PS1FPHC500 Reg No : | | | | | | | | |

St Aloysius (Deemed to be University)
Mangaluru
Semester I – P.G. Examination – M.Sc. Physics
November - 2024
MATHEMATICAL PHYSICS I

Time : 2 ½ Hours Max. Marks : 60

PART - A

Answer any FOUR questions (Each question carries 10 marks) **(4x10=40)**

1. Solve the Bessel differential equation and obtain a general series solution.
2. Find the eigenvalues and eigenvectors of the matrix $A = \begin{bmatrix} 2 & 1 & -2 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix}$
3. Obtain the solution of Laplace's equation in general spherical polar coordinates.
4. Solve the Legendre equation, $(1-x^2)y'' - 2xy' + n(n-1)y = 0$ by power series method and arrive at the Legendre Polynomials.
5. State Stoke's theorem, verify Stoke's theorem for the square surface of unit side $\vec{v} = (2xz + 3y^2)\hat{j} + (4yz^2)\hat{k}$.
6. Express $\vec{\nabla}.\vec{E}$ in curvilinear coordinate system and hence express it in the spherical polar coordinate system.

PART - B

Answer any FOUR questions (Each question carries 5 marks) **(4x5=20)**

7. Prove that taking inner product of two tensors is equivalent to finding their outer product and then contracting the result of the outer product.
8. What are Hermitian, skew Hermitian and Unitary matrices? Give examples for each.
9. Give an account of the classification of second order parlial differential equations with examples.
10. Derive the relation between beta and gamma function.
11. Show that Legendre Polynomials satisfy the orthogonality properties
$\int_o^\infty e^{-x} L_n(x) L_m(x) dx = \delta_{mn}$ where $\delta_{mn} = \begin{bmatrix} 0 & m \neq n \\ 1 & m = n \end{bmatrix}$
12. If $H_n(x)$ is the Hermite polynomial, show that it satisfies the recurrence relation $2xH_n(x) - 2nH_n(x) = H_{n+1}(x)$

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PS1FPHC501 Reg No. : | | | | | | | | |

St Aloysius (Deemed to be University)
Mangaluru
Semester I - P.G. Examination - M.Sc Physics
November - 2024
CLASSICAL MECHANICS

Time : 2 ½ Hours **Max. Marks : 60**

PART - A

Answer any FOUR questions (Each question carries 10 marks) **(4x10=40)**

1. Prove conservation of energy for a system of particles.
2. Define Poisson brackets. Derive eqution of motion interms of Poisson brackets.
3. Obtain the equations of motion and the first integrals for the motion of a particle under a central force.
4. Obtain Euler equation of motion for rigid body with a fixed point and discuss the torque free motion of a rigid body.
5. Discuss the scattering of a particles by a Coulomb field and hence obtain the expression for Rutherford scattering cross section. Evaluate the total cross section.
6. Dervie the Lagrangian for a charged particle in an electomagnetic field.

PART - B

Answer any FOUR questions (Each question carries 5 marks) **(4x5=20)**

7. What is Action integral? What is the statement of Hamilton's variational principle?
8. Explain about the importance of correspondence between symmetries and conservation laws.
9. For a linear harmonic oscillator from virial theorem show that average kinetic energy equals average potential energy.
10. Write the matrices for rotation of axes about the x axis and y axis.
11. Briefly explain the process of solving for a system by Hamilton's formalism.
12. Write a note on Moment of inertia tensor.

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PS1FPHC502 Reg No : | | | | | | | | | |

St Aloysius (Deemed to be University)
Mangaluru
Semester I - P.G. Examination - M.Sc. Physics
November - 2024
QUANTUM MECHANICS I

Time : 2 ½ Hours Max. Marks : 60

PART - A

Answer any FOUR questions (Each question carries 10 marks) **(4x10=40)**

1. Show that a quantum mechanical wave packet moves like a classical particle. Also define group velocity of a wave packet.

2. Give the physical importance of commutation of observables and explain the fundamental postulates of quantum mechanics.

3. Solve the one dimensional well problem and arrive an expression for energy eigen values for finite case.

4. Solve the eigen value equation for $\hat{L}^2$ and $\hat{L}_z$ operators and hence define spherical harmonics.

5. What are eigen values? What is an eigen value equation? Explain the concept of degeneracy. What is degree of degeneracy?

6. For the pair of momentum and force, show that quantum mechanical expectation values obey Newton's classical equations of motion.

PART - B

Answer any FOUR questions (Each question carries 5 marks) **(4x5=20)**

7. Explain with reference to de Broglie hypothesis. Also explain Heisenberg's uncertainty principle.

8. Define
    1. Linear independence and dependence
    2. Basis.

9. Starting from time dependent Schrodinger equation, arrive at the time independent one.

10. Write the physical significance of various quantum numbers defining a state of the atom.

11. How is tunneling problem applied in alpha decay?

12. Using Born approximation, show that the scattering amplitude is Fourier transform of the potential.

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PS1FPHC503

Reg No : | | | | | | | | |

St Aloysius (Deemed to be University)
Mangaluru
Semester I - P.G. Examination - M.Sc Physics
November - 2024
ELECTRONICS

Time : 2 ½ Hours

Max. Marks : 60

PART - A

Answer any FOUR questions (Each question carries 10 marks) **(4x10=40)**

1. Exaplin any OpAmp Feedback amplifier. Differentaite between positive and negative feedback.
2. Explain the Strucure of Uni junction transistor . How it is used for relaxation Oscillator?
3. Discuss charecteristics of a Silicon Controlled Rectifier.
4. What are registers ? Explain Serial Shift and Parallel shift Registers with relevant circuit diagrams.
5. Construct an Integrator circuit using OpAmp and explain its working.
6. Construct an OpAmp based Schmitt-trigger and explain its working.

PART - B

Answer any FOUR questions (Each question carries 5 marks) **(4x5=20)**

7. What is Second Harmonic Generation ? Explain.
8. What is a Register? Explain the functioning of a 4- bit serial shift register.
9. Illustrate with examples the importance of input and output resistances in an Opamp.
10. Explain monostable multivibrator circut using IC555.
11. What is a transducer? Discuss any two types of transducers.
12. What are the applications of counter circuit? Explain the working of a 4-bit binary ripple counter.

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PS1FPPR500 Reg No : | | | | | | | |

St Aloysius (Deemed to be University)
Mangaluru
Semester I - P.G. Examination - M.Sc Physics
November - 2024
RESEARCH METHODOLOGY AND ETHICS

Time : 2 ½ Hours **Max. Marks : 60**

PART - A

Answer any FOUR questions (Each question carries 10 marks) **(4x10=40)**

1. Write a note on intelectual honesty and research integrity.
2. What is data acquisition and data analysis? Give the outline of reproducibility of data and its application in the study of relevance of research.
3. Evaluate the impact of Intellectual Property Rights on sustainable development, emphasizing the role of innovation.
4. Evaluate the significance of databases in research, focusing on indexing databases, citation databases, and prominent platforms like Web of Science and Scopus.
5. Critically discuss the significance of identifying research gap. Explain how researchers can bridge these gaps using innovative methodologies.
6. Explain in detail with example the different types of research.

PART - B

Answer any FOUR questions (Each question carries 5 marks) **(4x5=20)**

7. Describe conflicts of interest in the context of publication ethics. How can they influence research outcomes and credibility
8. Explain data analysis and data reproducibility.
9. Define Intellectual Property Rights (IPR) and briefly outline the nature and characteristics of IPR.
10. Define the concept of a problem statement and its significance in research planning and execution.
11. Summarize the key steps involved in the filing and registration process of Intellectual Property Rights.
12. How can journal finder tools like JANE and Elsevier Journal Finder assist authors in avoiding predatory journals? Provide a brief overview of their key features.

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