K16P 1296

Reg. No. : .....

Name : .....

First Semester M.Sc. Degree (Reg./Suppl./Imp.) Examination, November 2016
(2014 Admission Onwards)
PHYSICS
PHY 1C01 : Mathematical Physics – 1

Time : 3 Hours Max. Marks : 60

SECTION – A

Answer **both** questions. (either **a** or **b**). **Each** question carries **12** marks.

1. a) Define orthogonal matrices. What do you meant by diagonalisation of matrices ? Diagonalize the matrix A given below :

$$A = \begin{bmatrix} 5 & -4 & 4 \\ 12 & -11 & 12 \\ 4 & -4 & 5 \end{bmatrix}.$$

OR

b) Obtain an expression for gradient in cylindrical and spherical coordinate system.

2. a) Define tensor in four-dimensional space. What do you meant by Rank of a tensor. Determine the metric tensor in :

i) Spherical polar co-ordinates

ii) Cylindrical co-ordinates.

OR

b) i) Derive the orthogonality condition for Legendre polynomials.

ii) Show that for integral 'n' $J_n(x) = (-1)^n \; J_{-n}(x)$. **(2×12=24)**

P.T.O.

SECTION – B

Answer **any four** (**1** mark for Part – **a)**; **3** marks for Part – **b)**; **5** marks for Part – **c)**).

3. a) What is Hermitian matrix ?

   b) Show that eigen matrices of a Hermitian matrix for distinct eigen values are orthogonal.

   c) Derive the property of a Hermitian matrix regarding its eigen values.

4. a) Define an analytic function.

   b) Show that the covariant derivative of the metric tensor is zero.

   c) Prove that an arbitrary covariant or contravariant tensor of the second rank can be written as the sum of a symmetric and a skew-symmetric tensor.

5. a) Define Wronskian function.

   b) Illustrate Frobenius method for the series solution of ordinary differential equation.

   c) Solve $y' = zxy$ by the Frobenius method.

6. a) What is Laurent series expansion ?

   b) Obtain the Laurent series expansion of $f(z) = \dfrac{1}{z^2 - 3z + 2}$ in the region $1 < |z| < 2$.

   c) What is residue ? Explain how it act as a powerful method of evaluating integrals around closed contours ?

7. a) What is Beta function ? Give its importance in physics.

   b) Express the integrals $I = \int_0^\infty \dfrac{x^3}{(1+x)^5}\,dx$ in terms of Beta function and then find its value.

   c) Show that $\Gamma\left(\frac{1}{4}\right)\Gamma\left(\frac{3}{4}\right) = \sqrt{2}\,\pi$.

8. a) Define spherical Bessel function.

   b) State and prove Bessel's Inequality.

   c) Explain the regular and irregular singularities of Bessel's equation. **(4×9=36)**

K16P 1297

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First Semester M.Sc. Degree (Reg./Suppl./Imp.)
Examination, November 2016
PHYSICS
(2014 Admission Onwards)
PHY 1CO2 : Classical Mechanics

Time : 3 Hours Max. Marks : 60

SECTION – A

Answer **both** questions (either **a** or **b**). **Each** question carries **12** marks.

1. a) Distinguish between differential and total cross section. Obtain the differential cross section for the scattering of two rigid spheres of the same size. Explain why the variation with angle is independent of the radius.

OR

b) What is meant by a rigid body ? Is it possible to have a perfectly rigid body ? Justify your answer. Derive the Euler's equation of motion. Explain the significance of the solutions of Euler's equation.

2. a) Distinguish between Lagrangian, Hamiltonian and Newtonian formulations. Explain the advantages and disadvantages of each. Derive the Hamilton's equation of motion.

OR

b) Explain the terms :

i) Orthogonal transformation

ii) Canonical transformation

iii) Inverse transformation

iv) Identity transformation.

Show that the transformations $Q = \log(1/q \sin p)$, $p = q \cos P$ and $Q = p \tan q$, $p = \log(\sin P)$ are canonical. (2x12=24)

P.T.O.

SECTION – B

Answer **any four** questions. (**1** mark for Part **a**, **3** marks for Part **b** and **5** marks for Part **c**)

3. a) What are constraints ?
   b) Explain the meaning of holonomic and non holonomic constraints with examples.
   c) State and obtain the mathematical form of D'Alembert's principle.

4. a) What is phase space ?
   b) Illustrate the concept of phase space.
   c) Prove that the shortest distance between two points in a plane is a straight line.

5. a) What is the significance of Hamilton Jacobi theory ?
   b) Obtain the Hamilton Jacobi equations.
   c) Discuss the problem of one dimensional harmonic oscillator by the Hamilton Jacobi method.

6. a) Write down the Hamiltonian for a conservative system.
   b) Obtain Hamiltonian for a sphere pendulum.
   c) Hence derive the Hamilton's equations.

7. a) What is torque free motion ?
   b) Distinguish between body cone and space cone.
   c) Obtain the Lagrangian equation for the torque free motion of a symmetric rigid body and calculate the motion of the axis of symmetry.

8. a) What is degenerary ?
   b) Explain using an example.
   c) Investigate the small oscillations of a CO_2 like molecule.

(4x9=36)

K16P 1298

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Name : .....

First Semester M.Sc. Degree (Reg./Suppl./Imp.) Examination, November 2016
(2014 Admission Onwards)
PHYSICS
PHY1C03 : Electrodynamics

Time : 3 Hours

Max. Marks : 60

SECTION – A

Answer both questions (either **a** or **b**). **Each** question carries **12** marks.

1. a) Explain the concept of the method of images. Apply the image theory to determine the total induced charge in the case of a point charge placed above a grounded conducting plane.

OR

b) Explain the concept of radiation reaction. Derive the Abraham-Lorentz formula.

2. a) Starting from Maxwell's equations prove Coulomb's law and continuity equation.

Using Maxwell's equations, obtain the relation $\frac{1}{c}\frac{\partial}{\partial t}\left(\frac{E^2+B^2}{2}\right)+\bar{\nabla}.\left(\bar{E}\times\bar{B}\right)=0$.

OR

b) Explain the basic concept of Lorentz transformation. Deduce expressions for the Lorentz transformation of coordinates. What is meant by light cone ?

(2×12=24)

SECTION – B

Answer **any four** questions. **1** mark for Part **a**, **3** marks for Part **b**, **5** marks for Part **c**.

3. a) State Biot and Savart law.

b) Obtain Biot and Savart law mathematically.

c) Discuss any one application of the Biot and Savart law.

P.T.O.

4. a) What is Poynting's theorem ?
   b) Derive Poynting's vector.
   c) Show how Poynting's theorem can be interpreted for the microscopic fields $(\bar{E}, \bar{B})$ as a statement of conservation of energy of the combined system of particles and fields.

5. a) What is meant by boundary-value problems ?
   b) Obtain Fresnel coefficients for normal incidence reflections.
   c) Prove that all the incident energy is either reflected or transmitted at the boundary of two non conducting media.

6. a) What is a retarded potential ?
   b) Explain the significance of Lienard Wiechert potentials.
   c) Obtain the scalar Lienard-Wiechert potential.

7. a) Explain what is meant by invariance of electric charge.
   b) Discuss the covariant formulation of Maxwell's equations.
   c) Obtain the electromagnetic field tensor.

8. a) What is a wave guide ?
   b) Explain the difference between TE and TM modes.
   c) A rectangular hollow metal wave guide is designed to propagate a 9375 MHz signal in the TE_{10} mode. Calculate the breadth of wave guide 'a' if the guide wavelength is equal to the cutoff wavelength. Calculate the cutoff frequency of the next higher order mode if b = a/2.

(4×9=36

K16P 1299

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First Semester M.Sc. Degree (Reg./Suppl./Imp.) Examination, November 2016
(2014 Admission Onwards)
PHYSICS
PHY1C04 : Electronics

Time : 3 Hours | Max. Marks : 60

SECTION – A

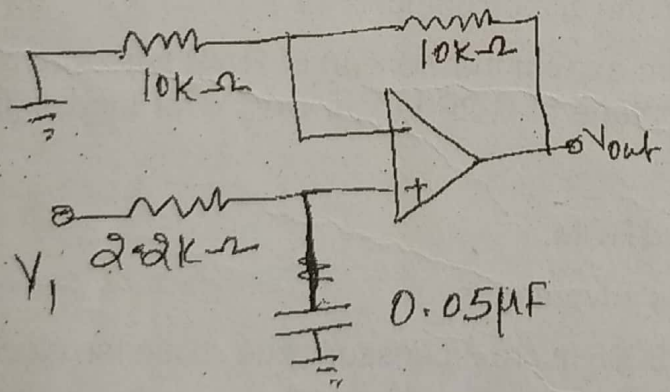
Answer **both** questions (Either **a)** or **b)**). **Each** question carries **12** marks.

1. a) Draw the basic differential amplifier circuit using transistors and explain. Derive expressions for the AC voltage gain in the single ended and double ended configuration.

OR

b) Distinguish between combinational sequential logic circuits. Draw the circuit diagram of a master slave JK flip flop and explain its working using a truth table. How is it different from edge triggering ?

2. a) What are active filters ? How are various types of filters classified ? Explain the working of a first order low pass Butter worth filter. Give the frequency response. Calculate the cutoff frequency of a first order low pass filter, given below.



OR

b) What are the advantages and disadvantages of ripple counters ? Explain the construction and working of amod-8 ripple counter. What is problem of lock out ? How is it eliminated. **(2×12=24)**

P.T.O.

SECTION – B

Answer **any four** questions. **1** mark for Part **a)**, **3** marks for Part **b)**, **5** marks for Part **c)** :

3. a) What is slew rate of an O pamp ?
   b) Obtain the slew rate equation.
   c) Explain the causes and significance of slew rate in applications. How does slew rate differ from transient response ?

4. a) What are waveform generators ?
   b) Explain the construction and working of a triangular wave generator.
   c) Derive the expression for the frequency of oscillation.

5. a) What is a flip flop ? Give its applications.
   b) Distinguish between synchronous and asynchronous latches.
   c) Convert a J-K flip flop into a D- flip flop.

6. a) Explain Universal shift register.
   b) Distinguish between static and dynamic shift registers.
   c) Explain with diagram the working of serial- IN, serial- out shift register. Give the applications of shift registers.

7. a) What is DIA conversion ?
   b) The logic levels used in an 8- bit R-2R ladder DAC are O=OV and 1 = 5V. What is the binary input when the analog output is 4V ?
   c) With the help of neat diagram explain the working of R-2R ladder network type DAC. What is the advantage of R-2R ladder DAC over the weighted resistor type DAC ?

8. a) Distinguish between RAM and ROM.
   b) What is an EPROM ? Give its advantages.
   c) Draw the functional block of 8085 micro processor and explain the blocks.

(4×9=36)
