

**GOVERNMENT COLLEGE (A), RAJAHMUNDRY**

**DEPARTMENT OF PHYSICS**

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

**w.e.f-2025-26**

**Model question paper**

**Section –A**

Answer All questions

5 x 7 = 35

Q.No	Question	BT Level	CLO	PLO	PI
1	State and prove the divergence of a vector field.	BT4	CLO2	PLO1, PLO2	1.1.2, 2.2.1
[OR]					
2	State and prove Stokes' theorem of vector calculus.	BT5	CLO3	PLO1, PLO3	2.3.1, 3.3.4
3	Determine the Eigen values and Eigen vectors of the given matrix.	BT4	CLO2	PLO2	2.2.1, 2.3.1
[OR]					
4	By using matrices, find the tension in two ropes supporting a weight of 100 N, making angles 30° and 45° with the horizontal.	BT4	CLO3	PLO2, PLO3	2.2.1, 3.3.1
5	Derive the expression for impedance of a series LCR circuit using phasor concept.	BT4	CLO3	PLO1, PLO2	1.1.2, 2.2.1
[OR]					
6	Explain modulus and argument of a complex number with an example.	BT2	CLO1	PLO1	1.1.1
7	State Bayes' Theorem and 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
[OR]					
8	State Binomial Distribution and 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
9	State and explain Fourier Theorem and evaluate Fourier coefficients.	BT4	CLO3	PLO1, PLO2	1.1.2, 2.2.1

[OR]

- 10 State Fourier Theorem and analyse a square wave using Fourier series. BT4 CLO3 PLO1, 2.2.1, PLO3 3.3.3

**Section –B**

Answer Any FIVE questions

5 x 3 = 15

- 11 Write the physical significance of gradient of a scalar field. BT2 CLO1 PLO1 1.1.1
- 12 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
- 13 Check whether the given matrix is orthogonal or not.  
 $A = \begin{pmatrix} 12 & 12 & 0 \\ -12 & 12 & 0 \\ 0 & 0 & 1 \end{pmatrix}$  BT3 CLO2 PLO2 1.3.2
- 14 Find the inverse of the given matrix.  
 $A = \begin{pmatrix} 1 & 3 & 3 \\ 3 & 1 & 4 \\ 3 & 1 & 3 \end{pmatrix}$  BT3 CLO2 PLO2 1.3.2
- 15 Represent the complex number  $Z=-1-i$  in polar form. BT3 CLO2 PLO2 1.3.2
- 16 Write a short note on sample space and events of probability theory. BT2 CLO1 PLO1 1.1.1
- 17 If two dice are thrown at a time, find the probability that the sum of digits is 9. BT3 CLO2 PLO2 1.3.2, 2.1.2
- 18 Explain briefly the importance of Fourier analysis. BT2 CLO1 PLO1 1.1.2

**GOVERNMENT COLLEGE (AUTONOMOUS), RAJAHMUNDRY**

**DEPARTMENT OF PHYSICS**

**Programme:** B.Sc. (Material Science)  
**Course:** Mechanics & Properties of Matter  
**Time:** 2:30 Hours

**Semester:** I  
**Academic Year:** 2025–26  
**Max. Marks:** 50

**SECTION – A**

**Answer All Questions**

*(5 × 7 = 35 Marks)*

Q.No	Question	CLO	PLO	BT	PI
1	Derive equation of motion for a variable mass system and obtain the equation of a rocket moving in space.	3	1, 2	4	1.1.2, 1.3.2, 2.2.1
2	Discuss collisions in two dimensions. Derive the expressions for initial and final velocities.	4	1, 2	4	1.3.2, 2.2.1, 2.3.1
3	Define central force. Show that the force is a negative gradient of potential energy.	3	1, 2	4	1.1.2, 2.2.1
4	Define Kepler's 3 laws. Derive equation for Kepler's first law.	3	1	3	1.1.2, 1.3.2
5	Define Young's modulus, rigidity modulus & bulk modulus. Also deduce the relation between Y, N & K.	3	1	3	1.1.2, 1.3.2
6	Derive the equation for the energy stored in a stretched wire.	3	1	3	1.3.2
7	Derive the expression for depression at the free end of a cantilever beam.	3	1	3	1.3.2
8	Explain uniform bending. Derive the formula for depression and mention applications.	4	1, 2	4	1.3.2, 2.2.2
9	State and derive Bernoulli's theorem. Explain its applications in a Venturimeter.	3	1	3	1.2.2, 1.3.2
10	Derive equation of continuity and write its applications.	3	1	3	1.2.2, 1.3.2

**SECTION – B**

**Answer Any Five Questions**

*(5 × 3 = 15 Marks)*

Q.No	Question	CLO	PLO	BT	PI
11	Define impact parameter.	1	1	1	1.1.1
12	Define elastic and inelastic collisions.	2	1	2	1.1.2
13	Write expressions for escape velocity and orbital velocity.	2	1	2	1.1.2
14	What is Hooke's law?	1	1	1	1.1.1
15	What is elastic fatigue?	1	1	1	1.1.1
16	What is torsional pendulum?	2	1	2	1.1.2
17	Define an ideal fluid.	1	1	1	1.1.1
18	What is turbulent flow?	2	1	2	1.1.2

**GOVERNMENT COLLEGE (AUTONOMOUS), RAJAHMUNDRY**  
**(Accredited by NAAC "A+" Grade) DEPARTMENT OF COMPUTER SCIENCE & APPLICATIONS**

**Semester-I**  
**Fundamentals of AI**  
**MODEL QUESTION PAPER**

Time: 2 ½ Hrs.

Max Marks: 50M

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SECTION-A

**Answer Any Five Questions**

**Each Question Carries 6 Marks 5 X 6 = 30M**

- 1 Differentiate between narrow AI, general AI, and super AI, with examples. BT4 CLO1 PLO2 2.1.1
- 2 Explain the types of learning in AI (supervised, unsupervised, reinforcement) with real-life examples and advantages/limitations. BT3 CLO2 PLO2 2.1.1
- 3 Discuss the applications of AI in healthcare BT2 CLO3 PLO1 1.2.1
- 4 Discuss AI in agriculture BT2 CLO3 PLO1 1.2.1
- 5 Explain the common ethical challenges in AI, including bias, privacy, transparency, and accountability BT2 CLO4 PLO1 1.2.1
- 6 Analyze how to address bias in AI systems and its impact on fairness BT4 CLO4 PLO2 2.1.1
- 7 Discuss real-world examples of AI in research, such as drug discovery, protein folding, and climate modeling. BT2 CLO3 PLO1 1.2.1
- 8 Explain prompt engineering, its definition, why it is necessary, and components of an effective prompt. BT2 CLO5 PLO1 1.2.1
- 9 Describe how prompt engineering is used in content creation for writing, design, and video scripts BT2 CLO5 PLO1 1.2.1

10 Explain popular tools for prompt engineering in education and business.

BT2 CLO5 PLO1 1.2.1

### SECTION-B

Answer ALL Questions (Multiple Choice Questions) 20 X 1 = 20M

11. Which period marks the birth of artificial intelligence?

- 16th–19th Century      b) Early 20th Century  
c) 2000s–Present      d) 1950s–1960s

12. Knowledge engineering involves:

- Generating images      b) Building robots  
c) Collecting and structuring knowledge for AI      d) Processing natural language

13. Expert systems are used for:

- Playing games      b) Simulating human expert decision-making  
c) Generating music      d) Driving cars

14. The main component of a robot is:

- Only actuators      b) Sensors, actuators, and AI brain  
c) Only wheels      d) Only sensors

15. Autonomous vehicles use AI for:

- Self-driving and navigation      b) Swimming  
c) Manual driving      d) Flying

16. Benefits of AI in education include:

- Accessibility for all learners      b) Limited access  
c) Only for some      d) No accessibility

17. A challenge of AI in healthcare is:

- A) Too cheap      b) Always accurate  
c) Ethical considerations like privacy      d) No challenges

18. Algorithmic trading in finance is:

- A). No trading      b) Random trading  
c) Manual trading      d) AI-driven buying/selling

19. Responsible hardware usage in AI involves:

- Buying new      b) Reusing and recycling  
c) No usage      d) Wasting hardware

20. Robustness in AI means:

- Handling unusual inputs without errors      b) Failing on inputs
- c) Ignoring inputs      d) No handling
- A cause of AI failures is:
- Perfect data      b) Too much data
- c) Poor quality data      d) No data
- To improve reliability, use:
- Continuous monitoring      b) Random monitoring

- c) Stop monitoring      d) No monitoring
- AlphaFold is used for:
- No prediction    b) Protein folding prediction
- c) Weather prediction    d) Stock prediction

A challenge of AI in research is:

No data b) Data quality

c) Too much data      d) Perfect data

Generative AI uses:

Large language models like LLMs      b) Small models

c) Old models    d) No models

Perplexity AI is:

Manual search    b) No search

c) AI-powered search with citations      d) No citations

Tools like Jasper AI are for:

Marketing content      b) Random content

c) No content    d) Video content

Holistic learning prompts include:

No diagrams    b) More Text

c) Random      d) Diagrams and examples

Runway ML is for:

Manual video    b) Audio Only

c) Visuals      d) Video creation

**GOVERNMENT COLLEGE (A), RAJAHMUNDRY**  
**DEPARTMENT OF PHYSICS**  
**I B.Sc MATERIAL SCIENCE (HONS)**  
**SEMESTER-II - COURSE-3: WAVES AND OPTICS**  
**MODEL PAPER**

**Time: 2 ½ Hours**

**Maximum Marks: 50**

**SECTION – A**

**Answer ONE question**  
*(Marks)*

*(5 × 7 = 35)*

Q.No	Question	CLO	PLO	BTL	PI
1	Derive the differential equation of a simple harmonic oscillator and obtain its solution <b>OR</b>	3	1	3	1.3.2
2	Explain differential equation of damped harmonic oscillations and obtain its solution	4	2	4	2.2.1
3	Derive the equation for the velocity of transverse waves along a stretched string? <b>OR</b>	3	1	3	1.3.2
4	Longitudinal vibrations in bars (fixed ends & fixed at midpoint)	4	2	4	2.2.1
5	Newton's rings in reflected light and wavelength determination? <b>OR</b>	4	3	4	3.3.4
6	Fresnel's biprism experiment and wavelength determination	3	2	3	2.2.1
7	Distinguish between Fresnel and Fraunhofer diffraction? <b>OR</b>	4	3	4	3.3.3
8	Construction and working of Zone plates	4	3	4	3.3.4
9	Construction and working of Nicol prism with diagrams? <b>OR</b>	3	2	3	2.2.1
10	Quarter wave plate and Half wave plate	4	3	4	3.3.4

**SECTION – B**

**Answer any FIVE questions.**

*(5 × 3 = 15 Marks)*

Q.No	Question	CLO	PLO	BTL	PI Code
11	Define Simple Harmonic Motion	1	1	1	1.1.1
12	What is the Quality factor?	1	1	1	1.1.1
13	Explain briefly about Tuning fork	2	2	2	2.1.1
14	Write the conditions for Interference of Light	2	1	2	1.1.2
15	What is coherence?	1	1	1	1.1.1
16	Write any three differences between interference and diffraction	4	3	4	3.3.3
17	Explain about Brewster law	3	2	3	2.2.1
18	State Malus law	2	1	2	1.1.2

**GOVERNMENT COLLEGE (A), RAJAHMUNDRY**  
**DEPARTMENT OF PHYSICS**  
**I.B Sc –MATERIAL SCIENCE**  
**Multidisciplinary Courses Offered for B.A./B.Com./BBA/BCA Majors**  
**w.e.f. AY 2023-24**  
**SEMESTER-II**  
**PRINCIPLES OF PHYSICAL SCIENCES**  
Model question paper

**SECTION – A**

**Answer any four of the following questions:**

**4 × 5 = 20M**

1. State base quantities and their units in SI system?
2. Write the differences between vectors and scalars?
3. Write Newton's 3 laws of motion
4. Define work and state work-energy theorem?
5. What is Doppler effect? State any three applications?
6. Define reflection and refraction?
7. State the differences between interference and diffraction?
8. Discuss briefly vector addition and subtraction?

**SECTION – B**

**Answer all the following questions?**

**3 × 10 = 30M**

9. What is scientific method? Explain various steps that involved in scientific method?  
( OR )
10. Discuss how physics related to other branches of science?
11. Define energy and discuss various forms of energy?  
( OR )
12. State Newton's law of gravitation and discuss its applications?
13. What is a wave? State its characteristics and explain various types of waves?  
( OR )
14. Explain the process of image formation by mirrors?

**GOVERNMENT COLLEGE (A) :: RAJAMAHENDRAVARAM**  
**DEPARTMENT OF PHYSICS**  
**II.B.Sc. Material Science Single Major**  
**SYLLABUS (w.e.f. 2023-24)**  
**SEM-III**  
**COURSE 5 - Crystallography and Crystal Structures**  
**Model Question Paper**

**SECTION-A**

**Answer ALL questions**

**7x5=35**

1. Explain different types of Bravais lattices with neat diagrams? [BT 1 & BT2]  
[OR]
2. State crystal defects? Discuss point defects and line defects in detail? [BT 1 & BT2]
3. State and explain Bragg's Law? What is the physical significance of Bragg's law [BT 2 & BT 3]  
[OR]
4. Explain powder diffraction method to study the crystal structure? [BT2]
5. State principles of electron diffraction? Explain the LEED electron diffraction Method? [BT 1 & BT2]  
[OR]
6. Explain the interaction of neutrons with matter? Discuss the study of magnetic materials using neutron diffraction method? [BT 2 & BT 3]
7. Describe the role of crystal defects in electrical and thermal properties? [BT 3]  
[OR]
8. Describe the role of crystal defects in mechanical properties? [BT 3]
9. Explain the construction of Ewald sphere and its applications? [BT 2 & BT 3]  
[OR]
10. State principles of crystal growth? Explain Czochralski technique of crystal growth? [BT 1 & BT 2]

**Answer Any FIVE questions**

**SECTION-B**

**3 x 5 =15**

11. State crystal lattice and basis? [BT 1]
12. The intercepts made by the crystal plane are  $1a$ ,  $2a$  and  $3a$ . Determine the miller indices of the crystal plane? [BT 3]
13. Briefly explain the properties of x-rays? [BT 2]
14. Determine the strain using x-ray diffraction technique? [BT 3]
15. Discuss the similarities and differences between X-ray diffraction and electron diffraction? [BT 2]
16. State and explain creep and fatigue of the material? [BT 2]
17. State reciprocal lattice and briefly explain its properties? [BT 1 & BT 2]
18. Analyse the electron density maps to study the crystal structure? [BT 4]

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

**SECTION–A**

**ANSWER ALL QUESTIONS**

**(5 × 7 = 35 Marks)**

Q.No	Question	BTL	CLO	PLO	PI Code
1	Explain the Carnot cycle and derive the expression for the efficiency of a Carnot heat engine.	BT2, BT3	CLO1	PLO1, PLO2	1.1.2, 2.2.1
(OR)					
2	Explain the thermodynamic applications in materials science.	BT3	CLO1	PLO1	1.2.2
3	Explain the unary phase diagram of water with suitable representation.	BT2	CLO2	PLO1	1.1.2
(OR)					
4	Explain the binary phase diagram with a suitable example relevant to materials science.	BT2	CLO2	PLO1, PLO2	1.1.2, 2.1.1
5	Compare Maxwell–Boltzmann statistics, Fermi–Dirac statistics, and Bose–Einstein statistics.	BT4	CLO3	PLO2, PLO3	2.2.2, 3.2.1
(OR)					
6	Explain the applications of statistical mechanics in materials science.	BT3	CLO3	PLO1	1.2.2
7	Explain Fick’s laws of diffusion and the Kirkendall effect.	BT3	CLO4	PLO1, PLO2	1.1.2, 2.2.1
(OR)					
8	Explain kinetic models and reaction mechanisms involved in material transformations.	BT2	CLO4	PLO1	1.1.2
9	Explain the thermodynamics of biomolecules.	BT2	CLO5	PLO1	1.1.2
(OR)					
10	Explain the synthesis and growth mechanisms of nanomaterials.	BT2	CLO5	PLO1, PLO2	1.1.2, 2.1.1

**Section–B**

**(Answer any FIVE – 5 × 3 = 15 Marks)**

11	Explain the concepts of heat, work, and the first law of thermodynamics.	BT2	CLO1	PLO1	1.1.1
12	Explain open systems, closed systems, and isolated systems with examples.	BT2	CLO1	PLO1	1.1.1
13	Explain the lever rule and tie line rule used in phase diagrams.	BT2	CLO2	PLO1, PLO2	1.1.2, 2.1.1
14	Explain the phase rule and its applications in materials science.	BT3	CLO2	PLO1	1.2.2
15	Explain the concepts of microstates and macrostates.	BT2	CLO3	PLO1	1.1.2
16	Explain the process of sintering and densification of materials.	BT2	CLO4	PLO1	1.1.2
17	Explain homogeneous and heterogeneous nucleation processes.	BT2	CLO4	PLO1	1.1.2
18	Explain the thermodynamics of nanomaterials.	BT2	CLO5	PLO1	1.1.2

**GOVERNMENT COLLEGE (A) :: RAJAMAHENDRAVARAM**  
**DEPARTMENT OF PHYSICS**  
**B.Sc. Material Science Single Major**  
**SYLLABUS (w.e.f. 2023-24)**  
**COURSE 7: Mechanical Properties of Materials**  
**MODEL PAPER**

**Section-A**

*Answer all five questions*

**7x5 = 35M**

1. Explain the difference between elastic and plastic deformation. (BL-2: Understanding) OR
2. Discuss the mechanical testing methods for materials, including tensile, hardness, and impact tests. (BL-4)
3. Describe ductile and brittle fracture. How do microstructural aspects influence these types of fractures? (BL-2) OR
4. Explain the factors affecting fatigue strength and interpret the significance of S-N curves in predicting fatigue life. (BL-4: Analyzing)
5. Explain the Hall-Petch relationship. How does grain size influence the mechanical properties of materials? (BL-2: Understanding) OR
6. Discuss precipitation hardening. Provide examples of alloy systems that utilize this technique, such as Al-Cu alloys. (BL-3: Applying)
7. Compare the mechanical properties of ferrous and non-ferrous alloys. What makes these materials suitable for different industrial applications? (BL-4: Analyzing) OR
8. Describe the deformation mechanisms in polymers and explain how their viscoelastic behavior affects their applications. (BL-2: Understanding)
9. Discuss the role of mechanical properties in material selection for structural components in aerospace and automotive industries. (BL-4: Analyzing) OR
10. Explain the mechanical properties that are critical for biomedical implants. Provide case studies of material selection for prosthetics. (BL-5: Evaluating)

**Section-B**

*Answer any five questions.*

**5x3 = 15M**

11. Define stress and strain, and differentiate between tensile and compressive stress. (BL-1: Remembering)
12. What are the elastic constants, and how are they related? (BL-1: Remembering)
13. Explain the mechanisms of work hardening and its impact on material properties. (BL-3: Applying)
14. What is fracture toughness, and why is it important in material design? (BL-2: Understanding)
15. Describe the basic mechanisms of creep in materials. (BL-2: Understanding)
16. Define viscoelasticity and give examples of materials. (BL-2: Understanding)
17. Explain the significance of the matrix and reinforcement in fiber-reinforced composites. (BL-3)
18. Describe the importance of wear-resistant materials in industrial applications. (BL-3: Applying)

**GOVERNMENT COLLEGE (A) :: RAJAMAHENDRAVARAM**  
**DEPARTMENT OF PHYSICS**  
**B.Sc. Material Science Single Major**  
**SYLLABUS (w.e.f. 2023-24)**

**COURSE 8: Electrical and Magnetic Properties of Materials**

**MODEL PAPER**

**Section-A**

**Answer all five questions**

**7x5 = 35M**

1. Explain the differences between conductors, semiconductors, and insulators based on their band structure. (BL-2: Understanding) **OR**

2. Derive the expression for carrier concentration in intrinsic semiconductors. How does doping modify the carrier concentration? (BL-3: Applying)

3. Describe the construction and working of a p-n junction diode. How is it used in rectification? (BL-2: )

**OR**

4. Compare the structure and operational characteristics of BJTs and MOSFETs. Highlight their applications in amplification. (BL-4: Analysing)

5. Discuss the various polarization mechanisms in dielectric materials. How does the frequency affect polarization? (BL-3: Applying) **OR**

6. Explain the working principle of piezoelectric materials and their applications in sensors and actuators.

7. Describe the magnetic hysteresis loop and its significance in the classification of soft and hard magnetic materials. (BL-2: Understanding) **OR**

8. Discuss the working principles of Type I, Type II superconductors, and their applications in modern technology. (BL-4: Analysing)

9. Explain the concept of Nano electronics and its significance in the development of quantum dots and nanowires. (BL-2: Understanding) **OR**

10. Discuss the role of thermoelectric materials in energy harvesting devices. How do these materials contribute to sustainable energy solutions? (BL-5: Evaluating)

**Section-B**

**Answer any five questions**

**5x3= 15M**

11. Define Ohm's Law and explain its significance in electrical circuits. (BL-1)

12. What are the key differences between intrinsic and extrinsic semiconductors? (BL-2)

13. What are the applications of light-emitting diodes (LEDs) in modern electronics? (BL-3)

14. Describe dielectric constant and dielectric loss in materials. (BL-2: Understanding)

15. What is the significance of Curie temperature in magnetic materials? (BL-2)

16. Explain the piezoelectric effect and name two applications of piezoelectric materials. (BL-2)

17. What are the basic principles behind molecular electronics? (BL-2)

18. Define organic semiconductors and discuss their role in flexible electronics. (BL-3)

**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**

Time : 2 ½ Hours

Max Marks: 50

**Section A –**

**Answer all the questions**

Q. No	Question	<b>5x7=35 M</b>			
		<b>BTL</b>	<b>CLO</b>	<b>PLO</b>	<b>PI</b>
1	Explain the basic components of an optical microscope. Discuss the factors that determine magnification and the physical limits of resolution. <span style="float: right;">OR</span>	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.	4	3	2	2.2.1
3	Explain the fundamental principles and working of Scanning Electron Microscopy (SEM). Discuss its specific applications in surface morphology analysis. <span style="float: right;">OR</span>	2	2	1	1.1.2
4	Describe the principles of Transmission Electron Microscopy (TEM). Elaborate on imaging and diffraction modes used for crystallography and defect analysis	2	2	1	1.1.2
5	Explain the principles of FTIR spectroscopy. Discuss its specific applications in functional group identification analysis. <span style="float: right;">OR</span>	2	2	1	1.1.2
6	Explain the principle of Raman spectroscopy and its applications in material identification.	4	3	2	2.2.1
7	Describe the principles 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> <span style="float: right;">OR</span>	2	2	1	1.1.2
8	Discuss the principles of Thermo Gravimetric Analysis (TGA) and explain its application in evaluating the thermal stability of composite materials	2	2	1	1.1.2
9	Explain the principles of Atomic Force Microscopy (AFM). Differentiate between contact, tapping, and non-contact imaging modes <span style="float: right;">OR</span>	2	2	1	1.1.2
10	Analyze the current trends in material characterization, focusing on the advantages of <i>in-situ</i> and <i>operando</i> techniques in research	5	5	3	3.3.4

**Section B**

<b>Short Answer Questions</b>	<b>5x3=15 M</b>			
11 Define the term "Resolution" in optical microscopy. (Unit I)	1	1	1	1.1.1
12 What is selected area electron diffraction (SAED) and how is it used in material analysis?	1	1	1	1.1.1
13 Write any three applications of Raman scattering. (Unit III)	1	1	1	1.1.1
14 Calculate the total magnification if the objective lens is 40x and the eyepiece is 10x.	3	2	1	1.3.2
15 Identify the main difference between DTA and DSC.	4	3	2	2.3.2
16 Define the principle of Scanning Tunneling Microscopy (STM).	1	1	1	1.1.1
17 Briefly explain the role of X-ray Computed Tomography (CT) in non-destructive testing.	2	2	1	1.1.2
18 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	2	1	1.2.2

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

**COURSE 10: Polymer science**  
**Modal Paper**

**Time:2.30Hrs**

**Max: 50 Marks**

**Section A**

Answer all Essay Questions

**5x7 = 35 M**

Q.No	Question	Unit	BL	CLO	PLO	PI
1	Define polymer and Explain their classification.in detailed	I	BL2	CLO1	PLO1	1.1.2
2	Describe the mechanisms of addition (chain-growth) and condensation (step-growth) polymerization, with examples	I	BL2	CLO1	PLO2	2.1.2
3	Explain crystallinity in polymers. Discuss the structure and properties of amorphous and semi-crystalline polymers.	II	BL4	CLO2	PLO3	3.1.1
4	Define glass transition temperature (Tg) and melting temperature (Tm). Explain their significance in polymers	II	BL4	CLO2	PLO2	2.2.2
5	Explain the extrusion process used in polymer processing.	III	BL2	CLO3	PLO1	1.2.2
6	Describe injection molding and blow molding techniques in detail	III	BL2	CLO3	PLO2	2.2.1
7	Explain conductive polymers—their structure, conduction mechanism, types, properties, and applications	IV	BL4	CLO4	PLO3	3.3.4
8	Describe biodegradable polymers with examples, degradation mechanism, properties, and applications	IV	BL4	CLO4	PLO10	7.2.3
9	Explain the spectroscopic techniques used for polymer characterization	V	BL4	CLO5	PLO2	2.2.1
10	Discuss DSC and TGA as thermal analysis techniques in polymer testing	V	BL5	CLO5	PLO3	3.3.3

**Section B**

**Answer any 5 from the following**

**5x3 = 15 M**

11	Differentiate between thermoplastics and thermosets	I	BL2	CLO1	PLO1	1.1.2
12	Define homopolymers and copolymers, providing examples of each?	I	BL2	CLO1	PLO1	1.1.2
13	What is crystallinity in polymers? Mention any two methods used to measure it..	II	BL2	CLO2	PLO2	2.3.1
14	What is thermal degradation of polymers? Mention one factor affecting it	II	BL2	CLO2	PLO2	2.1.1
15	What is meant by polymer recycling? State one challenge associated with it	III	BL2	CLO3	PLO10	7.2.1
16	What are reinforcement materials in polymers, and how do they affect polymer properties	III	BL3	CLO3	PLO3	3.3.1

# GOVERNMENT COLLEGE (A) RAJAHMUNDRY

DEPARTMENT OF PHYSICS

II.BSc-Material Science. - Semester-IV,

Course – 11: Ceramics and Composite materials

MODEL QUESTION PAPER

Time:2.30Hrs

Answer all questions

Max Marks : 50

5x7 = 35 M

Q. No	Question	BTL	CLO	PLO	PI
1	Explain the historical development of ceramics and discuss their applications in various industries such as construction, electronics, biomedical, and aerospace sectors.	BL2	CLO1	PLO1	1.1.2
<b>OR</b>					
2	Describe the process of sintering in ceramic materials and explain its impact on the physical and mechanical properties of ceramic materials.	BL2	CLO1	PLO1	1.1.2
3	Discuss the properties of bioceramics and explain their applications in the medical field, including orthopedic and dental applications.	BL2 CLO2	PLO1, PLO7	1.1.2, 7.1.2	
<b>OR</b>					
4	Explain the different types of advanced ceramics and discuss their applications in aerospace and electronics industries.	BL3 CLO2	PLO1, PLO7	1.1.2, 7.1.2	
5	Describe the classification of composite materials based on matrix materials and provide suitable examples for each classification.	BL2	CLO3	PLO1	1.2.2
<b>OR</b>					
6	Discuss the various fabrication methods used in composite materials, such as filament winding and pultrusion, highlighting their principles and applications.	BL3	CLO3	PLO1, PLO2	1.2.2, 2.2.1
7	Compare and contrast fiber-reinforced composites and particle-reinforced composites with respect to their properties and applications.	BL3	CLO4	PLO2	2.3.1
<b>OR</b>					
8	Explain the fabrication methods, properties, and applications of nanocomposites.	BL3–BL4	CLO4	PLO2, PLO3	2.3.1, 3.2.1
9	Describe the mechanical testing methods used for ceramic and composite materials, including hardness testing and fracture toughness measurements.	BL3	CLO5	PLO1, PLO2	1.2.2, 2.3.1
<b>OR</b>					
10	Discuss the significance of non-destructive testing methods such as ultrasonic testing and radiographic testing in material characterization.	BL3	CLO5	PLO1, PLO2	1.2.2, 2.3.1

## Section - B

**Answer any five questions. (Each question carries 3 marks)**

11 Define ceramics and explain how they are classified	BL2 CLO1 PLO1 1.1.2
12 Role of bonding in determining ceramic properties	BL2 CLO1 PLO1 1.1.2
13 Impact of crystallinity on properties of ceramics	BL2 CLO2 PLO1 1.1.2
14 Importance of dielectric ceramics in electronics	BL1 CLO2 PLO1, 1.1.2,
15 Primary components of composite materials	BL1 CLO3 PLO1 1.1.1
16 Economic and environmental considerations in using composites	BL3 CLO3 PLO7 7.1.2
17 Advantages of using laminates in structural composites	BL3 CLO3 PLO2 2.2.1
18 Use of SEM in analyzing ceramic microstructures	BL2 CLO4 PLO1, 1.1.2,

**GOVERNMENT COLLEGE (A) RAJAHMUNDRY**

DEPARTMENT OF PHYSICS

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

COURSE 12: FUNDAMENTALS OF NANOMATERIALS

**MODEL QUESTION PAPER**

Time: 2.5 Hours

Max Marks: 50

**Section A – Answer ALL**

**(5 × 7 = 35)**

1. Explain the fundamentals of nanoscience and nanotechnology.  
OR
2. Explain the classification of nanomaterials and quantum confinement effect.
3. Explain top-down and bottom-up approaches for nanomaterial synthesis.  
OR
4. Describe sol-gel and chemical vapor deposition methods.
5. Explain SEM and TEM characterization techniques.  
OR
6. Explain the principle and applications of XRD in nanomaterials.
7. Discuss the properties and applications of carbon nanotubes.  
OR
8. Explain electrical and optical properties of nanomaterials.
9. Explain nanomaterial applications in medicine and drug delivery.  
OR
10. Discuss environmental and safety issues in nanotechnology.

**Section B –**

**Answer any FIVE**

**(5 × 3 = 15)**

11. Define nanotechnology.
12. What is quantum confinement?
13. Write a short note on green synthesis of nanoparticles.
14. Define AFM and STM.
15. What are fullerenes?
16. Distinguish between single walled and multiwalled CNT
17. Write applications of nanomaterials in sensors.
18. What are ethical issues in nanotechnology?

**GOVERNMENT COLLEGE (A) RAJAHMUNDRY**  
DEPARTMENT OF PHYSICS  
III.BSc-Material Science. - Semester-VI,  
**COURSE 13: SMART MATERIALS AND STRUCTURES**  
**MODEL QUESTION PAPER**

Time: 2.5 Hours

Max Marks: 50

**Section A –**

**Answer ALL**

**(5 × 7 = 35)**

1. Explain the concept and classification of smart materials.

OR

2. Describe the basic requirements of smart structures.

3. Explain the piezoelectric effect and its applications.

OR

4. Compare piezoelectric and electrostrictive materials.

5. Explain the shape memory effect in shape memory alloys.

OR

6. Discuss properties and applications of Nitinol.

7. Explain magnetostrictive materials and their applications.

OR

8. Describe electrochromic materials used in smart windows.

9. Explain smart sensors and actuators in engineering systems.

OR

10. Discuss biomedical applications of smart materials.

**Section B –**

**Answer any FIVE**

**(5 × 3 = 15)**

11. Define smart materials.

12. What is piezoelectricity?

13. Define shape memory alloys.

14. Write three applications of shape memory polymers

15. What is magnetostriction?

16. What are electrochromic materials?

17. Write applications of smart materials.

18. What are smart sensors?

**Model Paper**  
**GOVERNMENT COLLEGE (A) RAJAHMUNDRY**  
**Department of Physics**  
**III B.Sc. Materials Science – Semester VI**  
**MAT–14: Non-Destructive Testing**

**Time: 2.5 Hours**

**Max Marks: 50**

**Section A –**

**Answer ALL questions**

**(5 × 7 = 35)**

1. Describe the classification of NDT techniques based on the probe used.  
OR
2. Explain the role of NDT in product life cycle.
3. Describe the fields where Visual Inspection is used as NDT technique.  
OR
4. Explain various steps involved in Liquid Penetration Test.
5. What are various types of ultrasonic waves? Explain.  
OR
6. Explain about A-Scan, B-Scan and C-Scan in Ultrasonic Testing.
7. Describe the experimental setup and procedure for eddy current test in NDT.  
OR
8. Explain the experimental setup and procedure for magnetic particle testing.
9. Explain the principle and applications of Neutron Radiography.  
OR
10. Explain the principle and Applications of Acoustic Emission Testing.

**Section B –**

**Answer ANY FIVE questions**

**(5 × 3 = 15)**

11. What is the need for NDT?
12. Distinguish NDT 4.0 and NDT 5.0.
13. What are various factors that affect the Visual inspection data collection?
14. What is the role of Visual inspection in NDT 4.0 and NDT 5.0?
15. What is the basic principle of Ultrasonic Testing?
16. What are various types of Ultrasonic Transducer?
17. What is the principle of Eddy Current Test?
18. What are the safety measures to be taken for various Radiographic techniques in NDT?

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

**Time: 2.30Hrs**

**Model Question Paper**

**Max Marks:50**

**Section A**

**Answer ALL the following questions**

**(5 × 7 = 35M)**

1. Explain the generalized measurement system with block diagram.  
OR
2. Discuss static characteristics of measuring instruments.
3. Explain the construction and working of permanent moving coil instruments (PMMC).  
OR
4. Derive the expression for extending the range of an ammeter using a shunt..
5. Explain the construction and working of CRO with a neat diagram.  
OR
6. Explain how voltage, frequency, and phase difference are measured using an Oscilloscope.
7. What is a transducer? Explain classification of transducers with examples.  
OR
8. Compare RTD with Thermistor.
9. Explain the basic components of an optical microscope with a neat diagram.  
OR
10. Explain different types of optical microscopy

**Section B –**

**Answer any FIVE**

**(5 × 3 = 15)**

11. Explain sensitivity of an instrument.
12. Compare analog and digital display measuring systems.
13. Write four applications of oscilloscope.
14. What is the role of a trigger in an oscilloscope?
15. Write any four differences between active and passive transducers
16. Explain briefly Optical and ultrasonic sensors
17. Write any four applications of optical microscopy.
18. Write differences between a Bright Field image and a Dark Field image of the same specimen