K18P 1374

Reg. No. : .....

Name : .....

First Semester M.Sc. Degree (Reg./Supple./Imp.) Examination, October 2018

(2014 Admn. 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. **(2×12=24)**

1. a) Find the spectral decomposition of the matrix $A = \begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$.

OR

b) Obtain the series solution to the Bessel's equation

$x^2 y'' + xy' + (x^2 - n^2)y = 0$

2. a) State and prove Cauchy's residue theorem for complex functions. Using residue theorem, evaluate $\int_{|z|=2} \frac{z}{z^2+1} dz$.

OR

b) Write Laguerre ordinary differential equation and Laguerre polynomial $L_n(x)$. Obtain Rodrigues' formula for Laguerre polynomials. Deduce first three Laguerre polynomials.

P.T.O.

SECTION – B

Answer **any four** (**1** mark for part **'a'**, **3** marks for part **'b'**. **5** marks for part **'c'**) **(4×9=36)**

3. a) Define curl of a vector field.
   b) Express the spherical polar unit vectors in Cartesian unit vectors.
   c) For a fluid flowing through a cylindrical pipe in the z-direction, the velocity fluid is given by $\vec{v} = \hat{z}\, v(p)$. Show that the nonlinear term in Navier-Stoke's equation in hydrodynamics vanishes.

4. a) Define contravarient tensor.
   b) Obtain the Christoffel symbol of the first kind $|i, j, k| = g_{mk}\, \Gamma^{m}_{ij}$ as derivartive of the metric tensor.
   c) Prove that every square matrix A can be expressed as sum of two matrices of the form A = B + iC where B and C are Hermitian matrices.

5. a) Check whether the differential equation $(x^2 - 2xy + y^2)\, dx + (x^2y - x^3 + y^2)\, dy$ is exact or not.
   b) Discuss the singular points of the Legendre's equation.
   c) Obtain the indicial equation of $y'' - 2xy' + 2\alpha y = 0$.

6. a) Check whether $f(z) = e^z$ is analytic or not.
   b) What are different types of singularities of a complex functions ? Give examples in each case.
   c) State and prove Liouville's theorem for an analytic function.

7. a) What is the relation between beta and gamma functions ?
   b) Find the value of $\int_0^\infty e^{-x^4}\, dx$ in terms of gamma function.
   c) Define double factorial notation. Express the coefficient of nth term of the expansion of $(1 + x)^{1/2}$ in terms of the double factorial notation.

8. a) Write the first three-Legendre polynomials.
   b) Prove that $H_{2n}(0) = (-1)n\, \frac{(2n)!}{n!}$.
   c) Define spherical Bessel function. Obtain the expressions for $j_1(x)$ and $j_2(x)$.

K18P 1375

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(2014 Admn. Onwards)
PHYSICS
PHY 1C02 : Classical Mechanics

Time : 3 Hours Max. Marks : 60

SECTION – A

Answer **both** questions. (Either **(a)** or **(b)**) :

1. a) Derive Euler-Lagrange equations of motion using the calculus of variation and hence obtain Lagranges equation of motion for a system of particles.

   OR

   b) Enumerate the normal modes of a linear triatomic molecule.

2. a) Write down the Hamilton-Jacobi equation for Hamiltons principal function. Give its complete solution and apply it to the problem of one dimensional harmonic oscillator.

   OR

   b) Discuss the force free motion of a symmetrical top and hence obtain an equation for its period. **(2×12=24)**

SECTION – B

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

3. a) Differentiate between holonomic and non holonomic constraints.

   b) Explain the principle of least action.

   c) A particle of mass m is projected with an initial velocity u at an angle α with horizontal. Use Lagranges equation to describe the motion of the projectile.

P.T.O.

4. a) What do you mean by Legendre transformation ?
   b) Write a note on action angle variables.
   c) Show that the transformation
   $P = 2(1 + q1/2 \cos p)\, q1/2 \quad Q = \log(1 + q1/2 \cos p)$ is canonical.

5. a) List out any two properties of Poisson bracket.
   b) Write a note on Hamiltons characteristic function.
   c) Using Hamilton Jacobi method, determine the motion of a body falling vertically in a uniform gravitational field.

6. a) Define Euler angles.
   b) Write a note on coriolis force.
   c) Derive an expression for the angular velocity of a rigid body in terms of Euler angles.

7. a) Write down the Lagranges equation of motion for small oscillations.
   b) Write a note on small oscillations.
   c) Find out the period of oscillation of a compound pendulum using Hamiltons method.

8. a) Define Hamiltonian function.
   b) When does the Hamiltonian function represents total energy of a system ?
   c) Find out the period of oscillation of a compound pendulum using Hamiltons method. **(4×9=36)**

K18P 1376

Reg. No. : .....

Name : .....

First Semester M.Sc. Degree (Reg./Suppl./Imp.) Examination, October 2018
(2014 Admn. Onwards)
PHYSICS
PHY 1C03 : Electrodynamics

Time : 3 Hours Max. Marks : 60

SECTION – A

Answer **both** questions. (Either **(a)** or **(b)**) : **(2×12=24)**

1. a) Discuss the propagation of plane monochromatic waves in conducting media. Derive the dispersion equation and thus obtain (a) phase velocity (b) refractive index and (c) skin depth.

OR

b) Give an account of Lienard and Wiechert potentials and find an expression for the field of a charge in uniform motion.

2. a) What are wave guides ? Compare their working with transmission lines. Starting from Maxwell's equations derive expressions for fields above cut off for a rectangular wave guides in TE modes.

OR

b) Define Lorentz force and find relativistic transformation of force component by expressing the law in the tensor form.

SECTION – B

Answer **any four**. (**One** mark for Part **a**, **3** marks for Part **b**, **5** marks for Part **c**). **(4×9=36)**

3. a) Define Gauss law.

b) Explain Ampere's theorem.

c) Calculate the position and magnitude of the image charge for a charge +3C placed at a distance of 30 units from a grounded conducting sphere of radius 2 units.

P.T.O.

4. a) What is Poynting vector ?
   b) Show that Electromagnetic wave is a transverse wave.
   c) Calculate skin depth of silver which has a conductivity 3×107 S/m at 10 GHz and 50 Hz and compare the results.

5. a) What is Brewsters law ?
   b) Write a note on cavity resonators.
   c) A rectangular waveguide has dimensions of 2.5 cm and 5 cm. Determine guide wave length phase velocity and phase constant at a wave length of 4.5 cm for dominant mode.

6. a) Define Electric dipole radiation.
   b) Write a note on radiation reaction.
   c) Derive Abraham Lorentz equation of motion.

7. a) Define four vectors.
   b) Write a short note on electromagnetic field tensor.
   c) If an electrostatic electric field E is represented as $E = (400i + 500j)$ V/m then represent it in a frame of reference moving with a velocity $V = (4i + 3j) \times 10^7$ m/s relative to static charges..

8. a) What do you mean by gauge transformations ?
   b) Write a note on Retarded potentials.
   c) If the retarded scalar electric potential $V = x - v_0 t$ and vector magnetic potential $A = (x/v_0 - t)\, a_x$, where v_0 is the velocity of propagation. Find B, H, E and D.

K18P 1377

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Examination, October 2018
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PHYSICS
PHY 1C04 : Electronics

Time : 3 Hours Max. Marks : 60

SECTION – A

Answer both questions (either **a** or **b**). **(2×12=24)**

1. a) Explain the electrical characteristics of an ideal op amp. Describe with circuit diagram the working of V to I converter with floating load. Explain a differentiator with suitable figure and derive the expression for output frequency. Also draw the figure of practical differentiator.

OR

b) Draw the circuit diagram and explain the working of first order Butterworth high pass filter. Derive the expression for magnitude of voltage gain. Draw the frequency response. Also explain the steps involved in the design and the frequency scaling procedure of this filter.

2. a) Explain with logic symbol, logic diagram and truth table, the working of
i) NOR gate S-R latch ii) gated S-R latch

OR

b) What is an astable multivibrator ? What are its applications ? Describe with circuit diagram and waveforms the operation of an astable multivibrator
i) using 555 timer ii) using only inverters.

SECTION – B

Answer **any four** (**1** mark for part **'a'**, **3** marks for part **'b'. 5** marks for part **'c'**)
(4×9=36)

3. a) What is an op-amp ?

b) Explain with necessary figures the double ended input operation.

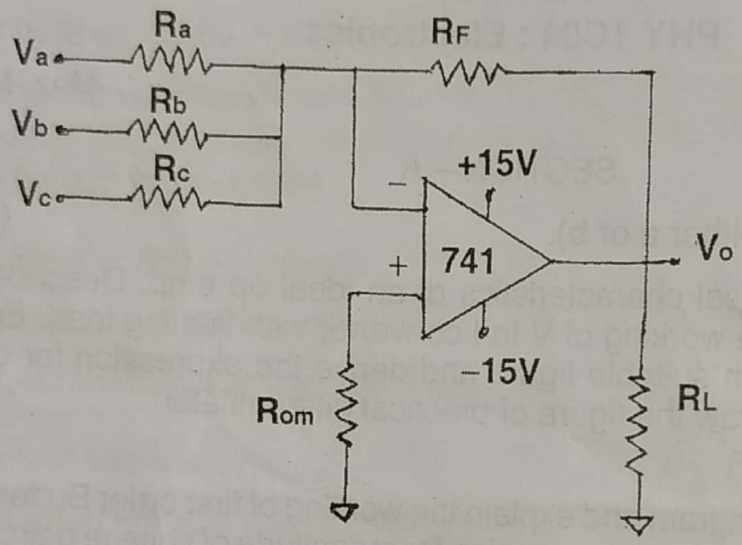
c) Determine the output voltage of an op-amp for input voltages of V_{i1} = 150 μV and V_{i2} = 140 μV. The amplifier has a differential gain of A_d = 4000 and the value of CMRR is 100.

P.T.O.

4. a) What is a compensating network in an op-amp ?

   b) Explain the difference between inverting and non inverting averaging amplifier with suitable figures.

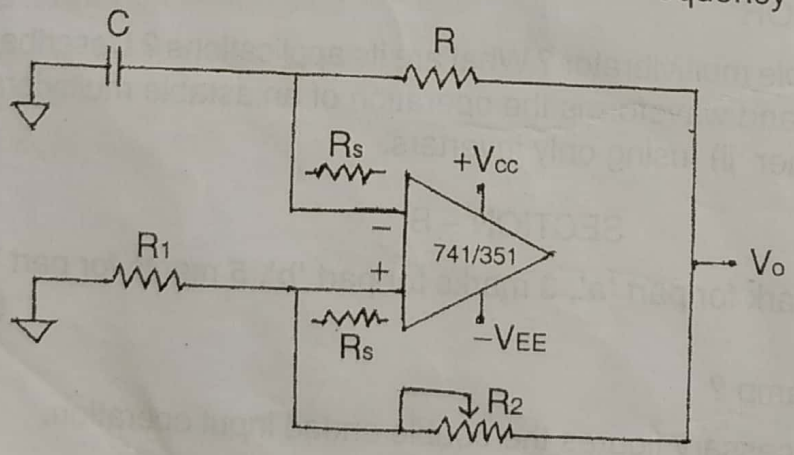
   c) In the circuit diagram shown below $V_a = +1V$, $V_b = +2V$, $V_c = +3V$, $R_a = R_b = R_c = 3k\Omega$, $R_F = 1k\Omega$, $R_{om} = 270\ \Omega$ and supply voltages. $\pm 15V$. If the op-amp is initially nulled, calculate the output voltage V_o.



5. a) How is a triangular wave generated using op-amp ?

   b) Explain the characteristics of a comparator.

   c) In the square wave generator shown below, if $R_1 = 12\ k\Omega$, $R = 13.92\ k\Omega$ $R = 100\ k\Omega$ and $C = 0.01\ \mu F$. What is the frequency of oscillation ?



6. a) What are the different types of shift registers ?

   b) What are shift registers ? What is the basic difference between a shift register and a counter ?

   c) Describe with logic diagram and timing diagram, the working of an asynchronous 2-bit down-counter using positive edge triggered J-K flip-flops.

7. a) What is race around condition associated with J-K flip-flop ?

   b) Briefly explain

      i) RAM

      ii) ROM

      iii) EEPROM

   c) An 8-bit successive approximation ADC has a resolution of 30 mV. What will be its digital output for an analog input of 2.88 V ?

8. a) What is a microprocessor ?

   b) Write a brief note on temporary register and general purpose register.

   c) Give a detailed account of the evolution of microprocessors.
