain conductive polymers—their structure, conduction mechanism, types, properties, and applications | BL4 CLO4 PLO3 3.3.4  |
| 2 Describe biodegradable polymers with examples, degradation mechanisms, properties, and applications.   | BL4 CLO4 PLO10 7.2.3 |
| 3 Explain polymer nanocomposites and smart polymers (including hydrogels) and their applications         | BL5 CLO4 PLO3 3.2.2  |

#### Short Answer Questions

- |  |                      |
|--|----------------------|
| 1 What are conductive polymers? Give examples                          | BL1 CLO4 PLO1 1.1.1  |
| 2 Define biodegradable polymers. Mention the advantages of using them. | BL2 CLO4 PLO10 7.2.1 |
| 3 What is a polymer nanocomposite? Name nanofiller used.               | BL2 CLO4 PLO3 3.1.2  |
| 4 What are smart polymers? Mention application of hydrogel             | BL2 CLO4 PLO3 3.2.1  |

### UNIT 5

#### Essay Questions

- |  |                     |
|--|---------------------|
| 1 Explain the spectroscopic techniques used for polymer characterization.. | BL4 CLO5 PLO2 2.2.1 |
| 2 Discuss DSC and TGA as thermal analysis techniques in polymer testing.   | BL4 CLO5 PLO3 3.3.2 |
| 3 Describe the mechanical and rheological testing of polymers.             | BL5 CLO5 PLO3 3.3.3 |

#### Short Answer Questions

- |  |                     |
|--|---------------------|
| 1 What information does FTIR spectroscopy provide about polymers             | BL2 CLO5 PLO2 2.1.1 |
| 2 Define Differential Scanning Calorimetry (DSC) and mention one application | BL2 CLO5 PLO2 2.2.1 |
| 3 What is impact testing in polymers? Name one standard test method          | BL2 CLO5 PLO3 3.3.1 |
| 4 Define rheology and state its importance in polymer processing             | BL2 CLO5 PLO3 3.3.2 |

**GOVERNMENT COLLEGE (A) RAJAHMUNDRY**  
**DEPARTMENT OF PHYSICS**  
**II B.Sc. Material Science - Question Bank**  
**Semester IV Course: Major 11 Ceramics and Composite Materials**

**UNIT 1:**

**Essay Questions**

Q.No	Question	BTL CLO	PLO	PI Code
1	Explain the historical development and applications of ceramics in various industries.	BL2 CLO2	PLO1	1.1.2
2	Describe the mechanical, thermal, and electrical properties of ceramics.	BL2 CLO2	PLO1	1.1.2
3	Discuss common crystal structures found in ceramics, including examples of silicates and oxides.	BL3 CLO3	PLO1, PLO2	1.2.2
4	Explain the process of sintering in ceramics and its role in material densification.	BL2 CLO2	PLO1	1.1.2

**Short Answer Questions**

1	Define ceramics and list their primary classifications.	BL1 CLO1	PLO1	1.1.1
2	What role does bonding play in determining the properties of ceramic materials?	BL2 CLO2	PLO1	1.1.2
3	Differentiate between hardness and brittleness in ceramics.	BL2 CLO2	PLO2	2.1.1
4	List two forming techniques used in ceramic processing.	BL1 CLO1	PLO1	1.1.1

**UNIT 2:**

**Essay Questions**

1	Describe the properties and applications of traditional clay-based ceramics and glass.	BL3 CLO3	PLO1, PLO7	1.2.2, 7.1.2
2	Explain the differences between oxide and non-oxide ceramics, giving examples of each.	BL3 CLO3	PLO1, PLO2	1.2.2
3	Discuss the biocompatibility of bio ceramics and their use in medical applications.	BL2 CLO2	PLO1, PLO7	1.1.2, 7.1.2
4	Explain the working principles and applications of dielectric and piezoelectric electro ceramics.	BL2 CLO2	PLO1	1.1.2

**Short Answer Questions**

1	List two examples of traditional ceramics and their applications.	BL1 CLO1	PLO1	1.1.1
2	What are bio inert ceramics, and where are they used?	BL2 CLO2	PLO1	1.1.2
3	Define ferroelectric materials and give one application.	BL1 CLO1	PLO1	1.1.1
4	How are ferrites utilized in magnetic applications?	BL2 CLO2	PLO1	1.1.2
5	Name one advanced ceramic material used in aerospace and its benefits.	BL2 CLO3	PLO7	7.1.2

**UNIT 3**

**Essay Questions**

1	Define composite materials and discuss the role of matrix and reinforcement components.	BL2 CLO3	PLO1	1.1.2
2	Describe the filament winding process and its applications in composite fabrication.	BL3 CLO3	PLO2	1.3.2
3	Explain the impact of fiber orientation on the mechanical properties of composites.	BL2 CLO3	PLO1	1.1.2
4	Discuss environmental and cost considerations involved in composite material	BL3 CLO3	PLO3	2.2.2
5	Describe applications of composite materials in aerospace, automotive, and construction industries.	BL2 CLO3	PLO1	1.2.1

**Short Answer Questions (**

- |  |                     |
|--|---------------------|
| 1 List three types of composite materials based on the matrix material | BL1 CLO3 PLO1 1.1.1 |
| 2 What is pultrusion, and where is it used?                            | BL2 CLO3 PLO1 1.1.2 |
| 3 Define toughness in the context of composites.                       | BL1 CLO3 PLO1 1.1.1 |
| 4 Why is recycling of composite materials challenging?                 | BL2 CLO3 PLO2 2.1.2 |

**UNIT 4:****Essay Questions**

- |   |                     |
|---|---------------------|
| 1 Compare the properties and applications of glass, carbon, and aramid fiber-reinforced composites. | BL3 CLO4 PLO2 1.3.2 |
| 2 Explain the differences between thermosets and thermoplastics as matrix materials in composites.  | BL2 CLO4 PLO1 1.1.2 |
| 3 Discuss the properties and applications of particle-reinforced composites.                        | BL2 CLO4 PLO1 1.1.2 |
| 4 Describe the unique properties of nano composites and their applications in electronics.          | BL3 CLO4 PLO2 1.3.2 |
| 5 Analyze environmental considerations when designing and using composite materials.                | BL4 CLO4 PLO3 2.3.3 |

**Short Answer Questions**

- |   |                     |
|---|---------------------|
| 1 What is a structural composite, and where is it used?             | BL1 CLO4 PLO1 1.1.1 |
| 2 List two common particles used in particle-reinforced composites. | BL1 CLO4 PLO1 1.1.1 |
| 3 What are Nano fillers, and why are they added to composites?      | BL2 CLO4 PLO1 1.1.2 |
| 4 Explain the concept of a sandwich panel.                          | BL2 CLO4 PLO1 1.1.2 |

**UNIT 5:****Essay Questions**

- | Q.No |   | BTL CLO PLO PI      |
|------|---|---------------------|
| 1    | Explain the process and importance of hardness testing in ceramics.                               | BL2 CLO5 PLO1 1.1.2 |
| 2    | Describe how thermal and electrical conductivity of ceramics are tested.                          | BL3 CLO5 PLO2 1.3.2 |
| 3    | Compare the applications of optical, SEM, and TEM microscopy in ceramics characterization.        | BL4 CLO5 PLO3 2.3.1 |
| 4    | Discuss the principles and applications of ultrasonic and radiographic non-destructive testing. ( | BL3 CLO5 PLO2 1.3.2 |

**Short Answer Questions**

- |   |                     |
|---|---------------------|
| 1 Define Vickers hardness testing.                              | BL1 CLO5 PLO1 1.1.1 |
| 2 What is the purpose of thermal shock resistance testing?      | BL2 CLO5 PLO1 1.1.2 |
| 3 List one advantage of using SEM in materials characterization | BL1 CLO5 PLO1 1.1.1 |
| 4 Name two non-destructive testing methods for ceramics.        | BL1 CLO5 PLO1 1.1.1 |

**GOVERNMENT COLLEGE (A) RAJAHMUNDRY**

DEPARTMENT OF PHYSICS

III.BSc-Material Science. - Semester-VI,

**COURSE 12: FUNDAMENTALS OF NANOMATERIALS**

**QUESTION BANK**

**UNIT I: Introduction to Nanoscience and Nanotechnology**

Essay Questions

1. Explain the fundamentals of nanoscience and nanotechnology and discuss the classification of nanomaterials based on dimensionality. (L2)
2. Describe the concept of quantum confinement and surface-to-volume ratio and explain their importance in nanomaterials. (L3)
3. Discuss the historical development and major milestones in nanotechnology. (L2)

Short Answer Questions

1. Define nanoscience and nanotechnology. (L1)
2. What are 0D, 1D, 2D and 3D nanomaterials? (L1)
3. Write a short note on size dependent properties of nanomaterials. (L2)

**UNIT II: Synthesis of Nanomaterials**

Essay Questions

1. Explain top-down and bottom-up approaches used for synthesis of nanomaterials. (L3)
2. Describe the sol-gel method and hydrothermal synthesis of nanomaterials. (L2)
3. Compare physical, chemical and biological synthesis methods of nanomaterials. (L4)

Short Answer Questions

1. What is mechanical milling? (L1)
2. Define chemical vapor deposition (CVD). (L1)
3. Write a short note on green synthesis of nanoparticles. (L2)

**UNIT III: Characterization Techniques**

Essay Questions

1. Explain the working principle of Scanning Electron Microscopy (SEM) and its applications. (L2)
2. Describe the Transmission Electron Microscopy (TEM) technique used for nanomaterial characterization. (L2)
3. Explain the principle of X-ray diffraction (XRD) and its role in determining crystal structure. (L3)

Short Answer Questions

1. What is Atomic Force Microscopy (AFM)? (L1)
2. Define Scanning Tunneling Microscopy (STM). (L1)
3. What is Dynamic Light Scattering (DLS)? (L1)

## UNIT IV: Properties of Nanomaterials

### Essay Questions

1. Discuss the mechanical, electrical and optical properties of nanomaterials. (L2)
2. Explain the structure, properties and applications of carbon nanotubes and graphene. (L3)
3. Describe metal and metal oxide nanoparticles with suitable examples. (L2)

### Short Answer Questions

1. What are fullerenes? (L1)
2. Define quantum size effect. (L1)
3. Write a short note on ZnO nanoparticles. (L2)

## UNIT V: Applications of Nanomaterials

### Essay Questions

1. Explain the applications of nanomaterials in electronics and sensors. (L3)
2. Discuss the role of nanomaterials in medical applications such as drug delivery and imaging. (L2)
3. Explain environmental and safety issues associated with nanotechnology. (L4)

### Short Answer Questions

1. What are nanomaterials used for in energy storage? (L1)
2. Write a short note on nanomaterials in water purification. (L2)
3. What are the ethical concerns of nanotechnology? (L2)

### Blue print

#### SCHEME FOR SEMESTER END THEORY EXAMINATION (SEE) – (Major1 /Major-2)

#### EXTERNAL (50)

TYPE OF QUESTION	MARKS	SCHEME
<b>PART-A</b> Essay Questions	Each question carries 7 Marks	<b>Answer all the questions</b> <b>5x7 = 35 M</b> Theoretical Questions, Maximum 2 questions from Each unit with internal choice
<b>PART-B</b> Short Answer Questions	Each question carries 3 Marks	<b>Answer any 5 out of 8 questions</b> <b>5x3= 15 M</b> <ul style="list-style-type: none"><li>• Minimum 1 question from Each unit.</li><li>• 2 questions from Unit II, IV &amp; V</li></ul>

**GOVERNMENT COLLEGE (A) RAJAHMUNDRY**  
DEPARTMENT OF PHYSICS  
III.BSc-Material Science. - Semester-VI,

**COURSE 13: SMART MATERIALS AND STRUCTURES**

**QUESTION BANK**

**UNIT I: Introduction to Smart Materials**

Essay Questions

1. Explain the concept of smart materials and classify them into active and passive smart materials. (L2)
2. Describe the basic requirements and components of smart structures. (L2)
3. Discuss different examples of smart material systems used in engineering applications. (L3)

Short Answer Questions

1. Define smart materials. (L1)
2. What are active smart materials? (L1)
3. Write a short note on smart structures. (L2)

**UNIT II: Piezoelectric and Electrostrictive Materials**

Essay Questions

1. Explain the principle of piezoelectric effect and its applications. (L3)
2. Describe the direct and converse piezoelectric effects with examples. (L2)
3. Compare piezoelectric and electrostrictive materials with their applications. (L4)

Short Answer Questions

1. Define piezoelectricity. (L1)
2. What is electrostriction? (L1)
3. List applications of piezoelectric sensors. (L2)

**UNIT III: Shape Memory Alloys and Polymers**

Essay Questions

1. Explain the shape memory effect and its mechanism in alloys. (L3)
2. Describe the properties and applications of Nitinol. (L2)
3. Explain the concept and applications of shape memory polymers. (L2)

Short Answer Questions

1. Define shape memory alloy (SMA). (L1)
2. What is Nitinol? (L1)
3. Write a short note on applications of SMAs in biomedical devices. (L2)

## UNIT IV: Magnetostrictive and Electrochromic Materials

### Essay Questions

1. Explain the principle of magnetostriction and its applications. (L2)
2. Describe electrochromic materials and smart window devices. (L2)
3. Discuss thermochromic and photochromic materials and their applications. (L3)

### Short Answer Questions

1. Define magnetostrictive materials. (L1)
2. What are electrochromic materials? (L1)
3. Write applications of photochromic materials. (L2)

## UNIT V: Applications of Smart Materials

### Essay Questions

1. Discuss smart sensors and actuators in engineering systems. (L3)
2. Explain biomedical applications of smart materials. (L2)
3. Discuss future prospects and challenges in smart materials research. (L4)

### Short Answer Questions

1. Define smart actuator. (L1)
2. Write applications of smart materials in aerospace. (L2)
3. What are smart biomedical devices? (L1)

## Blue print

### SCHEME FOR SEMESTER END THEORY EXAMINATION (SEE) – (Major1 /Major-2)

### EXTERNAL (50)

TYPE OF QUESTION	MARKS	SCHEME
<b>PART-A</b> Essay Questions	Each question carries 7 Marks	<b>Answer all the questions</b> <b>5x7 = 35 M</b> Theoretical Questions, Maximum 2 questions from Each unit with internal choice
<b>PART-B</b> Short Answer Questions	Each question carries 3 Marks	<b>Answer any 5 out of 8 questions</b> <b>5x3= 15 M</b> <ul style="list-style-type: none"><li>• Minimum 1 question from Each unit.</li><li>• 2 questions from Unit II, IV &amp; V</li></ul>

**GOVERNMENT COLLEGE (A) RAJAHMUNDRY**

DEPARTMENT OF PHYSICS

III.BSc-Material Science. - Semester-VI,

**COURSE 14: NON-DESTRUCTIVE TESTING (NDT)**

**QUESTION BANK**

**UNIT I: Visual Inspection and Liquid Penetrant Testing**

Essay Questions

1. Explain the principles and importance of Non-Destructive Testing (NDT). (L2)
2. Describe visual inspection methods and their limitations. (L2)
3. Explain the liquid penetrant testing (LPT) method and procedure. (L3)

Short Answer Questions

1. Define NDT. (L1)
2. What are surface defects? (L1)
3. Write applications of liquid penetrant testing. (L2)

**UNIT II: Magnetic Particle Testing and Radiography**

Essay Questions

1. Explain the principle and procedure of magnetic particle testing (MPT). (L2)
2. Describe X-ray and gamma ray radiography techniques. (L3)
3. Discuss radiographic safety measures. (L2)

Short Answer Questions

1. Define magnetic particle testing. (L1)
2. What is radiography in NDT? (L1)
3. Write advantages of radiographic testing. (L2)

**UNIT III: Eddy Current Testing**

Essay Questions

1. Explain the principle and instrumentation of eddy current testing. (L3)
2. Discuss the applications and limitations of eddy current testing. (L2)
3. Compare eddy current testing with other NDT methods. (L4)

Short Answer Questions

1. Define eddy currents. (L1)
2. What is eddy current probe? (L1)
3. Write applications of eddy current testing. (L2)

## UNIT IV: Ultrasonic Testing

### Essay Questions

1. Explain the principles of ultrasonic testing. (L2)
2. Describe the normal beam inspection method. (L3)
3. Discuss advantages and limitations of ultrasonic testing. (L2)

### Short Answer Questions

1. Define ultrasonic waves. (L1)
2. What is ultrasonic transducer? (L1)
3. Write applications of ultrasonic testing. (L2)

## UNIT V: Acoustic Emission and Applications of NDT

### Essay Questions

1. Explain the principles of acoustic emission testing. (L2)
2. Discuss defects in materials detected by NDT methods. (L3)
3. Explain the selection of suitable NDT methods for different materials. (L4)

### Short Answer Questions

1. Define acoustic emission. (L1)
2. What are casting defects? (L1)
3. Write advantages of NDT methods. (L2)

### Blue print

#### **SCHEME FOR SEMESTER END THEORY EXAMINATION (SEE) – (Major1 /Major-2) EXTERNAL (50)**

TYPE OF QUESTION	MARKS	SCHEME
<b>PART-A</b> Essay Questions	Each question carries 7 Marks	<b>Answer all the questions</b> <b>5x7 = 35 M</b> Theoretical Questions, Maximum 2 questions from Each unit with internal choice
<b>PART-B</b> Short Answer Questions	Each question carries 3 Marks	<b>Answer any 5 out of 8 questions</b> <b>5x3= 15 M</b> <ul style="list-style-type: none"><li>• Minimum 1 question from Each unit.</li><li>• 2 questions from Unit II, IV &amp; V</li></ul>

**GOVERNMENT COLLEGE (A) RAJAHMUNDRY**  
**Department of Physics**  
**III B.Sc. Materials Science – Semester VI**  
**COURSE 15: INSTRUMENTATION**

**Question bank**

**Unit I: Basics of Measurement Systems**

**Essay questions (7 marks)**

1. Explain the generalized measurement system with a neat block diagram.
2. Explain different types of errors in measurement.
3. What are static characteristics of an instrument? Explain.

**Short Answer questions (3 marks)**

1. What are dynamic characteristics of an instrument?
2. Explain sensitivity of an instrument.
3. Compare analog and digital display measuring systems.

**Unit II: Electrical Measuring Instruments**

**Essay questions (7 marks)**

1. Explain the construction and working of a permanent magnet moving coil (PMMC) instrument.
2. Explain the construction and working of an attraction-type moving iron instrument.
3. Derive the expression for extending the range of an ammeter using a shunt.

**Short answer questions (3 marks)**

1. Compare moving coil and moving iron instruments
2. Derive the balance equation of a Wheatstone bridge.
3. List the advantages of digital voltmeters over analog voltmeters.

**Unit III: Oscilloscopes and Signal Analysis**

**Essay questions (7M)**

1. Describe the construction and working of CRO with a neat diagram.
2. Explain how voltage, frequency, and phase difference are measured using an oscilloscope.
3. Explain about the basic controls of CRO.

**Short Answer Questions (3 marks)**

1. What is the role of a trigger in an oscilloscope?
2. Mention any three practical applications of an oscilloscope in circuit diagnostics.

3. What is meant by waveform comparison? Give one example.

## **UNIT IV: Transducers and Sensors**

### **Essay questions (7M)**

1. What is a transducer? Explain the classification of transducers.
2. What parameters should be considered in selecting a transducer?
3. Compare RTD with Thermistor.

### **Short Answer Questions (3 marks)**

1. Write any three differences between active and passive transducers.
2. What physical quantities can be measured using piezoelectric and capacitive transducers?
3. Explain briefly Optical and ultrasonic sensors

## **Unit V: Optical Instruments for Materials Science**

### **Essay questions (7M)**

1. Explain the basic components of an optical microscope with a neat diagram.
2. Explain different types of optical microscopy.
3. Explain the basics and uses of Fluorescence microscopy.

### **Short Answer Questions (3 marks)**

1. Write any four applications of optical microscopy.
2. Identify two main differences between a Bright Field image and a Dark Field image of the same specimen
3. Explain the concept of numerical aperture, Magnification and resolving power