

QPCode

Reg.No :

Name :

MAHATMA GANDHI UNIVERSITY, KOTTAYAM
MGU-UGP (HONOURS) THEORY EXAMINATION OCTOBER 2026
V SEMESTER
DSC - MG5DSCPHY300 - CLASSICAL MECHANICS
(2024 ADMISSION ONWARDS)

Duration: 2 hours

Maximum Marks: 70

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 Questions

Answer any **10** questions

Each question carries **3** marks

1. Define a constraint. Give one example each of a holonomic and a non-holonomic constraint. [K][1]
2. Determine the degrees of freedom of a particle constrained to move on the surface of a sphere. [A][1]
3. State Noether's theorem. [K][1]
4. What do you mean by the reduced mass of a two body system? Write its expression. [U][2]
5. For a two body central force problem, write down the differential equation of an orbit and explain the terms. [U][2]
6. Write the expression for the transverse acceleration (a_θ) of a particle in plane polar coordinates and state its physical significance. [An][2]
7. State the Principle of Least Action? [U][3]
8. State any two advantages of the Hamiltonian formulation over the Newtonian formulation [K][3]
9. Write down the Hamiltonian H of a system in terms of the Lagrangian Generalized velocities, and generalized momenta. [U][3]
10. What was the objective of the Michelson–Morley experiment? [K][4]
11. Calculate the energy equivalent of 1kg of matter. [A][4]
12. State the Principle of Equivalence? [U][4]

[3 x 10 =30]

Part B

Short Essay Questions

Answer any **5** questions

Each question carries **8** marks

13. Derive Lagrange's equations of motion for a conservative system starting from D'Alembert's principle. [U][1]
14. Obtain the Lagrangian of a simple pendulum and derive the corresponding Lagrange's equation of motion. [A][1]
15. For $E > 0$, with necessary diagram, explain the nature of the orbit, the minimum radial distance and why the motion is unbounded. [An][2]
16. Derive Kepler's third Law [An][2]
17. Obtain Hamilton's equations for a simple pendulum. Hence, obtain an expression for its period.. [A][3]
18. Show that Lagrange's equation of motion can be obtained from Hamilton's variational principle. [A][3]
19. Show that the Lorentz transformation reduces to the Galilean transformation when $v \ll c$. [An][4]
20. Two events occur simultaneously at two points separated by 1km in a stationary frame. What time difference is measured by an observer moving at $0.6c$ along the direction joining the two points? [A][4]

[8 x 5 =40]

Model Question
Paper

Reg.No :

Name :

MAHATMA GANDHI UNIVERSITY, KOTTAYAM
MGU-UGP (HONOURS) EXAMINATION October 2026
V SEMESTER
Major - MG5DSCPHY301 - INTRODUCTION TO QUANTUM
MECHANICS
(2024 ADMISSION ONWARDS)

Duration: 2 hours

Maximum Marks: 70

*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 Questions

Answer any **10** questions

Each question carries **3** marks

1. What was Feynman's "Proposition A" regarding trajectories in the electron interference experiment. [U]/[CO1]
2. Compare and contrast the double-slit interference patterns produced by classical particles and classical waves. [U]/[CO1]
3. Explain why Max Born proposed that $|\psi(x,t)|^2$, rather than the wave function $\psi(x,t)$ itself, represents a physical probability density in quantum mechanics. [U]/[CO1]
4. Differentiate between the expectation value, variance, and standard deviation of physical observables in quantum mechanics. [U]/[CO1]
5. Write the time-independent Schrodinger equation. Explain the terms involved. [U]/[CO2]
6. Write the boundary conditions satisfied by the wave function at a finite potential step. [U]/[CO2]
7. Find the inner product of $|\alpha\rangle = (1i, 2, 3)$ and $|\beta\rangle = (4i, 5i, 6)$ [A]/[CO3]
8. State the two conditions for a transformation T to be linear. [U]/[CO3]
9. Define an eigenvector and an eigenvalue of a linear operator. [U]/[CO3]
10. Distinguish between a vector space and Hilbert space. [U]/[CO4]
11. Show that the expansion coefficients c_n of a state ψ , in an orthonormal basis, satisfy $\sum |c_n|^2 = 1$. State the assumption about ψ required for this result. [A]/[CO4]
12. An electron and a proton has the same momentum uncertainty Δp . Which one has smaller uncertainty in velocity? [A]/[CO4]

[3x10 = 30]

Part B

Short Essay Questions

Answer any **5** questions

Each question carries **8** marks

13. Describe Young's double slit experiment with water waves and explain the results of the experiment [U]/[CO1]
14. A classical particle can be described by its position $x(t)$, whereas a quantum particle can be described by a wave function $\psi(x, t)$. Explain the significance of this difference. [U]/[CO1]
15. Explain the completeness of the infinite square-well eigenfunctions and obtain the expansion coefficients. [A]/[CO2]
16. Starting with the definitions of the operators a_+ and a_- , rewrite the Schrödinger equation in terms of these operators. [A]/[CO2]
17. Solve the time-independent Schrödinger equation for a free particle in one dimension. Discuss the significance of the energy eigenvalues and write down the general solution. [U]/[CO2]
18. Find the norm of $f(x) = x$ on the interval $[0,1]$, and construct normalized (unit-norm) function $f(x)$ [A]/[CO3]
19. Prove that eigenvectors belonging to different eigenvalues of a Hermitian transformation are orthogonal. [Taxonomy]/[CO3]
20. Prove that the identity operator $\hat{I}$ and the zero operator $\hat{0}$ are both linear. Explain why every vector space must contain these two trivial linear operators. [A]/[CO4]

[8x5 = 40]

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MAHATMA GANDHI UNIVERSITY, KOTTAYAM
MGU-UGP (HONOURS) THEORY EXAMINATION OCTOBER 2026
SEMESTER V
DSC–MG5DSCPHY302–ATOMIC AND MOLECULAR PHYSICS
(2024 ADMISSION ONWARDS)

Duration: 2 hours

Maximum Marks: 70

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 Questions

Answer any **10** questions

Each question carries **3** marks

- | | | |
|----|--|--------------|
| 1. | What is an absorption spectrum? Explain how it is produced. | [U] / [CO1] |
| 2. | State Pauli's exclusion principle | [U] / [CO2] |
| 3. | Write a note on spectral terms | [U] / [CO3] |
| 4. | Write down the difference between normal and Anomalous Zeeman effect | [U] / [CO4] |
| 5. | A radio wave has a wavelength of 300 m. Calculate its frequency. | [A] / [CO4] |
| 6. | Explain visible and ultraviolet regions in the electromagnetic spectrum. | [U] / [CO4] |
| 7. | What are Stokes and Anti-Stokes lines? | [U] / [CO5] |
| 8. | Explain the factors affecting the intensity of Raman lines. | [An] / [CO5] |
| 9. | State Beer Lambert law | [U] / [CO4] |

- | | | |
|-----|--|-------------|
| 10. | What is chemical shift? Explain it with a suitable example | [U] / [CO5] |
| 11. | List any three applications of Mossbauer spectroscopy | [U] / [CO5] |
| 12. | Explain the basic components of ESR | [U] / [CO5] |

[3x10 = 30]

Part B

Short Essay Questions

Answer any **5** questions

Each question carries **8** marks

- | | | |
|-----|--|-------------|
| 13. | With a neat diagram explain Stern Gerlach experiment | [U] / [CO1] |
| 14. | Briefly explain vector atom model | [U] / [CO2] |
| 15. | Explain the fine structure of sodium D lines | [U] / [CO3] |
| 16. | How molecules are classified on the basis of their principal moments of inertia? | [U] / [CO3] |
| 17. | Draw a neat labelled diagram of electromagnetic spectrum | [U] / [CO4] |
| 18. | Briefly explain the classical and quantum theory of Raman effect | [U] / [CO5] |
| 19. | Explain the principle of NMR spectroscopy | [U] / [CO5] |
| 20. | Briefly explain ESR spectroscopy | [U] / [CO5] |

[8x5 = 40]

QP Code

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MAHATMA GANDHI UNIVERSITY, KOTTAYAM

MGU-UGP (HONOURS) Exam Type EXAMINATION Month YYYY

Semester 5

Discipline Specific Elective (DSE)- MG5DSEPHY300 - SEMICONDUCTOR

OPTOELECTRONIC DEVICES

(2024 ADMISSION ONWARDS)

Duration: 1 hour 30 minutes

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 Questions

Answer any **10** questions

Each question carries **2** marks

1. What is cathodoluminescence? [K]/[CO1]
2. Write the k-selection rule for absorption in semiconductors. [K]/[CO1]
3. What is bandtailing? [U]/[CO1]
4. Mention a distinguishing feature in the absorption spectra of a bound exciton [U]/[CO1] in comparison to a free exciton.
5. How does the presence of O and N increase the radiative efficiency of GAP? [A] / [CO2]
6. What is meant by a binary and a ternary LED material? Give one example for [K] / [CO2] each.
7. Why are GaAs/AlGaAs heterostructure lasers used for short-distance [U] / [CO3] communication?
8. What are the factors on which the end losses of heterojunction lasers depend? [U] / [CO3]

9. What are the functions of optically controlled hi-lo switching devices? [U] / [CO4]
10. Explain the need for modulation in communication. [A] / [CO4]
11. Give the schematic illustration of photonic switching characteristics. [A] / [CO4]
12. What is half-wave voltage? [K] / [CO4]

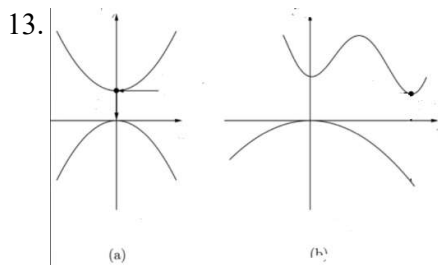
[2x10 = 20]

Part B

Short Essay Questions

Answer any **5** questions

Each question carries **6** marks



Identify the direct and indirect [U]/ [CO1] semiconductors from the figure. Give reason for your choice. Mark the axes and the bands.

14. The radiative lifetime is 10 ns and the nonradiative lifetime is 0.5 ns in GaN. [U]/[CO1]
Find the total or effective lifetime and the internal quantum efficiency.
15. Discuss the various low-energy absorption processes. [K]/[CO1]
16. Compare homojunction and heterojunction LEDs [U] / [CO2]
17. Explain the spectral response and V-I characteristics of LED. [U] / [CO2]
18. With the help of a diagram, explain the stripe geometry of a heterojunction [A] / [CO3]
semiconductor laser.
19. Describe the quantum-confined Stark Effect. [U] / [CO4]
20. Draw the block diagram for electro-optic amplitude modulation and explain it. [U] / [CO4]

[6x5 = 30]

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Reg. No :

Name :

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

Semester 5: MODEL QUESTION PAPER

Computational Physics: Python

MG5DSEPHY301

Time: 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 (Answer any 10 questions)

1. Differentiate between a list and a tuple in Python, with an example of each. (CO1)
2. Trace the output of the following code and write the result:

```
fruits = ['mango', 'apple', 'grapes']  
fruits.append('kiwi')  
fruits.reverse()  
print(fruits)
```

 (CO1)
3. Differentiate between a set and a dictionary in Python, with a suitable example for each. (CO1)
4. Write a Python code snippet using if...elif...else to check whether a given number is positive, negative, or zero. (CO2)
5. Write a Python program using a for loop to print numbers from 1 to 5. (CO2)
6. What is pickling in Python? Mention the module used and one situation where it is useful. (CO2)
7. Write the Python statement(s) to compute the factorial of 5 using the math module. (CO3)
8. How do you create a NumPy array from a Python list? Write the code with an example. (CO3)
9. Differentiate between array indexing and array slicing in NumPy, with an example. (CO3)
10. Write Python code using matplotlib to plot a simple line graph for the points $x = [1, 2, 3, 4]$ and $y = [10, 20, 25, 30]$. (CO3)
11. What is the use of the linspace() function in NumPy? Give an example. (CO3)
12. Write Python code to find the maximum value in the NumPy array $[3, 7, 2, 9, 4]$. (CO3)

[2 X 10 = 20]

PART B (Answer any 5 questions)

13. Explain any six list operations in Python with suitable examples (e.g., append, reverse, insert, remove/del, sort, count). (CO1)
14. Write a Python program to demonstrate dictionary operations: create a dictionary, add/update a key-value pair, use get(), keys(), values(), items(), and delete an entry using pop(). (CO1)
15. Write a Python program using a user-defined function to check whether a given number is prime. Use it to display all prime numbers between 1 and 50. (CO2)

16. Explain the basic concept of Object-Oriented Programming in Python. Write a program to create a class 'Student' with attributes name and marks, and a method to display the student's details.(CO2)
17. Write a Python program to read data from a CSV file using pandas and display the first five rows. Also write code to write a DataFrame to a new CSV file. (CO2)
18. Write a Python program using NumPy to create a 3×3 matrix and perform the following operations: transpose, matrix multiplication, and determinant. (CO3)
19. Write a Python program to generate 100 random numbers using NumPy's random module and plot a histogram of the data using matplotlib. (CO3)
20. Explain, with a Python program, how to create subplots to display a line plot, a scatter plot, and a bar plot of given data in a single figure, with proper titles and axis labels. (CO3)

[6 X 5 = 30]

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MAHATMA GANDHI UNIVERSITY, KOTTAYAM

MGU-UGP (HONOURS) EXAMINATION

Semester 5

PHYSICS OF ATMOSPHERE

(2024 ADMISSION ONWARDS)

Duration: 1 hour 30 minutes

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 QUESTIONS

Answer any 10 questions. Each question carries 2 marks.

CO1 — 5 questions; CO2 — 4 questions; CO3 — 3 questions

1. What are the major gaseous constituents of the Earth's atmosphere? [K] [CO1]
2. State the hydrostatic equation and explain the physical meaning of each term. [U] [CO1]
3. Define potential temperature. [K] [CO1]
4. Distinguish between weather and climate. [U] [CO1]
5. What are climate indices? Give two examples. [K] [CO1]
6. State the Stefan–Boltzmann law and write its mathematical expression. [K] [CO2]
7. What is meant by radiative equilibrium? [K] [CO2]
8. What is Rayleigh scattering? Mention the condition for Rayleigh scattering in terms of particle size and wavelength. [K] [CO2]
9. Briefly explain Beer's law. [U] [CO2]
10. Define atmospheric vorticity. [K] [CO3]
11. What is Coriolis force? What is its direction? [K] [CO3]
12. What is the difference between geostrophic wind and gradient wind? [U] [CO3]

[10 × 2 = 20 marks]

PART B — SHORT ESSAY QUESTIONS

Answer any 5 questions. Each question carries 6 marks.

CO1 — 3 questions; CO2 — 3 questions; CO3 — 2 questions

- 13.** Write a note on the chemical composition of the atmosphere. [U] [CO1]
- 14.** Explain the hydrologic cycle in detail, describing evaporation, condensation, precipitation, infiltration, runoff and groundwater flow. [U] [CO1]
- 15.** Explain the concept of scale height and discuss its dependence on temperature and molecular weight. [U] [CO1]
- 16.** Explain Planck's radiation law and describe the dependence of spectral radiance on wavelength and temperature. [U] [CO2]
- 17.** Explain Kirchhoff's law of thermal radiation. Show why a good absorber is also a good emitter. [U] [CO2]
- 18.** Explain the greenhouse effect and describe how it increases the surface temperature of the Earth. [U] [CO2]
- 19.** Derive the equation for the geostrophic wind field from the horizontal equations of motion. [A] [CO3]
- 20.** Explain why the atmospheric general circulation can be regarded as a heat engine. [An] [CO3]

[5 × 6 = 30 marks]

QP CODE:

Reg. No. :.....
Name :.....

MAHATMA GANDHI UNIVERSITY, KOTTAYAM
MGU-UGP (HONOURS) MODEL QUESTION PAPER (THEORY)
SEMESTER FIVE
MG5DSEPHY303– Laser, Non-linear Optics and Fiber Optics
(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. Distinguish between a two-level and three-level laser system. [A][1]
2. What is the function of a resonator in a laser? [U][1]
3. Write down the Schawlow-Townes condition for laser oscillation and explain each term in it. [K][1]
4. Sketch the energy level diagram of a He-Ne laser. [U][1]
5. Define Q-switching and how it can be achieved? [U][2]
6. Compare the intensities of a mode-locked and mode-unlocked laser beam. [U][2]
7. What is meant by third harmonic generation? [U][3]
8. Explain self-focusing of laser beam. [U][3]
9. Distinguish between TE and TM modes in a slab waveguide [A][4]
10. Which are the two low-attenuation transmission windows in a silica glass optical fibre. Which unit is normally used to express the attenuation in an optical fibre. [U][4]
11. Sketch the schematic of a fibre optic communication system. [A][4]
12. Distinguish between step index and graded index optical fibre. [A][4]

[2×10 = 20]

Part B

Short Essay Type Questions

Answer any **6** questions

Each question carries **5** Mark

13. Obtain the expression for the number of resonant frequencies within an open resonator. [U][1]
14. With the help of a proper schematic diagram and energy level diagram, explain the construction and working of a ruby laser. [A][1]
15. Obtain the condition that must be satisfied to get stimulated emission from a semiconductor laser. [U][1]
16. Explain how Q-switching can be achieved in a laser using Kerr effect. [U][2]
17. What is meant by second harmonic generation? Prove that only non-centrosymmetric crystals can exhibit second harmonic generation. [U][2]
18. A laser operating at a pump wavelength of $\lambda_p = 360$ nm pumps a non-linear crystal to produce parametric generation. If the desired signal wavelength is $\lambda_s = 546$ nm: (1) Calculate the frequency of the pump photon ω_p and signal photon ω_s . (2) Determine the idler frequency and its corresponding wavelength [A][2]
19. Obtain the expression for the characteristic penetration depth of an evanescent wave in an optical fibre. [U][3]
20. A Fiber Bragg Grating is to be fabricated to reflect a target centre wavelength $\lambda_0 = 1300$ nm in a silica fibre core with effective refractive index $n = 1.5$. (i) Calculate the required grating pitch/spacing. (ii) Calculate the effective velocity of this wavelength inside the fibre. [A][3]

[5×6 = 30]

MAHATMA GANDHI UNIVERSITY, KOTTAYAM MGU-UGP (HONOURS)
EXAMINATION October 2026
V SEMESTER
Major- MG5DSEPHY304- PHYSICS OF ADVANCED MATERIALS
(2024 ADMISSION ONWARDS)

Duration: 2 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 Questions

Answer any 10 questions

Each question carries 2 marks

1. What are glass-ceramics? [U/CO1]
2. Give two examples of elastomers and mention one important application of each. [K/CO1]
3. Differentiate between Single-walled CNT and multi-walled CNT [K/CO1]
4. Name the three typical types of stress–strain behaviour exhibited by polymeric materials. [K/CO1]
5. What is viscoelastic creep? [U/CO1]
6. What is matrix phase in a composite? [U/CO1]
7. Write the relation between drift velocity and mobility. [K/CO2]
8. Define Hall voltage. [K/CO2]
9. What are conducting polymers? Explain the role of doping in enhancing their electrical conductivity, with suitable examples. [K/CO2]
10. Explain why repeatedly dropping a permanent magnet on the floor causes it to become demagnetized. [U/CO3]
11. Write the mathematical expression for steady-state heat conduction [K/CO4]
12. Why gold appear yellow in color?. [U/CO5]

(10x2=20)

MODEL QUESTION PAPER
B.Sc(Hons) Physics Major
MG5DSEPHY305 INTRODUCTION TO GROUP THEORY

Duration: 2 Hours

Max. marks : 70

Part A

(Answer any TEN questions. THREE marks each)

1. Define group. Check whether the set of all integers form a group with addition as the rule of composition. [CO1]
2. State Cayley's theorem. [CO1]
3. Define reflection and inversion operations of a point group. [CO2]
4. Write down the group table of the point group D_2 . [CO2]
5. Define a group representation. Write an example. [CO3]
6. Define character of a representation. [CO3]
7. When is a group representation irreducible? [CO3]
8. State the criteria for irreducibility of a group representation. [CO3]
9. Do the set of all translations on a plane form a continuous group? Is it abelian? [CO4]
10. Write an example of a rotation matrix. Show that it is orthogonal. [CO4]
11. Write down $SU(2)$ Lie algebra. [CO4]
12. What are weights of a $SU(2)$ representation? [CO5]

Part B

(Answer any 8 questions. FIVE marks each)

13. Define proper subgroup. Find proper subgroup of C_4 . [CO1]
14. Using Lagrange's theorem, show that any group with order that is a prime number must be abelian. [CO1]
15. Write down the permutation operations of three objects and obtain the group table of permutation group S_3 . [CO1]
16. Explain equivalent axes by choosing any point group as example. [CO2]
17. Explain how Uniaxial groups and Dihedral groups form groups with pure rotations. Give an example each. [CO2]
18. Give an example of point group containing rotation reflections. Write down its group table. [CO2]

19. State Schur's lemmas and explain its relevance for determining irreducibility. [CO3]
20. What is group algebra? How are the number of non equivalent irreducible representations of a group determined? [CO3]
21. Show that any rotation matrix can be expressed as $e^{i\mathbf{n}\cdot\mathbf{L}}$. You may choose $\mathbf{n}$ to be any convenient unit vector. [CO4]
22. Show that the $SU(2)$ generators $L_{\pm} = L_x \pm iL_y$ raises or lowers eigenvalues of L_z . [CO4]

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MAHATMA GANDHI UNIVERSITY, KOTTAYAM
MGU-UGP (HONOURS) THEORY EXAMINATION OCTOBER 2026
V SEMESTER

DSE - MG5DSEPHY307- OP AMP AND LINEAR INTEGRATED CIRCUITS
(2024 ADMISSION ONWARDS)

Duration: 1 hour 30 minutes

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 Questions

Answer any **10** questions. Each question carries **2** marks

1. State any four characteristics of ideal op-amp [K] / [CO1]
2. An op-amp has a differential gain 1500 and common mode gain 0.0075. Find the CMRR in decibels [U] / [CO1]
3. Define the concept of virtual ground in an inverting amplifier [U] / [CO1]
4. What is an instrumentation amplifier? Mention any two of its important features [U] / [CO2]
5. State the output relationship of an op-amp integrator for a sinusoidal input [A] / [CO2]
6. What is a current-to-voltage (I–V) converter? [U] / [CO2]
7. Write the output-voltage equation of an op-amp logarithmic amplifier [U] / [CO2]
8. What are astable and monostable multivibrators? [U] / [CO2]
9. Differentiate between voltage-series and voltage-shunt feedback [U] / [CO3]
10. Write the expression for input resistance of an amplifier with voltage-series feedback [U] / [CO3]
11. How does the voltage shunt feedback affect the input resistance of an amplifier [An] / [CO4]
12. An amplifier has an output resistance of 10 k Ω and loop gain $A\beta=9$. Calculate its output resistance with voltage shunt feedback [A] / [CO4]

[2x10 = 20]

Part B

Short Essay Questions

Answer any **5** questions. Each question carries **6** marks

13. With a neat circuit diagram derive the expression for the closed loop voltage gain of an inverting amplifier using the concept of virtual ground [U] / [CO1]
14. Explain the summing amplifier working in inverting configuration and obtain the expression for output voltage [U] / [CO1]
15. Explain the working of a three-op-amp instrumentation amplifier with a neat circuit diagram and state its applications. Obtain the expression for its output voltage [U] / [CO2]
16. An op-amp V–I converter is designed with an input voltage of 2 V and a resistance of 5 k Ω . a) Calculate the output current. b) If the input voltage is increased to 5 V, calculate the new output current [A] / [CO2]
17. With a neat circuit explain the operation of a triangular-wave generator [U] / [CO2]
18. Explain the operation of an op-amp differentiator and obtain the equation for output [U] / [CO2]
19. Derive the expression for the output resistance of a voltage series negative feedback amplifier [U] / [CO4]
20. Derive the expression for closed loop voltage gain of a voltage shunt feedback amplifier [U] / [CO3]

[6x5 = 30]

MAHATMA GANDHI UNIVERSITY, KOTTAYAM

B.Sc. (Hons) Physics – Semester V

MG5DSEPHYA00

Introduction to Radiological Physics

(2024 ADMISSION ONWARDS)

Duration: 2 Hours

Maximum Marks: 50

PART – A

Short Answer / Problems

Answer any 10 questions. Each carry 2 marks

1. What are the characteristic and continuous spectra of X-rays? [U][CO1]
2. A medical facility requires a high-energy beam of charged particles for radiotherapy. Which accelerator Van de Graaff generator or linear accelerator is more suitable? Give one reason. [A][CO1]
3. Distinguish between a cyclotron and a synchrotron. [U][CO1]
4. What is meant by artificial radioisotopes? Mention one medical application. [U][CO2]
5. Describe the role of work function in the photoelectric effect? [U][CO2]
6. An X-ray photon of energy 100keV undergoes photoelectric absorption in an atom. If the emitted photoelectron carries 75% of the photon energy, determine the binding energy of the electron. [A][CO2]
7. A detector is required to measure the energy of incident gamma radiation. Which is more suitable, a GM counter or a scintillation detector? Give one reason. [A][CO3]
8. What is meant by the quenching of a GM counter? [U][CO3]
9. What is the principle of operation of a scintillation detector? [U][CO3]
10. What is a thermoluminescent dosimeter (TLD)? [K][CO4]
11. Define linear energy transfer (LET). [K][CO4]
12. Why is shielding with a suitable material necessary when working with ionizing radiation? [U][CO4]
13. Define half-life and write its relation with the decay constant. [U][CO5]
14. What is meant by radioactive equilibrium? [U][CO5]
15. A radioactive substance has a half-life of 10 days. What fraction of the original radioactive nuclei remains after 30 days? [A][CO5]

$$10 \times 2 = 20$$

PART – B

Short Essays / Problems

Answer any 6 questions. Each carry 5 marks

16. An X-ray technician operates an X-ray tube to obtain a medical image. Apply your knowledge of electron-target interactions to explain how X-rays are produced and how continuous X-rays differ from characteristic X-rays. [A][CO1]

17. Explain the principle, construction and working of a cyclotron. Mention its applications. [U][CO1]
18. Explain the production of artificial radioisotopes and discuss their applications in medical fields. [U][CO2]
19. Explain the interaction of charged particles with matter. [U][CO2]
20. Explain the operating regions of gas-filled radiation detectors with a suitable diagram. [U][CO3]
21. Describe the construction and working of a solid-state detector. [U][CO3]
22. Describe the principle and working of a pocket dosimeter and mention its applications in radiation monitoring. [U][CO4]
23. Explain the principles of radiation protection based on Time, Distance and Shielding. Explain the concept of Half-Value Layer (HVL). [U][CO4]
24. Derive the radioactive decay law and obtain the relation between decay constant and half-life. [A][CO5]
25. Explain successive disintegration and distinguish between ideal, transient and permanent radioactive equilibrium. [U][CO5]

$$6 \times 5 = 30$$

QP Code: _____

Reg. No.:

Name :

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

SEMESTER 5 (MODEL QUESTION PAPER)

MG5SECPHY301: Physics using Computational Tools

Time: 1.5 Hours

Max. 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 (Answer any 10 questions)

1. Using the Newton-Raphson method, find the first approximation x_1 to a root of $f(x) = x^2 - 2$, starting from $x_0 = 1$. [CO1]
2. Using the Regula-Falsi method, find the first approximation to a root of $f(x) = x^2 - 4$ in the interval $[1, 3]$. [CO1]
3. For the system $x + y = 5$, $2x + 3y = 13$, eliminate x from the second equation using the Gauss elimination procedure and write the resulting equation. [CO1]
4. Write the coefficient matrix A and the constant vector B for the system $2x + y = 5$, $x + 3y = 10$. [CO2]
5. For the data points $(1, 2)$ and $(3, 8)$, find the slope b of the least-squares straight line $y = a + bx$ joining them. [CO1 & CO2]
6. Given $f(0) = 1$ and $f(1) = 3$, find the forward difference $\Delta f(0)$. [CO1 & CO2]
7. Given the points $(0, 1)$, $(1, 3)$ and $(2, 7)$, find the divided difference $f[0, 1]$. [CO1 & CO2]
8. Given $f_0 = 1$ and $\Delta f_0 = 2$ at $x_0 = 0$ with $h = 1$, estimate $f(0.5)$ using the linear term of Newton's forward difference formula. [CO1 & CO2]
9. Given $f(1) = 2$ and $f(3) = 8$, estimate $f'(1)$ using the two-point approximation $f'(1) \approx (f(3) - f(1)) / (3 - 1)$. [CO3 & CO4]
10. Using the trapezoidal rule, find the area under the curve between $x = 0$ and $x = 1$, given $f(0) = 2$ and $f(1) = 4$. [CO3 & CO4]
11. For $dy/dx = x + y$ with $y(0) = 1$, calculate the value of dy/dx at $x = 0$. [CO3 & CO4]
12. In Euler's method, given $y_0 = 1$, $f(x_0, y_0) = 2$ and $h = 0.1$, find y_1 . [CO3 & CO4]

[2 X 10 = 20]

PART B (Answer any 5 questions)

13. Using the Newton-Raphson method, find the root of the equation $x^2 - 5 = 0$, correct to three decimal places, starting with $x_0 = 2$ (perform two iterations). *[CO1]*

14. Solve the following system of equations using the Gauss elimination method: *[CO1]*

$$x + y + z = 6$$

$$2x - y + z = 3$$

$$x + 2y - z = 2$$

15. Fit a straight line $y = a + bx$ to the following data using the method of least squares. *[CO1 & CO2]*

$$x : 1 \ 2 \ 3 \ 4$$

$$y : 3 \ 5 \ 7 \ 8$$

16. Using Newton's forward difference interpolation formula, estimate the value of $f(2.5)$ from the following data. *[CO1 & CO2]*

$$x : 1 \ 2 \ 3 \ 4$$

$$f(x) : 2 \ 5 \ 10 \ 17$$

17. Using Lagrange's interpolation formula, find the value of y at $x = 2$ for the following data. *[CO1 & CO2]*

$$x : 0 \ 1 \ 3$$

$$y : 1 \ 3 \ 13$$

18. Using the trapezoidal rule, evaluate the integral of $f(x)$ between $x = 0$ and $x = 4$ from the following table ($n = 4$ intervals). *[CO3 & CO4]*

$$x : 0 \ 1 \ 2 \ 3 \ 4$$

$$f(x) : 1 \ 2 \ 5 \ 10 \ 17$$

19. Using the 4th order Runge-Kutta method, solve $dy/dx = x + y$, $y(0) = 1$, and find $y(0.1)$ taking a single step of size $h = 0.1$ (show all four k values). *[CO3 & CO4]*

20. Using Euler's method, solve $dy/dx = x + y$, $y(0) = 1$, and find $y(0.2)$ taking step size $h = 0.1$ (perform two steps).

[CO3 & CO4]

[5 × 6 = 30]

QPCode

Reg.No :

Name :

MAHATMA GANDHI UNIVERSITY, KOTTAYAM
MGU-UGP (HONOURS) MODEL EXAMINATION October 2026

Fifth Semester

SIGNATURE COURSE - MG5SECPHYA00 - RESEARCH METHODOLOGY AND SCIENTIFIC TYPESETTING
(2024 ADMISSION ONWARDS)

Duration: 1 hour 30 minutes 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

MCQ with options

Answer all questions

Each question carries 1 mark

1. Which research approach primarily develops or tests ideas through mathematical or conceptual reasoning? [Understand] / [CO1]
 - A. Use of concepts, models and logical reasoning
 - B. Computational research
 - C. Theoretical research
 - D. Computational research
2. Basic research is primarily undertaken to [Understand] / [CO1]
 - A. Develop or test knowledge, theories and hypotheses
 - B. Basic research
 - C. Advancement of knowledge
 - D. Solve problems of immediate practical concern
3. What is the main role of computational research? [Remember] / [CO1]
 - A. Computational tool
 - B. Computational research
 - C. Algorithms and numerical calculations
 - D. Using computation to model, simulate or analyse problems
4. Research problems are often found by [Understand] / [CO1]
 - A. Reading literature and identifying gaps or unresolved issues
 - B. Generate new or unexpected findings
 - C. Lead to meaningful discoveries or understanding
 - D. Formally test or challenge the finding
5. The first step in identifying a research problem is often to [Remember] / [CO1]
 - A. Recognize an issue, gap or unanswered question
 - B. The chosen field of study
 - C. Clearly defined and researchable
 - D. Something important is not adequately known
6. Defining a research problem means [Remember] / [CO1]
 - A. Unclear and overly broad wording
 - B. Variables, context or population where appropriate
 - C. Specifying exactly what will be investigated
 - D. Delimiting the study population/context
7. A research question is primarily intended to [Understand] / [CO1]
 - A. Guide what the study seeks to answer
 - B. Clearly formulated research questions
 - C. A research question

D. How does temperature affect the resistance of a given material?

8. A hypothesis is best described as [Remember] / [CO1]
- A. A theory
 - B. Testable
 - C. A scientifically reasonable prediction
 - D. Reconsidered or revised
9. Research design is best described as [Understand] / [CO1]
- A. A factor that can take different values
 - B. The experimental condition being tested
 - C. The purpose of each step
 - D. The overall plan for conducting the study
10. Accuracy refers to [Remember] / [CO1]
- A. Unreliable or biased results
 - B. Closeness of a measurement to the true or accepted value
 - C. Bias experimental conclusions
 - D. Recorded carefully
11. Quantitative data are data that [Understand] / [CO2]
- A. Can be represented numerically
 - B. Secondary data
 - C. Qualitative data
 - D. Quantitative data
12. The main purpose of a literature review is to [Remember] / [CO2]
- A. Research gaps
 - B. Describe and evaluate literature relevant to a topic
 - C. An overview of the field of inquiry
 - D. The research problem or question
13. Which is an effective literature-search strategy? [Understand] / [CO2]
- A. Digital academic information
 - B. Use focused keywords related to the research question
 - C. Refining terms based on relevant results
 - D. Indian theses and dissertations
14. A literature review should contain [Remember] / [CO2]
- A. The basis for selecting the literature
 - B. Introduction, body and conclusion
 - C. Major agreements, disagreements and general conclusions
 - D. Principal questions asked in the field
15. The final year report begins with [Understand] / [CO2]
- A. The issue that needs investigation
 - B. What new value the research provides
 - C. The specific tasks needed to achieve the project goals
 - D. An abstract
16. The methodology section primarily explains [Remember] / [CO2]
- A. A project proposal
 - B. How the research was conducted
 - C. Project schedule and milestones
 - D. Resources and time needed for the work
17. The Results section should primarily [Understand] / [CO2]
- A. Present the findings of the study
 - B. Interpret findings in relation to the research question
 - C. Observations, data and the hypothesis
 - D. Words, tables and graphics
18. Interpretation of results asks [Remember] / [CO2]

- A. Bring together the main findings
 - B. What the findings mean in relation to the research question
 - C. The research question and evidence
 - D. Illustrate relevant findings
19. Research ethics concerns [Understand] / [CO2]
- A. Responsible conduct of research
 - B. Honest reporting of data and methods
 - C. The integrity and credibility of research
 - D. Submitting the same research work to more than one journal
20. Plagiarism involves [Remember] / [CO2]
- A. Restating meaning in your own words
 - B. Using another person's work or ideas without proper credit
 - C. An accurate reference
 - D. Identified as a quotation and cited
21. A direct quotation is [Understand] / [CO3]
- A. Understanding the original text
 - B. Where the borrowed information originated
 - C. An exact reproduction of spoken or written words
 - D. Sparingly and for a clear purpose
22. LaTeX is primarily a [Remember] / [CO3]
- A. High-quality typesetting
 - B. Document preparation system
 - C. Professional typesetting and mathematical support
 - D. Automatic numbering and referencing
23. A LaTeX document has two main parts: [Understand] / [CO3]
- A. `\documentclass`
 - B. Articles and reports
 - C. Letters
 - D. Preamble and document body
24. The command for bold text is [Remember] / [CO3]
- A. `\texttt{}`
 - B. `enumerate`
 - C. `\textit{}`
 - D. `\textbf{}`
25. The environment used to create tables is [Understand] / [CO3]
- A. `\hline`
 - B. `Columns`
 - C. `tabular`
 - D. Laboratory observations
26. The package required for including graphics is [Remember] / [CO4]
- A. `\caption{}`
 - B. `graphicx`
 - C. `\centering`
 - D. Describe the figure clearly
27. Automatic cross-referencing is useful for [Analyse] / [CO4]
- A. Sections, figures, tables and equations
 - B. Point to the intended element
 - C. Renumber items manually
 - D. Maintains consistency when content changes
28. BibTeX is mainly used for [Analyse] / [CO4]
- A. Sources cited or referenced in a document
 - B. Scientific writing
 - C. Bibliography management

D. Managing bibliographic entries

29. Which sequence best represents the essential structure of a scientific project report prepared using LaTeX?

[Apply] / [CO4]

- A. Title/abstract → introduction → methodology → results and discussion → conclusion/future work → references
- B. Title → CV → acknowledgements only
- C. Figures → bibliography → title only
- D. Tables → equations → references only

30. Which combination of LaTeX features is most useful for professional scientific documentation and CV preparation?

[Apply] / [CO4]

- A. Structured sections, tables, figures, equations, lists and consistent formatting
- B. Only manual page formatting
- C. Only image editing
- D. Only plain text without document structure

Part B

Essay Question

Answer the following question

Each question carries 20 marks

31. Prepare a scientific project report titled “Experimental Investigation of the Dependence of Resistance on Temperature” using LaTeX. Explain and demonstrate how you would prepare the report containing: (a) title page and abstract, (b) introduction and objectives, (c) literature review, (d) experimental methodology, (e) results and discussion, (f) tables containing experimental observations, (g) figures/graphs representing experimental results, (h) conclusion and future scope, and (i) references. Write suitable LaTeX commands/environments for creating the major elements of the report.

[Apply] / [CO3 / CO4]

***** End of Question Paper *****