# (PHY10112)

M.Sc. DEGREE EXAMINATION, DECEMBER 2016.

First Semester

Physics

Paper I — MATHEMATICAL PHYSICS

(Regulation 2012)

Time : Three hours Maximum : 70 marks

Answer ALL questions.

1. (a) Using Hermite polynomial prove that $\int_{-\infty}^{\infty} e^{-x^2} H_n(x) H_m(x) dx = 2^x n! \sqrt{n} S_{nm}$ . .

(b) Prove that recurrence relation of Hermite polynomial $H_n^{\,1}(x) = 2nH_{n-1}(x), n > 1$ where $H^1(x) = 0$.

Or

(c) Discuss orthogonality of Bessel's functions of first kind.

(d) Prove that $\int_{-1}^{1} P_n(x) P_m(x) dx = \frac{2}{2n+1} S_{nm}$ .

2. (a) Define Lapalce transform and explain the properties of Inverse Laplace transform.

(b) Find $L\{e^{-3t}\sin 2t\}$.

Or

(c) Obtain the Laplace transform of a derivative.

(d) Find the inverse laplace transform of $\frac{1}{s^2(s^2+a^2)}$.

3. (a) Bring out the relation between fourier transform and Laplace transform.

(b) Find the fourier series of a triangular wave represented by

$$f(x) = \begin{cases} x & \text{for} \quad 0 < x < \pi \\ -x & \text{for} \quad -\pi < x < 0 \end{cases}$$

Or

(c) Explain the Half-Wave expansions in Fourier series.

(d) Explain FT of delta function.

4. (a) Prove that $u = e^{-\lambda}(x\sin y - y\cos y)$ is harmonic and find $v$ such that $f(z) = u + iv$ is analytic.

(b) Expand $f(x) = \sin z$ in a Taylor series about $z = \pi/4$.

Or



(c) State and explain Laurent's theorem.

(d) Evaluate $\int_0^1 \frac{x^2}{1+x^4}dx$ by contour integration.

5. (a) Define contravariant, covariant and mixed tensors giving suitable examples.

(b) If $A_r^{pq}$ and $B_r^{pq}$ are tensors prove that $C_{rt}^{pqs} = A_r^{pq}B_t^s$ is also a tensor.

Or

(c) State and explain quotient law of tensor.

(d) Show that the kronecker delta function is a mixed tensor of rank two.

# (PHY10212)

M.Sc. DEGREE EXAMINATION, DECEMBER 2016.

First Semester

Physics

Paper II — CLASSICAL MECHANICS

(Regulation 2012)

Time : Three hours Maximum : 70 marks

Answer ALL questions.

1. (a) Discuss the mechanics of a system of particles.

(b) What are constraints? Explain them with examples.

Or

(c) Obtain Lagrange's equation of motion in generalised co-ordinates.

(d) Explain what are velocity dependent potentials.

2. (a) Describe what is Hamilton function? From this obtain Hamilton's equations.

(b) Discuss the concept of conservation of energy and give simple applications of Hamilton's formulation.

Or

(c) Obtain equivalent one dimensional potential for inverse square law of force and obtain the nature of orbits for bounded motion.

(d) Obtain the differential equation for the orbit and discuss integrable power law potentials.

3. (a) Derive Lagrange's equations from variational Hamilton's principle.

(b) Explain some simple applications of Hamilton's principle.

Or

(c) Discuss equations of canonical transformations. Give examples of canonical transformations.

(d) Explain conservation theorems in poisson bracket notation.

4. (a) Obtain Hamilton's principal function in terms of the Lagrangian.

(b) Explain what is Hamilton's characteristic function and discuss its significance.

Or

(c) Explain what you understand by action angle variables.

(d) Obtain the solutions of a coupled oscillator and discuss its properties in terms of normal co-ordinates.



5. (a) Give an explanation of Euler angles in rigid body rotation.

(b) Discuss angular momentum and show how it depends on inertia tensor.

Or

(c) Give an account of torque-free motion of a rigid body.

(d) Explain Corialis force.

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# (PHY10312)

M.Sc. DEGREE EXAMINATION, DECEMBER 2016.

First Semester

Physics

Paper III – QUANTUM MECHANICS - I

(Regulation 2012)

Time : Three hours Maximum : 70 marks

Answer ALL questions.

1. (a) Explain the inadequacy of classical mechanics.

   (b) Discuss the formulation of Schrodinger's wave equation.

   Or

   (c) Explain what are stationary states.

   (d) Obtain the solutions of a particle in one dimensional and finite potential well.

2. (a) Explain Dirac's bracket rotation.

   (b) Discuss the Eigen value problem for operators. Explain what is meant by continuous spectrum.

   Or

(c) What is a Hermitian operator. Explain the properties of Hermitian operators.

(d) Explain Schmidt orthogonalisation procedure.

3. (a) Express $L_x$, $L_y$ and $L_z$ in cartesian co-ordinates and spherical polar co-ordinates.

(b) Obtain the eigen values and eigen functions of $L^2$ and $L_z$ in spherical polar co-ordinates.

Or

(c) What is a rigid rotator. Write its Schrodinger wave equation in spherical polar co-ordinates and obtain its eigen values and eigen functions.

(d) With a neat diagram explain the hydrogenic orbitals and discuss their redial probability density.

4. (a) Explain time independent perturbation theory for a degenerate case.

(b) Discuss how it can be used to explain linear stark effect in hydrogen atom.

Or

(c) Using variation method show how the ground state of the atom can be obtained.

(d) Briefly discuss WKB method and explain its application.



5. (a) Explain the formalism of time dependent perturbation theory.

(b) Assuming Harmonic perturbation discuss the transition to continuum states.

Or

(c) Describe the nature of Einstein's coefficients for spontaneous and stimulated emissions.

(d) Obtain the selection rules for spectroscopic transitions.

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# (PHY10412)

M.Sc. DEGREE EXAMINATION, DECEMBER 2016.

First Semester

Physics

Paper IV — ELECTRONICS (GENERAL)

(Regulation 2012)

Time : Three hours Maximum : 70 marks

Answer ALL questions.

All questions carry equal marks.

(5 × 14 = 70)

1. (a) With a neat circuit diagram explain the principle and working of balanced output differential amplifier.

(b) Explain the open loop configuration inverting amplifier with op-amp.

Or

(c) Explain the effect of feedback on closed loop gain input resistance and output resistance of op-amp.

(d) Discuss the oppset voltage and bandwidth of an op-amp.

2. (a) Explain briefly the method of CMRR measurement in an op-amp.

(b) Explain how op-amp used an integrator and differentiator.

Or

(c) With a neat circuit diagram explain the working of phase shift oscillator.

(d) What is multivibrator? Explain the working of astable multivibrator with a neat diagram.

3. (a) What is amplitude modulation? Explain the generation of AM waves.

(b) Define DSBSC modulation and explain the coherent detection of DSBSC waves.

Or

(c) What is meant by SSB modulation? Explain the detection of SSB waves.

(d) With a neat circuit diagram explain the working of FDM.

4. (a) Explain the operation of eight input multiplexer.

(b) Draw the circuit diagram to implement a three-variable logic function, with the following sum-of-products expression, using eight input multiplexer $Z = A\overline{B}\,\overline{C} + \overline{A}\,B\overline{C} + ABC$.

Or



(c) What is flip-flop? Explain the working of JK flip-flop with a necessary diagram.

(d) Draw the cascade counter and explain its operation.

5. (a) Draw the architectural diagram of 8085 CPU and explain each part in it.

(b) What is stack? Explain the working of stack in 8085 based system using PUSH and POP operations.

Or

(c) Explain the architecture and pin description of 8051 microcontroller.

(d) Write an assembly language program to find the largest number in 9 given series of 8-bit numbers.

**(PHY10116)**

M.Sc. DEGREE EXAMINATION, DECEMBER 2016.

First Semester

Physics

Paper I — MATHEMATICAL PHYSICS

(Regulation 2016)

Time : Three hours Maximum : 70 marks

Answer ALL questions.

1. (a) Obtain the series solution of Hermites differential equation.

(b) Show that $P_n(-x) = (-1)^n P_n(x)$

Or

(c) Prove the orthogonal property of Lagurre polynomial.

(d) From the generating function of Hermits polynomial show that $H_n'(x) = 2nH_{n-1}(x)$, $n \geq 1$.

2. (a) State and prove the change of scale property of Laplace Transform.

(b) Show that $L\{\cos at\} = \frac{s}{s^2 + a^2}$ and $L\{\sin at\} = \frac{a}{s^2 + a^2}$.

Or

(c) Obtain the Laplace Transform of derivative.

(d) Using Laplace Transform of derivative find the Laplace Transform of $F(t) = t^2$.

3. (a) Define periodic function and obtain the expressions for Fourier coefficients.

(b) Explain about Half-Wave expansions in Fourier series.

Or

(c) Find the Fourier series for the function $f(x) = x^2$ for $-\pi \le x \le \pi$.

(d) Find the sine and cosine Fourier Transform of $x^n e^{-cx}$.

4. (a) State and prove Cauchy's theorem.

(b) Evaluate $\oint_C \frac{e^{2x}}{(z+1)^4} dz$, where C is a cirle $|z| = 3$.

Or

(c) State and explain Taylor's theorem.

(d) Find the residue of $f(z) = \frac{z^2 - 2z}{(z+1)^2(z^2+4)}$.



5. (a) Explain about contravariant and covariant tensors with examples.

(b) Explain the addition of tensors.

Or

(c) Explain the quotient Law of tensor.

(d) Show that the covariant derivatives of fundamental tensors vanish.

**(PHY10216)**

M.Sc. DEGREE EXAMINATION, DECEMBER 2016.

First Semester

Physics

Paper II – CLASSICAL MECHANICS

(Regulation 2016)

Time : Three hours Maximum : 70 marks

Answer ALL questions.

1. (a) What are constraints? Explain with suitable examples.

(b) State and prove the conservation theorem for total angular momentum of a system of particles.

Or

(c) State and prove D'Alembert's principles.

(d) Derive Lagrange's equation of motion from D'Alembert's principle.

2. (a) Explain the conservation theorems and symmetry properties of H.

(b) What is first integral and obtain the equation of motion?

Or

(c) Explain the conditions for closed orbits.

(d) Discuss briefly the problem of scattering in a central force field.

3. (a) Obtain Lagrange's equations from variational principle.

(b) Explain principle of least action.

Or

(c) Define canonical transformation. Show that the canonical transformation form a group.

(d) Show that the poisson bracket is invariant under canonical transformation.

4. (a) Explain Hamilton-Jacobi theorem.

(b) Find the amplitude of a harmonic oscillator using Hamilton-Jacobi theorem.

Or

(c) What are normal coordinates and normal modes? Explain.

(d) Obtain the normal coordinates for a linear triatomic molecule.



5. (a) With a neat diagram, explain Euler's angles.

(b) Obtain an expression for the angular velocity of a rigid body in terms of Euler's angles.

Or

(c) Explain the torque-free motion of a rigid body.

(d) State and explain coriolis effect.

(PHY10316)

M.Sc. DEGREE EXAMINATION, DECEMBER 2016.

First Semester

Physics

Paper III — QUANTUM MECHANICS — I

(Regulation 2016)

Time : Three hours Maximum : 70 marks

Answer ALL questions.

1. (a) Derive continuity equation.

(b) Explain about admissible wave functions.

Or

(c) What are stationary states? Explain their significance.

(d) Derive Schroedinger equation of motion for one dimensional harmonic oscillator.

2. (a) Discuss Dirac's bra are ket rotations.

(b) Prove that eigen vectors belonging to the different eigen values are orthogonal.

Or

(c) What are Hermitian operators? Explain their significance.

(d) Explain the orthogonalization procedure.

3. (a) Express the angular momentum operators in spherical polar coordinates.

(b) Prove that the operators $L^2$ and $L_z$ commute and the operators $L_x$ and $L_y$ do not commute.

Or

(c) Obtain the eigen values of a rigid rotator.

(d) Show that $[L_z, L_+] = \hbar L_+$ and $[L^2, L_-] = 0$.

4. (a) Discuss the time-independent perturbation theory for degenerate system.

(b) Discuss the linear stark effect in hydrogen atom.

Or

(c) Using the variation method obtain the ground state energy of Helium atom.

(d) Discuss the WKB method.



5. (a) Describe the salient features of time dependent perturbation theory.

(b) Obtain Einstein transition probabilities using this theory.

Or

(c) Explain the interaction of an atom with electromagnetic radiation.

(d) Briefly explain sudden and adiabatic approximations in quantum mechanics.

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**(PHY10416)**

M.Sc. DEGREE EXAMINATION, DECEMBER 2016.

First Semester

Physics

Paper IV — ELECTRONICS

(Regulation 2016)

Time : Three hours Maximum : 70 marks

Answer ALL questions.

1. (a) With the help of circuit diagram explain the working of balanced output differential amplifier.

(b) Explain constant current and level translation in an Op-Amp.

Or

(c) Explain the operation of open loop configuration inverting amplifier using Op-Amp.

(d) What is negative feedback in Op-Amp? Explain the effect of feedback on closed loop gain input resistance.

2. (a) Write a note on CMRR frequency response in Op-amp.

(b) Explain how Op-amp can be used as integrator and differntiator.

Or

(c) Explain the working of phase shift oscillator and get expression for frequency stability.

(d) What is multivibrator? Explain the working of monostable multivibrators.

3. (a) Distinguish between AM and DSBSC modulation.

(b) Explain the generation of DSBSC waves.

Or

(c) Define what is meant by SSB modulation? Describe a method for the detection of SSB waves.

(d) Write a note on FDM.

4. (a) With a neat circuit diagram explain the working of multiplexer.

(b) Explain the applications of demultiplexer.

Or

(c) Draw the functional diagram of RS Flip-Flop and explain its working with truth table.

(d) Explain the working of shift register.



5. (a) Draw the functional block diagram of 8085 microprocessor and explain it.

(b) Explain the addressing modes of 8085 microprocessor.

Or

(c) Write an assembly language program to find the largest number is an array.

(d) Explain the interfacing devices of 8085.