(DPHY01)

ASSIGNMENT-1
M.Sc. DEGREE EXAMINATION, MAY/JUNE-2025

First Year

Physics

MATHEMATICAL PHYSICS
MAXIMUM MARKS :30
ANSWER ALL QUESTIONS

1. (a) Derive Bessel equation.

   (b) Derive Hermite equation.

2. (a) Explain $f(x) = x^4 + 3x^3 + 4x^2 - x + 2$ in terms of Legendre polynomials.

   (b) Find the Legendre series for

$$f(x) = \begin{cases} -1, & -1 \le x < 0 \\ 1, & 0 < x \le 1 \end{cases}$$

3. (a) Derive Cauchy's theorem.

   (b) Develop the Taylor expansion of $\ln(1+z)$.

4. Evaluate the following integrals :

   (a) $\int_0^{\alpha} \frac{\sin x}{x} dx$

   (b) $\int_{-\alpha}^{\alpha} \frac{dx}{1+x^2}$

5. (a) What is a tensor? Define contravariant and covariant tensors.

   (b) Show that the velocity of a fluid at any point is a contravariant vector of rank one.

(DPHY01)

ASSIGNMENT-2
M.Sc. DEGREE EXAMINATION, MAY/JUNE-2025

First Year

Physics

MATHEMATICAL PHYSICS
MAXIMUM MARKS :30
ANSWER ALL QUESTIONS

1. (a) Show that $g_{\alpha\beta}dx_\alpha\, dx_\beta$ is an invariant.

   (b) Explain the role of tensors in elasticity.

2. (a) Obtain Fourier's series for the expansion of $f(x)=x\sin x$ in the interval $-\pi<x<\pi$. Hence deduce that

   $$\frac{\pi}{4}=\frac{1}{2}+\frac{1}{1.3}-\frac{1}{3.5}+\frac{1}{5.7}-.....$$

   (b) Find Fourier series for $f(x)$ in the interval $(-\pi,\ \pi)$

   where $f(x)=\pi+x$ when $-\pi<x<0$,

   $f(x)=\pi-x$ when $0<x<\pi$.

3. (a) If $f(x)=x$ for $0\le x\le\frac{\pi}{2}$

   $f(x)=\pi=x$ for $\frac{\pi}{2}\le x\le\pi$,

   express this function by a sine series and also by a cosine series.

   (b) Give a brief note on first and second shifting theorems in Laplace transforms.

4. Write the following.
   (a) Generating function
   (b) Double circle contours
   (c) Anti-Symmetric Tensor
   (d) Delta function.

(DPHY02)

ASSIGNMENT-1
M.Sc. DEGREE EXAMINATION, MAY/JUNE-2025

First Year

Physics

CLASSICAL MECHANICS AND STATISTICAL MECHANICS
MAXIMUM MARKS :30
ANSWER ALL QUESTIONS

1. (a) Explain the concept of constraints in the mechanics of a system of particles.

   (b) Discuss the principle of virtual work in the context of mechanics.

2. (a) Explain D'Alembert's principle and its role in analyzing the dynamics of particle systems.

   (b) Explain the significance of velocity-dependent and potential dissipation functions in Lagrange's equations.

3. (a) Discuss Hamilton's principle and its application in deriving Lagrange's equations.

   (b) Explore Hamilton's equations of motion and elaborate on their derivation from Lagrange's equations.

4. (a) Explain the conservation theorem.

   (b) Discuss the coordinates of a rigid body, Eulerian angles, and the transformation matrix.

5. (a) Explain the Lorentz transformation and its significance in the special theory of relativity.

   (b) Discuss the force and energy equations in relativistic mechanics.

(DPHY02)

ASSIGNMENT-2
M.Sc. DEGREE EXAMINATION, MAY/JUNE-2025

First Year

Physics

CLASSICAL MECHANICS AND STATISTICAL MECHANICS
MAXIMUM MARKS :30
ANSWER ALL QUESTIONS

1. (a) Explain the Lagrangian formulation of relativistic mechanics.

   (b) Discuss its advantages to classical Lagrangian mechanics.

2. (a) Explain the canonical transformations, and generating functions, with examples.

   (b) Discuss Hamilton-Jacobi equations and their significance.

3. (a) Derive formulation of the small oscillation problem.

   (b) Provide examples of a linear triatomic molecule to illustrate the application of the small oscillation problem formulation.

4. Write the following.

   (a) Coriolis Theorem.

   (b) Explore the relationship between centripetal acceleration and Coriolis force.

   (c) Frequencies of free vibrations.

   (d) Explain the key concepts and equations associated with the Hamiltonian formulations and small oscillation problems.

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(DPHY03)

ASSIGNMENT-1
M.Sc. DEGREE EXAMINATION, MAY/JUNE-2025

First Year

Physics

QUANTUM MECHANICS
MAXIMUM MARKS :30
ANSWER ALL QUESTIONS

1. (a) Explain the fundamental differences between classical and quantum mechanics.
   (b) Discuss the interpretation of wave functions in quantum mechanics.
2. (a) Give a brief note on eigenvalues and eigenfunctions in quantum mechanics.
   (b) Discuss the orthogonality and normalization of eigenfunctions in quantum mechanics.
3. (a) Explain the principles of time-independent perturbation theory.
   (b) Discuss the principles and applications of the WKB method.
4. (a) Discuss the variation method in quantum mechanics.
   (b) Give a detailed note on sudden and adiabatic approximation methods.
5. (a) Explain commutation relations for the angular momentum operator and their significance in quantum mechanics.
   (b) Briefly explain total angular momentum (J) in quantum mechanics.

ASSIGNMENT-2
M.Sc. DEGREE EXAMINATION, MAY/JUNE-2025

First Year

Physics

QUANTUM MECHANICS
MAXIMUM MARKS :30

ANSWER ALL QUESTIONS

1. (a) Give a note on Pauli's spin matrices and discuss their properties.
   (b) Explain the Clebsch-Gordan coefficients.
2. (a) Explain the application of Heisenberg's picture to the harmonic oscillator.
   (b) Explain Dirac's equation in the presence of an electromagnetic field.
3. (a) Give a detailed note on Schrödinger's relativistic equation.
   (b) Discuss probability and current densities.
4. Write the following
   (a) Uncertainty Principle.
   (b) Stark Effect in the hydrogen atom.
   (c) Wagner-Eckart theorem.
   (d) Klein-Gordon equation.

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(DPHY04)

ASSIGNMENT-1
M.Sc. DEGREE EXAMINATION, MAY/JUNE-2025

First Year

Physics

ELECTRONICS
MAXIMUM MARKS :30
ANSWER ALL QUESTIONS

1. (a) Explain the concept of (CMRR) in operational amplifiers.

   (b) Discuss the operational principles of inverting and non-inverting amplifiers using operational amplifiers.

2. (a) Explain the effects of negative feedback on the closed-loop gain.

   (b) Discuss voltage follower configuration using operational amplifiers.

3. (a) Explain the applications of Maxwell's equations in the context of rectangular waveguides.

   (b) Discuss its structure, operation, and applications in microwave circuitry.

4. (a) Provide a detailed analysis of TEM waves in coaxial lines.

   (b) Explain the working principles of Klystron, Reflex Klystron.

5. (a) Discuss DeMorgan's theorems and give their application in simplifying Boolean expressions.

   (b) Explain D-FF and its applications.

ASSIGNMENT-2
M.Sc. DEGREE EXAMINATION, MAY/JUNE-2025

First Year

Physics

ELECTRONICS
MAXIMUM MARKS :30
ANSWER ALL QUESTIONS

1. (a) Explore the functionality of the decoder, demultiplexer and data selector in combinational logic.

   (b) Give a brief note on Shift registers.

2. Explain the architecture of the 8085 microprocessor.

3. Discuss instruction set in 8085 microprocessors with examples.

4. Write the following

   (a) Working principles of Class A power amplifiers.

   (b) Amplitude Modulation.

   (c) RS flip-flop.

   (d) Direct Addressing Mode.

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