K17P 1528

Reg. No. : .....

Name : .....

First Semester M.Sc. Degree (Reg./Suppl./Imp.) Examination, October 2017
(2014 Admission Onwards)
PHYSICS
PHY 1C01 : Mathematical Physics – I

Time : 3 Hours Max. Marks : 60

SECTION – A

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

1. a) Define orthogonal matrix. Give an example. If A is orthogonal, show that its determinant = ± 1.

OR

b) What do you mean by a normal matrix ? Prove that eigen vectors corresponding to different eigen values of a normal matrix are orthonormal. What about the converse of this result ?

2. a) What do you mean by an analytic function ? State and prove the necessary and sufficient condition for a complex function to be analytic.

OR

b) State and prove orthogonality condition of Legendre's functions. **(2×12=24)**

SECTION – B

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

3. a) Define divergence of a vector field.

b) Explain integration by parts of curl.

c) Obtain the Laplacian operator in spherical polar coordinates.

P.T.O.

4. a) Define a tensor of rank two.
   b) Explain three dimensional Levi-Civita symbol of tensors.
   c) Find the eigen values and eigen vector corresponding to the largest eigen value of $\begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$.

5. a) Give an example for a linear first order ordinary differential equation.
   b) What do you mean by singular points of a second order homogeneous differential equation ? What are the different kinds of singular points ?
   c) Obtain the indicial equation of $y'' + \omega^2 y = 0$.

6. a) State Liouville's theorem.
   b) Evaluate $\int_C \frac{dz}{z^2 - 1}$ where C is the circle $|z| = 2$.
   c) Expand $f(z) = \frac{1}{z}$ at the point $z = i$.

7. a) Define gamma function.
   b) Explain double factorial notation.
   c) Prove that $\beta(m, n) = \frac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}$.

8. a) What is the generating function of the Hermite polynomials ?
   b) Define spherical Bessel function. Write the expressions for $j_1(x)$ and $j_2(x)$.
   c) Write down the Laguerre ordinary differential equation. Derive Rodrigues' formula for Laguerre polynomials. **(4×9=36)**

K17P 1529

Reg. No. : .....

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First Semester M.Sc. Degree (Reg./Suppl./Imp.) Examination, October 2017
(2014 Admission Onwards)
PHYSICS
PHY 1C02 : Classical Mechanics

Time : 3 Hours

Max. Marks : 60

SECTION – A

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

1. a) What is Hamiltons principle ? Derive Lagranges equation from Hamiltons principle.

OR

b) Discuss the force free motion of a symmetric top.

2. a) What are the essential features of Hamilton Jacobi method ? Use Hamilton Jacobi theory to obtain Keplers laws of planetary motion.

OR

b) Deduce the eigen value equation for small oscillations. How will you obtain eigen values and Eigen vectors from this equation ? **(2×12=24)**

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 coupled oscillators ?

b) What do you mean by orthogonality of eigen vectors ?

c) Write a note on normal coordinates.

4. a) What are constraints ?

b) Differentiate between holonomic and non holonomic constraints.

c) Explain the advantages of Lagrangian formulation over Newtonian approach.

P.T.O.

5. a) What are Euler's angles ?
   b) Discuss the torque free motion of a rigid body.
   c) Discuss the effect of Coriolis force on a freely falling particle.

6. a) Establish Hamilton Jacobi equation.
   b) What are action angle variables ?
   c) Show that the transformation $Q = 1/p$ is a canonical transformation.

7. a) What do you mean by phase space ?
   b) Explain the physical significance of Hamiltonian.
   c) What is the Hamiltonian for a simple pendulum ? Obtain its equation of motion.

8. a) What is differential scattering cross section ?
   b) Explain the significance of impact parameter in scattering.
   c) Determine the differential scattering cross section for the scattering of a particle by a rigid elastic sphere. (4×9=36)

K17P 1530

Reg. No. : .....

Name : .....

First Semester M.Sc. Degree (Reg./Suppl./Imp.) Examination, October 2017
(2014 Admission Onwards)
PHYSICS
PHY 1C03 : Electrodynamics

Time : 3 Hours Max. Marks : 60

SECTION – A

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

1. a) Write the Laplace's and Poisson's equation. Derive the equation for the potential of a uniform sphere of charge.

OR

b) Starting from Maxwell's equations obtain the continuity equation. Derive the relation $\frac{1}{c}\frac{\partial}{\partial t}\left(\frac{E^2+B^2}{2}\right)+\bar{\nabla}.\left(\bar{E}\times\bar{B}\right)=0$.

2. a) Define and derive the Lienard – Wiechert potentials for a point charge in arbitrary motion.

OR

b) Explain the basic concepts of Lorentz transformations as an orthogonal transformation. Deduce expressions for Lorentz transformation of coordinates.

(2×12=24)

SECTION – B

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

3. a) State BIOT – SAVART law.
   b) Obtain Ampere's circuital law.
   c) Explain one application of Ampere's circuital law.

P.T.O.

4. a) State Poynting's theorem.
   b) Obtain Poynting's vector.
   c) Prove how the Poynting's theorem can be interpreted as a statement of conservation of energy for the microscopic fields $(\bar{E},\bar{B})$.

5. a) State Snell's law.
   b) Explain Brewster's angle and critical angle.
   c) Obtain an equation for the Brewster angle.

6. a) What is a wave guide ?
   b) In what respects does a wave guide differ from a transmission line ?
   c) Briefly explain the principle and working of a cavity resonator.

7. a) What is electric dipole radiation ?
   b) What are the characteristics of dipole radiation ?
   c) Briefly give the theory of electric dipole radiation.

8. a) Where is Larmor formula used ?
   b) Give the concept of Larmor formula of radiation.
   c) Obtain the Larmor formula. (4×9=36)

K17P 1531

Reg. No. : .....

Name : .....

First Semester M.Sc. Degree (Reg./Suppl./Imp.)
Examination, October 2017
(2014 Admission Onwards)
PHYSICS
PHY 1C04 – Electronics

Time : 3 Hours Max. Marks : 60

SECTION – A

Answer **both** questions (either **a** or **b**).

1. a) Describe with necessary circuit diagram the dc offset parameters and frequency parameters of an op-amp.

OR

b) Explain in detail the operating characteristics of flip flops with neat figures.

2. a) Explain with necessary circuit diagrams and waveforms the working of
   i) Schmitt Trigger.
   ii) Voltage limiter with positive output voltage limiting.

OR

b) Explain the working of counter type A/D converter with necessary logic diagram and output waveform. What is its resolution ? What are its advantages and disadvantages ?

(2×12=24)

SECTION – B

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

3. a) Draw the equivalent circuit of an op-amp.

b) What are the characteristics of an ideal op-amp ?

c) In an open loop differential amplifier using op-amp 741 with $A = 2\times10^5$ and supply voltage = $\pm$ 15 V, calculate V_o for $V_{in1} = 5\ \mu V$ dc and $V_{in2} = -7\ \mu V$ dc.

P.T.O.

4. a) What is an integrator ?

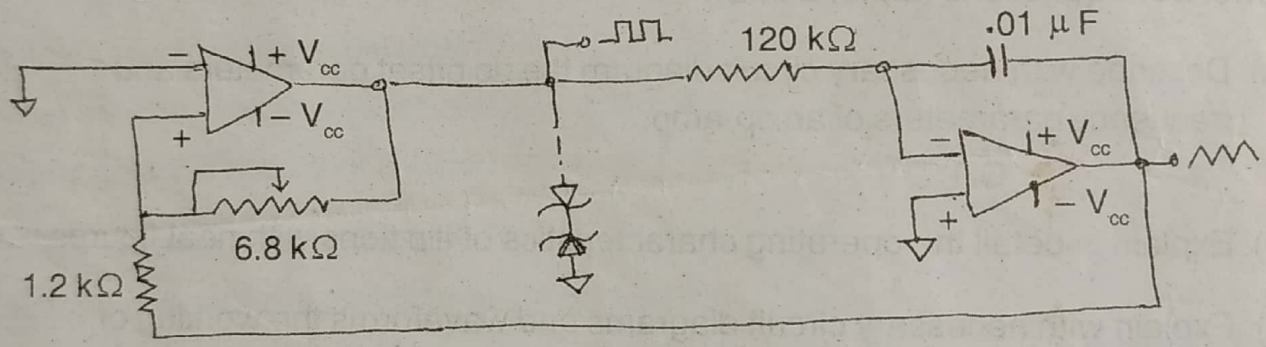
   b) Draw the circuit diagram of a differentiator using op-amp and obtain the expression for output voltage.

   c) In an inverting scaling amplifier, the input voltages given to the three input resistors $R_a = 1k\Omega$, $R_b = 2\ k\Omega$ and $R_c = 3\ k\Omega$ are $V_a = 1$ V, $V_b = 4$ V and $V_c = 6$ V respectively. If the feedback resistor $R_F = 1\ k\Omega$, calculate the output voltage.

5. a) What are the advantages of active filters over passive filters ?

   b) Draw the circuit diagram of a first order low pass Butterworth filter and explain its design parameters.

   c) Determine the peak to peak output amplitude and frequency of the given triangular wave generator using an op-amp with $V_{sat} = 14$ V.



6. a) What are the applications of multiplexers ?

   b) Can a demultiplexer be used as a logic element ? If yes, what are its advantages over realization using gates ?

   c) Implement $F = \sum m\ (0, 1, 2, 3, 4, 10, 11, 14, 15)$ using 8 : 1 MUX.

7. a) Why are asynchronous counters also called ripple counters ?

   b) Compare asynchronous and synchronous counters.

   c) A binary ripple counter is required to count up to 16, 383_{10}. How many flip flops are required ? If the clock frequency is 8.192 MHz, what is the frequency at the output of the MSB ?

8. a) What is a program counter in 8085 microprocessor ?

   b) Explain S, Z and AC flags in 8085 microprocessor.

   c) Draw a neat functional block diagram of 8085 microprocessor and mark the various parts.

(4×9=36)