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Reg.No :.....

Name :.....

MAHATMA GANDHI UNIVERSITY, KOTTAYAM

MGU-UGP (HONOURS) THIRD SEMESTER EXAMINATION

MG3DSCPHY201 Essential Mathematics for Physics

Time:- 2 Hour

Marks:- 70

Part A

Short Answer Type Questions

Answer any 10 questions

Each question carries 3 marks

(10 × 3 = 30)

1. Define the scalar(Dot) product and explain the dot product in the context of work done by a force. [U][CO:1]
2. Explain the physical concept of vector(cross) product in the context rotational motion in physics? [U][CO:1]
3. Demonstrate the orthogonality(orthonormality) of the unit basis vectors in a right-handed Cartesian coordinate system. [U][CO:1]
4. Define the inverse of a matrix. [An][CO:2]

5. What do you mean a Hermitian matrix and give any two properties. [U][CO:3]

6. If $A = \begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$, find its eigenvalues and eigenvectors. [A][CO:7]

7. Explain the physical interpretation of divergence for the following cases

(a) $\nabla \cdot \mathbf{E} = \frac{\rho}{\epsilon_0}$

(b) $\nabla \cdot \mathbf{B} = 0$

Where $\mathbf{E}$, $\mathbf{B}$ are the electric and magnetic fields respectively. [An][CO:4]

8. Explain the concept of the gradient of a scalar field. Illustrate its significance by discussing the relationship between a potential field and the corresponding force field. [An][CO:4]

9. Give the expression for the $\nabla Q(r, \theta, \phi)$ in spherical polar coordinate system. [K][CO:5]

10. What is the value of the line integral of a conservative field over a closed loop, and why? [An][CO:6]

11. Can area be expressed as a vector quantity? If so, what determines its direction? If not, explain why? [U][CO:6]

12. State and explain divergence Theorem (Gauss's Theorem) [K][CO:6]

Part B

Short Essay Type Questions

Answer any 8 questions

Each question carries 5 marks

(8 × 5 = 40)

13. Let the vectors $\mathbf{a} = (1, 1, 0)$, $\mathbf{b} = (0, 1, 1)$, $\mathbf{c} = (1, 0, 1)$. Find the reciprocal vectors

$$\mathbf{a}', \mathbf{b}', \mathbf{c}' \text{ using the definition: } \mathbf{a}' = \frac{\mathbf{b} \times \mathbf{c}}{\mathbf{a} \cdot (\mathbf{b} \times \mathbf{c})}, \quad \mathbf{b}' = \frac{\mathbf{c} \times \mathbf{a}}{\mathbf{a} \cdot (\mathbf{b} \times \mathbf{c})}, \quad \mathbf{c}' = \frac{\mathbf{a} \times \mathbf{b}}{\mathbf{a} \cdot (\mathbf{b} \times \mathbf{c})}.$$

[A][CO:1]

14. A force $\mathbf{F}$ acts on a particle at position vector $\mathbf{r}$. Explain how the scalar and vector products are used to compute work done and torque, respectively.

[A][CO:7]

15. What is a diagonal matrix? How is it related to square matrices. Why are diagonal matrices important in physical applications?

[An][CO:2]

16. Solve the following system of equations using the Gauss elimination method:

$$\begin{cases} x + y + z = 6 \\ 2y + 5z = -4 \\ 2x + 5y - z = 27 \end{cases}$$

[A][CO:2]

17. Check whether the following matrix is orthogonal:

$$Q = \begin{bmatrix} \frac{\sqrt{2}}{2} & -\frac{\sqrt{2}}{2} & 0 \\ \frac{\sqrt{2}}{2} & \frac{\sqrt{2}}{2} & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

[A][CO:3]

18. Write the expressions for the gradient of a scalar field, and the divergence and curl of a vector field in Cartesian coordinates. Briefly explain their physical interpretations
[U,An][CO:4]
19. A scalar field is given by $\phi = x^2 + y^2$. Find the gradient at point (1,-2), explain the result.
[An][CO:4]
20. Show that $\nabla \times (\mathbf{r} \times \mathbf{F})$ is generally not zero, and explain what this means physically for the force field
[E][CO:7]
21. What does it mean for a force field to be path-independent, and what is the mathematical condition for this property?
[A][CO:6]
22. Let $\mathbf{F} = x\hat{\mathbf{i}} + y\hat{\mathbf{j}} + z\hat{\mathbf{k}}$ and let S be the surface of a sphere of radius R centered at the origin. Evaluate the surface integral $\iint_S \mathbf{F} \cdot d\mathbf{A}$ using the divergence theorem.
[A][CO:6]

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MAHATMA GANDHI UNIVERSITY , KOTTAYAM

MGU-UGP (HONOURS) EXAMINATION

SEMESTER III

Minor- DSC B: MG3DSCPHY202: Atomic and Molecular Spectroscopy

(2024 ADMISSION ONWARDS)

Duration: 1.5 hours

Maximum Marks: 50

Remember(K), Understand(U), Apply(A), Analyse(An), Evaluate(E), Create(C), Skill(S), Interest(I) and Appreciation(Ap)

Students should attempt at least one question from each course outcome to enhance their overall outcome attainability.

Part A

Short Answer Type Questions

Answer any **10** questions

Each question carries **2** marks

1.	If the Rydberg constant is $1.097 \times 10^7 \text{ m}^{-1}$, find the wave number of the Balmer series limit.	[U] / [1]
2.	Define gyromagnetic ratio	[K] / [1]
3.	How does spin angular momentum arise?	[U] / [1]
4.	What is Paschen Back effect?	[K] / [1]
5.	What does the term symbol $^2P_{3/2}$ represent?	[U] / [1]

6.	What is Zeeman effect?	[K] / [1]
7.	State mutual exclusion principle.	[K] / [2]
8.	Draw the first 4 energy levels of a rigid rotator	[U] / [2]
9.	What do you understand by a spherical top molecule?	[U] / [2]
10.	What is zero point energy?	[U] / [2]
11.	Among Electronic and Vibrational spectra which spectra comes in the visible range? Explain	[U] / [2]
12.	What is ESR?	[K] / [3]
13.	What is the principle of NMR?	[K] / [3]
14.	Why does ESR be used to study paramagnetic substances?	[U] / [3]
[2x10 = 20]		
Part B		
Short Essay Type Questions		
Answer any 6 questions		
Each question carries 5 marks		
15.	State and Explain the postulates of Bohr atom model.	[U] / [1]
16.	Briefly give an idea about the quantum numbers in vector atom model.	[U] / [1]
17.	Differentiate between LS and JJ coupling	[U] / [1]

18.	Explain the origin of the D-lines of sodium.	[U] / [1]
19.	Compare Stokes and anti-Stokes lines.	[U] / [2]
20.	Write the differences between fluorescence and phosphorescence.	[U] / [2]
21.	Give a brief idea about various types of molecular energies.	[K] / [2]
22.	Explain the resonance condition for NMR	[U] / [3]
[5x6 = 30]		

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MAHATMA GANDHI UNIVERSITY, KOTTAYAM
MGU-UGP (HONOURS) REGULAR EXAMINATION NOVEMBER 2025
THIRD SEMESTER
DSE - MG3DSEPHY200- Basic Semiconductor Physics
(2024 ADMISSION ONWARDS)

Duration: 1.5 Hours

Maximum Marks: 50

Remember(K), Understand(U), Apply(A), Analyse(An), Evaluate(E), Create(C), Skill(S),
Interest(I) and Appreciation(Ap)

Students should attempt at least one question from each course outcome to enhance their overall
outcome attainability.

Part A

Short Answer Type Questions

Answer any 10 questions

Each question carries 2 marks

1. Discuss how a barrier potential is developed at the PN Junction ? [U] / [CO1]
2. Define junction capacitance and diffusion capacitance. [K] / [CO1]
3. Differentiate between ideal diode and real diode. [U] / [CO2]
4. What is a zener diode ? Draw the schematic symbol for a Zener diode . [K] / [CO2]
5. Write an expression for diode current and explain the symbols used in it. [K] / [CO2]
6. Discuss the terms efficiency and ripple factor of a rectifier. [U] / [CO3]
7. What is a filter circuit? What is its function? [K] / [CO3]
8. Give the circuit diagram of a half wave rectifier and illustrate its input and output waveforms. [U] / [CO3]
9. What is meant by Q point of a transistor? [U] / [CO4]

10. For a transistor $\alpha = 0.95$ and $I_E = 1\text{mA}$, find the values of I_C and I_B . [A] / [CO4]
11. What are the advantages of negative feedback? [K] / [CO5]
12. Draw the block diagram of voltage-series and voltage-shunt feedback. [U] / [CO5]
13. Draw a voltage divider bias circuit for CE Amplifier. [K] / [CO5]
14. What is an oscillator? [U] / [CO6]

[2 x 10 = 20]

Part B

Short Essay Questions

Answer any 6 questions

Each question carries 5 marks

15. Explain how the process of avalanche breakdown occurs ? [U] / [CO1]
16. Define zener voltage ? How does a zener diode maintain a constant voltage across it ? [U] / [CO2]
17. Explain the working of a shunt capacitor filter and give the expression for ripple factor of the same. [U] / [CO3]
18. In a transistor circuit, collector load is $4\text{K}\Omega$ whereas quiescent current is 1mA . (i) what is the operating point if $V_{cc} = 10\text{V}$? (ii) what will be the operating point if $R_c = 5\text{K}\Omega$? [A] / [CO4]
19. With the help of a connection diagram draw and explain the output characteristic of a common- base configuration of a transistor. [U] / [CO4]
20. The voltage gain of an amplifier without feedback is 3000. Calculate the voltage gain of the amplifier if negative feedback is introduced in the circuit. [A] / [CO5]
21. Derive the expressions for Current, Voltage and Power gains. [U] / [CO5]
22. Explain the principle and working of Hartley Oscillator with the help of a circuit diagram. [U] / [CO6]

[5 x 6 = 30]

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**MAHATMA GANDHI UNIVERSITY, KOTTAYAM
MGU-UGP (HONOURS) THEORY EXAMINATION OCTOBER 2025
THIRD SEMESTER**

**DSE – MG3DSEPHY201 – COMPUTATIONAL PHYSICS- C++ PROGRAMMING
(2024 ADMISSION ONWARDS)**

Duration: 1.5 HOURS

Maximum Marks: 50

*Remember(K), Understand(U), Apply(A), Analyse(An), Evaluate(E), Create(C), Skill(S), Interest(I) and
Appreciation(Ap)*

Students should attempt at least one question from each course outcome to enhance their overall outcome attainability.

Part A

Short Answer Type Questions

Answer any **10** questions

Each question carries **2** marks

- | | | |
|-----|---|---------|
| 1. | Define algorithm with an example. | K / CO1 |
| 2. | What are unary operators? Give examples. | U / CO1 |
| 3. | What is the function of 'if' statement in C++? | U / CO2 |
| 4. | Differentiate between while and do-while loops. | U / CO1 |
| 5. | Define an array | K / CO1 |
| 6. | Define a function | K / CO1 |
| 7. | Write the syntax for function definition. | K / CO2 |
| 8. | How to access array elements? | U / CO2 |
| 9. | How can we call a function? | U / CO2 |
| 10. | What are pointers? | K / CO3 |
| 11. | What are member functions? | U / CO3 |
| 12. | What is polymorphism? | K / CO3 |

- | | | |
|-----|-------------------------------|---------|
| 13. | What are array of objects? | U / CO3 |
| 14. | What is function overloading? | U / CO3 |

[2x10 = 20]

Part B

Short Essay Type Questions

Answer any **6** questions

Each question carries **5** marks

- | | | |
|-----|--|---------|
| 15. | Explain the steps involved in developing a C++ program. | U / CO1 |
| 16. | Discuss different types of operators in C++ with examples. | U / CO1 |
| 17. | Write a program to find the largest of three numbers using if-else. | U / CO2 |
| 18. | Describe different types of loops with syntax and example. | U / CO2 |
| 19. | Explain the switch statement with syntax and example. | U / CO2 |
| 20. | Explain one-dimensional and two-dimensional arrays with examples. | U / CO2 |
| 21. | Write the syntax and usage of a function. Differentiate between user-defined and library functions | U / CO2 |
| 22. | Define class and object. Explain how to declare and create them in C++. | U / CO3 |

[5x6 = 30]

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MAHATMA GANDHI UNIVERSITY, KOTTAYAM

MGU-UGP (HONOURS) EXAMINATION

III SEMESTER

DSE: MG3DSEPHY202 INTRODUCTION TO SPACE PHYSICS

(2024 ADMISSION ONWARDS)

Duration: 1.5 hrs

Maximum Marks: 50

Remember(K), Understand(U), Apply(A), Analyse (An), Evaluate(E), Create(C), Skill(S), Interest(I) and Appreciation (Ap)

Students should attempt at least one question from each course outcome to enhance their overall outcome attainability.

Part A

Short Answer Type Questions Answer any

10 questions

Each question carries **2** marks

1. Mention two situations of naturally occurring plasma is found. [K] [CO1]
2. State the relationship between electric field E and magnetic field B in an electromagnetic wave. [U] [CO1]
3. Give an account on the Karman line and its significance. [Ap] [CO6]
4. What is meant by a geomagnetic storm. [I] [CO6]
5. Name the layers of Solar atmosphere. [K] [CO2]
6. Distinguish between solar flare and solar prominence. [S] [CO5]
7. What is meant by the term space weather? [U] [CO2]
8. Name any two space weather models with examples. [E] [CO2]
9. Which unique position in space does Aditya-L1 occupy, and why is it important? [A] [CO4]
10. Comment on Earth's magnetic field components. [K] [CO3]
11. Explain the structure of Earth's magnetosphere. [U] [CO3]
12. Discuss the formation of Earth's ionosphere. [An] [CO4]
13. Explain the propagation of radio waves through ionosphere and obtain the equation for critical frequency. [A] [CO4]
14. Comment on the measurement of TEC using GPS data. [An] [CO5]

[2x10 = 20]

Part B

Short Essay Type Questions

Answer any **6** questions

Each question carries **5** marks

15. Briefly outline the significance of space physics. [K] [CO1]
16. Derive and explain the rocket equation. [An] [CO6]
17. With a neat diagram explain the internal structure of Sun. [K] [CO2]
18. Explain the space weather Toy model by discussing the three phases of a geomagnetic substorm. [U] [CO2]
19. Briefly explain Indias Solar Mission Aditya L1. Compare its specialities with Nasa's Parker Solar Probe. [A] [CO4]
20. Explain the interaction of planetary atmosphere with solar wind. [U] [CO3]
21. Discuss the structure of Earth's ionosphere in detail. [An][CO4]
22. Briefly explain the measurement of total electron content (TEC) using ionosonde. [An] [CO5]

[5x6 = 30]

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MAHATMA GANDHI UNIVERSITY, KOTTAYAM
MGU-UGP (HONOURS)
THIRD SEMESTER EXAMINATION
(2024 ADMISSION ONWARDS)
MG3DSEPHY203– INTRODUCTION TO OPTICS

Duration: 1.5 hrs

Maximum Marks: 50

*Remember(K), Understand(U), Apply(A), Analyse (An), Evaluate(E), Create(C),
Skill(S), Interest(I) and Appreciation (Ap)
Students should attempt at least one question from each course outcome to
enhance their overall outcome attainability.*

Part A

Short Answer Type Questions
Answer any **10** questions
Each question carries **2** Mark

1. Foucault's and Michelson's experimental measurements of the speed of light disproved which prediction of Newton's corpuscular theory? [A][1]
2. Estimate the frequency of light corresponding to a wavelength of 500 nm. [U][2]
3. Calculate the equivalent optical path length if light propagates through a glass block of length 1 m and refractive index = 1.5 [A][3]
4. What happens to the path of a light ray entering from one medium to another if both medium have same refractive indices? [An][3]
5. Explain paraxial approximation in optics. [U][4]
6. Which two parameters are required to describe a ray with respect to optical axis? [U][4]
7. Which are the two operators used to describe the propagation of a ray through an optical system in the matrix method? [U][4]
8. Compare the shapes of a primary wavefront very near to a point source of light and that of a secondary wavefront far away from the source [A][4]
9. What is meant by a thin lens? [U][4]
10. Describe the role of entrance and exit pupils in light transmission. [U][6]
11. Two lenses have the same focal length, but one has a higher f-number than the other. Which one will produce a brighter image under identical lighting conditions? [An][6]
12. Distinguish between the objective and the eyepiece in an optical system. [An][6]
13. What are the two factors that determine the overall angular magnification of a compound microscope? [U][6]
14. How can spherical aberrations be avoided in a reflecting telescope? [A][6]

[2×10 = 20]

Part B

Short Essay Type Questions

Answer any 6 questions

Each question carries 5 Mark

15. Discuss Maxwell's electromagnetic theory and name the experiment that confirmed it. [U][1]
16. Using Fermat's principle of least time, derive Snell's law for refraction at the boundary between two media with different refractive indices. [A][3]
17. A ray of light travels inside a glass block of refractive index 1.67 and strikes the interface with an unknown liquid. It is observed that total internal reflection occurs when the angle of incidence exceeds the critical angle 53 degrees. (a) Calculate the refractive index of the liquid. (b) Identify the liquid based on your result. [An][3]
18. Derive the refraction matrix at a spherical surface and express it in terms of the power of the surface. [A][4]
19. The radii of curvature of the two surfaces of a double convex lens are +15 cm and -25cm, and its focal length is found to be 30cm in air. Determine the refractive index of the material of the lens. [A][4]
20. Based on Huygens' principle, discuss the reflection of a plane wavefront at a plane reflecting surface, and derive the relation between the angle of incidence and the angle of reflection. [A][5]
21. Draw the ray diagram of a simple refracting astronomical telescope made using two convex lenses and derive the expression for its magnifying power. Interpret the sign (positive or negative) of the magnification obtained. [An][6]
22. A thin convex lens has focal lengths of 98 cm for blue light and 102 cm for red light. Calculate the dispersive power of the material and the mean focal length of the lens. [A][6]

[5×6 = 30]

QP Code:

MAHATMA GANDHI UNIVERSITY, KOTTAYAM
MGU-UGP (HONOURS) REGULAR EXAMINATION OCTOBER 2025
THIRD SEMESTER
Discipline Specific Elective (DSE) - MG3DSEPHY204
INTRODUCTION TO MATERIALS SCIENCE
(2024 ADMISSION ONWARDS)

Duration: 1.5 Hours

Maximum Marks: 50

PART A

Short Answer Questions

Answer any 10 questions.

Each question carries 2 mark.

- | | |
|---|-----------|
| 1. Classify materials based on the types of bonding. | [K]/[CO1] |
| 2. Define ionic and covalent bonding with one example each. | [U]/[CO1] |
| 3. What is meant by secondary bonding? Give an example. | [U]/[CO1] |
| 4. Write down two differences between crystalline and non-crystalline solids. | [K]/[CO1] |
| 5. What is Bravais lattice and give any two examples. | [K]/[CO1] |
| 6. Define Unit cell. | [U]/[CO1] |
| 7. What is the physical significance of the Gibbs phase rule? | [K]/[CO4] |
| 8. Give one example each for unary and binary phase diagrams. | [K]/[CO4] |
| 9. Define elastic and plastic deformation. | [U]/[CO6] |
| 10. What is creep? Mention one factor affecting it. | [K]/[CO6] |
| 11. Explain the term ductility. | [U]/[CO6] |
| 12. What are point defects? Give two examples. | [K]/[CO3] |
| 13. What is toughness of a material? | [U]/[CO6] |
| 14. Define corrosion. Mention one way to prevent it. | [K]/[CO6] |

PART B

Short Essay Questions

Answer any 6 questions.

Each question carries 5 marks.

- | | |
|---|-----------|
| 15. Discuss the different types of atomic bonding in solids with suitable diagrams. | [U]/[CO1] |
| 16. Explain the concept of Miller indices and describe the procedure for finding the Miller indices of a plane. | [A]/[CO1] |
| 17. Draw and explain a typical binary phase diagram. Mention its important features. | [U]/[CO4] |
| 18. Explain phase transformations and write a note on the kinetics of transformation. | [K]/[CO5] |
| 19. Discuss elastic, inelastic and viscoelastic behaviour of materials with examples. | [U]/[CO6] |

20. What are different imperfections in crystals? Explain point and line defects with neat sketches. [U]/[CO3]
21. Write short notes on (a) Slip and Twinning, (b) Factors affecting fatigue in metals. [K]/[CO6]
22. Explain the mechanism of oxidation and corrosion in metals and describe one method to prevent it. [A]/[CO6]

MODEL QUESTION PAPER
B.Sc(Hons) Physics Major
MG3DSEPHY205 FOUNDATIONS OF THEORETICAL PHYSICS

Duration: 2 Hours

Max. marks : 70

Part A

(Answer any TEN questions. THREE marks each)

1. Provide an example of a fourth order differential equation of degree 2.
2. Is $xy^2dx + x^2y dy = 0$ an exact differential equation?
3. What is the singular solution to a Clairaut's equation $y = px + \frac{1}{p}$?
4. On the minimum of a functional $I = \int_{x_1}^{x_2} F(y, y', x)dx$, when does $\left(F - y' \frac{\partial F}{\partial y'}\right)$ become a constant?
5. What are Lagrange multipliers?
6. Find the Euler-Lagrange equations for a functional $I = \int_{x_1}^{x_2} (y'^2 + z'^2) dx$, with constraint $y'z' + kz = 0$.
7. If T_{ij} , U_{ij} are components of order 2 tensors and a_i are components of a vector, does the term $T_{ij}U_{ij}a_i$ represent a tensor, vector or a scalar?
8. Is Kronecker delta the same in coordinate systems related by rotations?
9. If $S_{ij} = S_{ji}$ and $A_{ij} = -A_{ji}$, evaluate $S_{ij}A_{ji}$.
10. Write Dirichlet conditions for the existence of a Fourier series for a function.
11. State Parseval identity for a function that has a Fourier series.
12. State *true* or *false* by giving proper reason : Fourier series of $f(x) = x^2 + x$, where $-\pi \leq x \leq \pi$ will have no sine terms and Fourier coefficients $b_n = 0$ for every n .

Part B

(Answer any 8 questions. FIVE marks each)

13. Solve $\frac{dy}{dx} + \frac{y}{x} = x$, given $y(x = 1) = 0$.
14. Write down wave equation, diffusion equation, Poisson equation and Schrödinger equation.

15. A general solution to Laplace equation has the form

$$\Phi(x, y, z) = \sum_k \sum_l \left(A_{kl} e^{\sqrt{k^2 + l^2} x} + B_{kl} e^{-\sqrt{k^2 + l^2} x} \right) (C_k \sin ky + D_k \cos ky) (E_l \sin lz + F_l \cos lz)$$

Find the solution that satisfies the boundary conditions

$$\begin{aligned} \Phi(x, y = 0, z) = \Phi(x, y = a, z) = \Phi(x, y, z = 0) = \Phi(x, y, z = a) = 0 ; \\ \lim_{x \rightarrow \infty} \Phi(x, y, z) = 0 \text{ and } \Phi(x = 0, y, z) = 5 \end{aligned}$$

16. Find the differential equation whose solution gives the minimum of the integral $I = \int_{x_1}^{x_2} \frac{1}{2} (y'^2 + y^2) dx$, given $\delta y(x_1) = 0 = \delta y(x_2)$.
17. Find the minimum area of the surface of revolution about y axis of a curve between (x_1, y_1) and (x_2, y_2) .
18. Components of a second order (rank 2) tensor $\mathbf{T}$ in a Cartesian coordinate system are

$$\mathbf{T} = \begin{bmatrix} 2 & \sqrt{3} & 0 \\ \sqrt{3} & 4 & 0 \\ 0 & 0 & 2 \end{bmatrix}$$

Find its components in another Cartesian coordinate system by rotating about z -axis through 30° .

19. Given the vectors $\mathbf{a}$, $\mathbf{b}$, $\mathbf{c}$ and $\mathbf{d}$, evaluate $(\mathbf{a} \times \mathbf{b}) \cdot (\mathbf{c} \times \mathbf{d})$
20. Find the Fourier series for

$$f(x) = \begin{cases} 0 & \text{for } 0 \leq x \leq \pi; \\ 1 & \text{for } \pi \leq x \leq 2\pi \end{cases}$$

21. For $0 \leq x \leq 2\pi$, find Fourier series for $f(x) = \sin^3 x - \sin^2 x$ in complex basis.
22. The function $f(x) = |x|$, for $-\pi \leq x \leq \pi$ has Fourier series

$$|x| = \frac{\pi}{2} - \frac{4}{\pi} \sum_{m=0}^{\infty} \frac{\cos(2m+1)x}{(2m+1)^2}.$$

Evaluate $\sum_{m=0}^{\infty} \frac{1}{(2m+1)^4}.$

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MAHATMA GANDHI UNIVERSITY, KOTTAYAM

MGU-UGP (HONOURS) EXAMINATION

III SEMESTER

Major - MG3DSEPHY207 - Properties of Matter

(2024 ADMISSION ONWARDS)

Duration: 1.5 hrs

Maximum Marks: 50

**Remember(K), Understand(U), Apply(A), Analyse(An), Evaluate(E), Create(C), Skill(S),
Interest(I) and Appreciation(Ap)**

Students should attempt at least one question from each course outcome to enhance their overall outcome attainability.

Part A

Short Answer Type Questions

Answer any **10** questions

Each question carries **2** marks

1. What are the three types of elastic moduli? [K][CO1]
2. Why does a perfectly plastic body not obey Hooke's law? [U][CO1]
3. What is Poisson's ratio? [K][CO2]
4. How do stress and strain differ? [U][CO2]
5. Estimate the Poisson's ratio of a rubber band 15 cm long and 3 cm wide, elongated by 20% and narrowed by 9.5%. [A][CO2]
6. Give the SI unit of surface tension. [K][CO3]
7. Why do small insects float on water? [U][CO3]
8. A box with a mass of 10 kg and a cross-sectional area of 0.5 m^2 is falling through air with a density of 2 kg/m^3 . Find its terminal velocity. (Assume the drag coefficient to be 0.5 and take $g=10 \text{ ms}^{-2}$.) [A][CO3]
9. Consider two identical pipes carrying water and petrol, evaluate which flow is more likely to be turbulent. [An][CO3]
10. What do you mean by sonic boom? [U][CO4]
11. Define a longitudinal wave. Give two examples. [U][CO5]
12. Why sound is a longitudinal wave? [A][CO5]
13. What is ultrasound imaging? [K][CO6]
14. Two adjacent piano keys are struck simultaneously. The notes emitted by them have frequencies 412 Hz and 417 Hz. Write down the number of beats heard per second. [U][CO6]

[2x10 = 20]

Part B

Short Essay Type Questions

Answer any **6** questions

Each question carries **5** marks

15. Describe stress-strain curve for a ductile material. [U][CO1]
16. How do torsion pendulum helps in determining moment of inertia of a circular disc? [U][CO2]
17. One end of a rope of length 5 m and diameter 8 mm hanging from an iron bar, where the other end is fixed. A weight of 100 N is attached to the free end. Then what will be the elongation of the rope. Young's modulus of the material is 2×10^{11} N/m² [A][CO2]
18. Describe the excess pressure inside spherical and cylindrical drops? [U][CO3]
19. Assuming that the surface tension of rain water is 0.072 N/m. Find the difference of pressure between inside and outside of a rain drop of diameter 0.02 cm. [A][CO3]
20. A wave is described by $y(x,t) = 0.02 \sin(3x - 4t)$. Find the wave number and angular frequency. [U][CO4]
21. Describe the differential equation of a one-dimensional wave. What are its applications? [U][CO5]
22. How is ultrasonic used in flaw detection? [U][CO6]

[5x6 = 30]

QPCODE

Reg.No :

Name :

**MAHATMA GANDHI UNIVERSITY, KOTTAYAM
MGU-UGP (HONOURS) EXAMINATION OCTOBER 2025**

THIRD SEMESTER

Value Addition Courses (VAC) – MG3VACPHY200

SCIENCE AND SOCIETY

(2024 ADMISSION ONWARDS)

Duration: 1.5 Hours

Maximum Marks:50

***Remember(K), Understand(U), Apply(A), Analyse(An), Evaluate(E), Create(C), Skill(S),
Interest(I) and Appreciation(Ap)***

Students should attempt at least one question from each course outcome to enhance their overall outcome attainability.

Part A

Objective Type Questions

Answer any **25** questions

Each question carries **2** marks

1. Which of the following is arranged in the correct sequence in scientific inquiry? [U] / [CO1]
A) Theory → Law → Hypothesis → Experiment
B) Experiment → Hypothesis → Observation → Theory
C) Observation → Hypothesis → Experiment → Theory
D) Law → Experiment → Hypothesis → Theory
2. Which of the following is NOT required for a hypothesis to become a theory? [U] / [CO1]
A) Consistent experimental support
B) Observation and data
C) Verification by multiple scientists
D) Approval from religious authorities
3. What does the open-ended nature of science imply? [U] / [CO1]
A) All current theories are wrong.
B) Science is a never-ending process of questioning and discovery.
C) Science ignores past knowledge completely.
D) Scientific facts keep changing randomly.

4. Which of these can lead to the revision of a scientific theory? [U] / [CO1]
A) Religious approval
B) Political opinion
C) New evidence and discoveries
D) Public voting
5. A single counter-observation can falsify a scientific theory, no matter how many times it has been confirmed before. [U] / [CO1]
A) True
B) False
C) Cannot say
D) True only in some cases
6. Match the scientists (List 1) with the ideas (List 2) they are most associated with: [K] / [CO1]
List I (Scientists)
1. Aristotle
2. Copernicus
3. Galileo Galilei
List II (Ideas)
a. Proposed the heliocentric model
b. Supported the geocentric model (Earth-centered universe)
c. Provided telescope evidence supporting heliocentrism

A) 1–c, 2–b, 3–a
B) 1–a, 2–c, 3–b
C) 1–b, 2–a, 3–c
D) 1–b, 2–c, 3–a
7. What does the term *heliocentric* literally mean? [K] / [CO1]
A) Moon-centered
B) Sun-centered
C) Earth-centered
D) Star-centered
8. Which celestial discovery by Galileo proved that not everything revolves around Earth? [U] / [CO1]
A) Rings of Saturn
B) Moons of Jupiter
C) Sunspots
D) Craters on the Moon
9. Which of the following thinkers did NOT believe in the heliocentric theory? [K] / [CO1]
A) Copernicus
B) Ptolemy
C) Galileo Galilei
D) None of these

10. Who accurately measured the Earth's circumference using shadows and geometry? [K] / [CO1]
A) Galileo
B) Ptolemy
C) Eratosthenes
D) Kepler
11. Which unique property is typically associated with nanostructures? [U] / [CO2]
A) High surface-to-volume ratio
B) Quantum effects
C) Enhanced reactivity
D) All of the above
12. **Assertion (A):** Uranium ore as mined from the earth cannot be directly used as reactor fuel. [U] / [CO2]
Reason (R): Natural uranium contains only about 0.7% of fissile isotope U, which is insufficient for most reactors.
A) Both A and R are true, and R is the correct explanation of A.
B) Both A and R are true, but R is not the correct explanation of A.
C) A is true, R is false.
D) A is false, R is true.
13. Why does the bottom of a swimming pool look closer to the surface than it really is? [U] / [CO2]
A) Reflection of Light on the surface of water

B) Refraction of Light when it comes out of water
C) Scattering of Light in water
D) Dispersion of Light in water
14. Which mission made the first successful human landing on the Moon? [K] / [CO2]
a) Luna 9
b) Apollo 11
c) Chang'e 3
d) Chandrayaan-1
15. Which element is commonly used to make integrated circuits and microchips? [R] / [CO2]
A) Silicon
B) Gold
C) Lead
D) Zinc
16. **Assertion (A):** Recommendation systems used by Netflix or Amazon are part of AI. [U] / [CO2]
Reason (R): They study user data to suggest movies, shows, or products.

- A) Both A and R are true, and R is the correct explanation of A.
 B) Both A and R are true, but R is NOT the correct explanation of A.
 C) A is true, but R is false.
 D) A is false, but R is true.
17. **Assertion (A):** Antibiotics are effective against all microorganisms including viruses. [U] / [CO2]
Reason (R): Antibiotics specifically target bacterial structures and processes, which viruses lack
- A) Both A and R are true, and R is the correct explanation of A.
 B) Both A and R are true, but R is NOT the correct explanation of A.
 C) A is true, R is false.
 D) A is false, R is true.
18. What is the basic unit of information in quantum computing? [U] / [CO2]
 A) Byte
 B) Bit
 C) Qubit
 D) Chip
19. What is AI bias? [U] / [CO3]
 A) AI performing tasks faster than humans
 B) AI showing unfair or skewed outcomes due to flawed data or algorithms
 C) AI refusing to work on certain devices
 D) AI replacing human jobs
20. Why are nuclear weapons considered ethically problematic? [A] / [CO3]
 A) They are too expensive to maintain
 B) They cause massive, indiscriminate destruction
 C) They only work in certain climates
 D) They cannot be transported easily
21. Which of the following is NOT a benefit of public awareness in science and technology? [U] / [CO4]
 A) Better health and safety choice
 B) Understanding environmental issues
 C) Increased superstition and myths
 D) Informed voting and policy support
22. What does 'scientific temper' in the Indian Constitution encourage? [U] / [CO4]
 A) Blind faith and superstition
 B) Rational thinking, inquiry, and evidence-based reasoning
 C) Ignoring scientific developments
 D) Memorizing laws of science.

23. Which of the following is a fact about eclipses? [A] / [CO5]
A) Eclipses bring bad luck or disasters.
B) Pregnant women should not step outside during an eclipse.
C) Eating food during an eclipse is harmful.
D) One should not look directly at the Sun without protection during a solar eclipse.
24. Even under normal operation, nuclear power plants emit dangerous levels of harmful radiation into the surrounding areas, endangering the people working in the vicinity. This statement is: [U] / [CO5]
A) True
B) False
25. **Assertion (A):** The Big Bang was a giant explosion. [An] / [CO5]
Reason (R): The Big Bang was actually the rapid expansion of space.
Choose the correct option:
A) Both A and R are true, and R explains A.
B) Both A and R are true, but R does NOT explain A.
C) A is false, but R is true
D) Both A and R are false.
26. Which of the following is NOT a myth about stars? [U] / [CO5]
A) Stars twinkle because they turn on and off.
B) Shooting stars are falling stars.
C) Stars are giant balls of hot gases.
D) Stars move around Earth every night.
27. **Assertion (A):** Humans evolved from monkeys we see today. [An] / [CO5]
Reason (R): Humans, apes, and monkeys share a common ancestor, and fossils show different stages of human evolution.
Choose the correct option:
A) Both A and R are true, and R is the correct explanation of A.
B) Both A and R are true, but R is NOT the correct explanation of A.
C) A is false, but R is true.
D) A is true, but R is false.
28. Which of the following is an example of a systematic error? [A] / [CO6]
A) Sometimes reading a scale slightly above, sometimes below the mark
B) A weighing scale that consistently overreads by 2 g
C) Recording fewer measurements than required for accuracy
D) Small unpredictable variations in repeated readings
29. Which of the following reduces random errors in an experiment? [U] / [CO6]
A) Using a new instrument
B) Taking multiple measurements and averaging them
C) Ignoring some of the measurements
D) None of these

30. What are spurious measurements?
- A) Measurements that are slightly inaccurate
 - B) Measurements taken with a faulty instrument
 - C) Readings that are wildly different from the rest
 - D) Measurements that have random error

[U / [CO6]

[2x25 = 50]

QP CODE

Reg.No :

Name :

MAHATMA GANDHI UNIVERSITY, KOTTAYAM

MGU-UGP (HONOURS) EXAMINATION

THIRD SEMESTER

MG3DSCPHY200 – Principles of Mechanics

(2024 ADMISSION ONWARDS)

Duration: 1.5 hrs

Maximum Marks: 50

Remember(K), Understand(U), Apply(A), Analyse(An), Evaluate(E), Create(C), Skill(S), Interest(I) and Appreciation(Ap)

Students should attempt at least one question from each course outcome to enhance their overall outcome attainability.

Part A

Short Answer Type Questions

Answer any **10** questions

Each question carries **2** Mark

- 1 Explain the Law of Inertia. [U][1]
- 2 Write down 2 equations of motions for the situation in which force is constant. [A][1]
- 3 A force $F(t) = 2t$ N acts on a 1 Kg mass. If the object starts from rest, find its velocity at $t = 3$ seconds. [A][1]
- 4 What is the equation representing Newton's law of gravitation? Explain the terms. [U][2]
- 5 What do you mean by the gravitational field? [U][2]
- 6 Plot the variation of potential and Kinetic energy with displacement of a harmonic oscillator [A][3]
- 7 Write the difference between the motion of critically damped and underdamped oscillation. [U][4]
- 8 What are the factors that affect the amplitude of a forced harmonic oscillator? [U][5]
- 9 What is the difference between linear momentum and angular momentum? [A][6]
- 10 A skater is spinning on the ice. They are initially spinning slowly with their arms outstretched. They then pull their arms in, causing them to spin much faster. Is the skater's kinetic energy conserved in this process? Explain. [A][6]
- 11 Express the angular momentum of a system of particles in terms of angular momentum of centre of mass. Explain the terms. [An][6]
- 12 In a symmetric rigid body rotating about a fixed axis, what happens to the perpendicular component of angular momentum? Explain. [An][6]
- 13 State and explain Kepler's second law. [U][7]
- 14 What are the features of central force? Give two examples of central forces. [An][7]

(2x10=20)

Part B

Short Essay Type Questions

Answer any 6 questions

Each question carries 5 marks

- | | | |
|----|--|---------|
| 15 | How will you determine the motion of a particle if the force F is a function of the speed of the particle? | [U][1] |
| 16 | What is meant by Gravitational Potential. Explain the Physical Significance. | [U][2] |
| 17 | Particle executing simple harmonic motion has a maximum velocity 50 m/s and maximum acceleration 80 m/s^2 . Calculate its amplitude and frequency. | [A][3] |
| 18 | Solve the differential equation of a damped harmonic oscillator. Discuss in detail about the underdamped oscillator. | [U][4] |
| 19 | Write an equation of motion and its solution for a forced damped oscillator. Explain the term resonance. | [U][5] |
| 20 | A 1 kg stone at the end of a 2 m long string makes 5 revolutions per second. Calculate the force on the stone as measured in an inertial frame and in a frame which is rotating with the string. | [A][6] |
| 21 | Calculate the effective weight of an astronaut ordinarily weighing 60 kg, when his rocket moves vertically (a) upward (b) downward with 6 g acceleration | [An][6] |
| 22 | Explain the concept of effective potential. Draw the plot of Effective potential versus radial distance from centre of force for the Kepler potential. | [U][7] |

(5x6=30)