

|  |  |  |  |  |  |  |  |
|--|--|--|--|--|--|--|--|
|  |  |  |  |  |  |  |  |
|--|--|--|--|--|--|--|--|

## St Aloysius (Deemed to be University)

Mangaluru

School of Physical Sciences (PG Programme)

M.Sc. (Physics) - Semester I – P.G. Examination

October/November - 2025

### MATHEMATICAL PHYSICS I

Time: 2 ½ Hours

Max Marks: 60

#### SECTION – A

Answer any **FIVE** of the following.

(5x2=10)

1. Prove that  $P_n(1) = 1$
2. Write the generating function for Laguerre polynomial.
3. Show that the addition and subtraction of two tensors is also a tensor of the same rank.
4. State Gauss Divergence Theorem
5. What are Hermitian matrices? Give an example.
6. Solve the equation  $\frac{\partial^2 u}{\partial x^2} = 1$  under the condition  $\frac{\partial u(x)}{\partial x} = 3$  when  $x = 0$ , and  $u(1) = 1$ .

St Aloysius (Deemed to be University) LIBRARY  
MANGALURU - 575003

#### SECTION - B

Answer any **FIVE** of the following.

(10x5=50)

7. Show that a)  $\beta(x, y) = \frac{\Gamma(x)\Gamma(y)}{\Gamma(x+y)}$  b)  $\Gamma\left(\frac{1}{2}\right) = \sqrt{\pi}$
8. Verify Green's theorem in the plane for  $\oint (xy + y^2) dx + x^2 dy$ , where  $c$  is the closed curve of the region bounded by  $y = x, y = x^2$
9. Express  $\vec{\nabla}\phi$  and  $\vec{\nabla}\cdot\vec{E}$  in curvilinear coordinate system and hence express it in the spherical polar coordinate system
10. Solve three dimensional Laplace equation in spherical polar coordinates.
11. Solve the differential equation  $x^2 \frac{d^2 y}{dx^2} + x \frac{dy}{dx} + (x^2 - n^2)y = 0$  by power series method.
12. Find the eigenvalues and normalised eigenvectors of the matrix  $A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 1 \\ 0 & 1 & 1 \end{bmatrix}$
13. Solve  $\frac{\partial u(x,t)}{\partial t} = \frac{h^2 \partial^2 u(x,t)}{\partial x^2}$  where  $h$  is a constant and  $u(a, t) = u(l, t) = 0$  and  $u(x, 0) = f(x)$
14. Diagonalize the following matrix.

$$A = \begin{bmatrix} -1 & -19 & -4 \\ 0 & -2 & 0 \\ 0 & 15 & 3 \end{bmatrix}$$

\*\*\*\*\*

PS1FPRM500

Reg. No.:

|  |  |  |  |  |  |  |  |
|--|--|--|--|--|--|--|--|
|  |  |  |  |  |  |  |  |
|--|--|--|--|--|--|--|--|

**St Aloysius (Deemed to be University)**

**Mangaluru**

**School of Physical Sciences (PG Programme)**

**M.Sc. (Physics) - Semester I – P.G. Examination**

**October/November - 2025**

**RESEARCH METHODOLOGY AND ETHICS**

**Time: 2 ½Hours**

**Max Marks: 60**

**SECTION – A**

**Answer any FIVE of the following.**

**(5x2=10)**

1. What is publication ethics, and why is it important?
2. Explain the importance of intellectual honesty in research.
3. Why is reproducibility important in research?
4. Differentiate between Web of Science and Scopus databases.
5. Why is protecting IPR justified?
6. What is the h-index, and how is it used in research metrics?

St Aloysius (Deemed to be University) LIBRARY  
MANGALURU - 575003

**SECTION - B**

**Answer any FIVE of the following.**

**(10x5=50)**

7. Differentiate between authorship and contributor ship in scientific publications. Why is proper attribution important for ethical research practices?
8. Describe conflicts of interest in the context of publication ethics. How can they influence research outcomes and credibility
9. Why is research important in medicine field?
10. Outline the components of an effective problem statement, including the identification of the research gap, the articulation of research objectives, and the delineation of key variables
11. - Identify and briefly discuss one significant IPR issue in the physical sciences
12. What is review of literature? Discuss the reporting of the review in detail.
13. Explain the characteristics of a problem statement.
14. Compare and contrast SJR and SNIP metrics in terms of their calculation methods and utility in evaluating journal impact.

\*\*\*\*\*

|  |  |  |  |  |  |  |  |
|--|--|--|--|--|--|--|--|
|  |  |  |  |  |  |  |  |
|--|--|--|--|--|--|--|--|

**St Aloysius (Deemed to be University)****Mangaluru****School of Physical Sciences****(PG Programme)****M.Sc. (Physics) - Semester I - P.G. Examination****October/November - 2025****CLASSICAL MECHANICS****Time: 2 ½Hours****Max Marks: 60****SECTION - A****Answer any FIVE of the following.****(5x2=10)**

1. Prove that the shortest distance between two points in a plane is a straight line.
2. Discuss the phase space of a simple harmonic oscillator.
3. What do you understand by cyclic co-ordinates? Show that the generalized momentum corresponding to a cyclic coordinate is a constant of motion.
4. Using Hamilton's equations of motion. Write equation of motion of L.H.O.
5. What are central forces? Discuss with examples.
6. Construct the Lagrangian for a linear diatomic molecules.

St Aloysius (Deemed to be University) LIBRARY  
MANGALURU - 575003

**SECTION - B****Answer any FIVE of the following.****(10x5=50)**

7. Express angular momentum of a rigid body in terms of angular velocity and moments of inertia.
8. What is D'Alembert's principle? Use D'Alembert's principle to derive the lagrangian equations of motion for a system using an appropriate generalized coordinate.
9. Establish Hamilton's equation from the variational principle.
10. What is canonical transformation? If each of the four types of generating functions exists for a given canonical transformation, use the Legendre transformation to derive relation between them.
11. Derive the differential equation for the orbit of a particle moving under a central force.
12. Obtain the Euler's equations of motion for a rigid body in motion with one point fixed. Write these equations for Torque free motion of a rigid body.
13. What are Euler angles? Obtain the matrix elements of the general rotation matrix in terms of the Euler angles by performing the multiplication of the successive component rotation matrices.
14. Discuss the generalized coordinates required to specify the motion of a rigid body.

**\*\*\*\*\***

PS1FPHC502

Reg. No.:

|  |  |  |  |  |  |  |  |  |  |
|--|--|--|--|--|--|--|--|--|--|
|  |  |  |  |  |  |  |  |  |  |
|--|--|--|--|--|--|--|--|--|--|

**St Aloysius (Deemed to be University)**

**Mangaluru**

**School of Physical Sciences (PG Programme)**

**M.Sc. (Physics) - Semester I- P.G. Examination**

**October/November - 2025**

**QUANTUM MECHANICS I**

**Time: 2 ½Hours**

**Max Marks: 60**

**SECTION - A**

**Answer any FIVE of the following.**

**(5x2=10)**

1. What is a wave packet?
2. Find the eigen values of the matrix  $A = \begin{bmatrix} 0 & -i \\ i & 0 \end{bmatrix}$ .
3. Explain space quantization.
4. Write the radial equation for hydrogen atom problem.
5. Work function of a photosensitive metal surface is 3.2 eV. Are photoelectrons emitted if photons of energy 3.8 eV are incident? If so what is the maximum Kinetic energy of the emitted electrons?
6. What is partial wave analysis in scattering?

St Aloysius (Deemed to be University) LIBRARY  
MANGALURU - 575003

**SECTION - B**

**Answer any FIVE of the following.**

**(10x5=50)**

7. State and prove Ehrenfest's theorem for position and momentum.
8. With the concept of probability density arrive at an expression for probability current density.
9. State and explain the postulates of quantum mechanics. Also explain the importance of expectation values in the same.
10. Evaluate  $[\hat{L}_x, \hat{L}_y]$  and  $[\hat{L}^2, \hat{L}_z]$ .
11. Solve the infinite well problem and arrive at the energy eigen values and normalized eigen functions.
12. Solve the finite well problem and hence arrive at the expression for energy eigen values.
13. Solve the radial equation for spherical well problem and arrive at the solutions using Bessel's functions.
14. Give the wave mechanical theory of scattering. How is scattering amplitude calculated using Green's function technique.

\*\*\*\*\*

PS1FPHC503

Reg. No.:

|  |  |  |  |  |  |  |  |
|--|--|--|--|--|--|--|--|
|  |  |  |  |  |  |  |  |
|--|--|--|--|--|--|--|--|

**St Aloysius (Deemed to be University)**

**Mangaluru**

**School of Physical Sciences (PG Programme)**

**M.Sc. (Physics) - Semester I- P.G Examination**

**October/November - 2025**

**ELECTRONICS**

**Time: 2 ½Hours**

**Max Marks: 60**

**SECTION - A**

**Answer any FIVE of the following.**

**(5x2=10)**

1. What are the characteristics of an ideal opamp?
2. What are the characteristics of a Phase-locked loop?
3. What is bunching in klystron?
4. What is a FlipFlop? Write the circuit of basic RS Flipflop.
5. Differentiate between practical OPAMP and Ideal OPAMP.
6. What is a synchrononous counter?

St Aloysius (Deemed to be University) LIBRARY  
MANGALURU - 575003

**SECTION - B**

**Answer any FIVE of the following.**

**(10x5=50)**

7. Explain the working of an inverting amplifier. Obtain expression for its output voltage.
8. Compare and contrast zero crossing detector and a comparator.
9. Explain the working of a Phase Locked loop using IC 565.
10. Explain feedback in oscillators and Barkhausen criteria for oscillators. Explain the working of a wein brjge oscillators.
11. Draw characteristic curve for a SCR. Explain the Structure of SCR.
12. Write a note on Distortion in amplifiers. What is SHG?
13. Compare and contrast microprocessor and micro controller.
14. What is a deMUX? Explain the working of a 1 to 4 line deMUX.

\*\*\*\*\*