D 93613 **(Pages : 2)** Name..............................

Reg. No..............................

FIRST SEMESTER P.G. (RADIATION PHYSICS) DEGREE EXAMINATION JANUARY 2021

(CCSS)

M.Sc. Radiation Physics

RPH 1C 03—BASIC ELECTRONICS

(2019 Admissions)

Time : Three Hours Maximum : 70 Marks

Section A

Answer any **six** *questions.*
Each question carries 3 *marks.*

1. Discuss the working of OP-AMP as a voltage regulator.
2. Draw the circuit diagram of Wein bridge oscillator.
3. Explain Barkhausen Criterion.
4. Distinguish between first order and second order Butterworth filters.
5. What is the significance of figure of merit of oscillator circuit ?
6. Write a note on comparators.
7. What is a universal shift register ?
8. Distinguish between synchronous counter and asynchronous counter.
9. Describe the Schmitt trigger using an OP-AMP.

(6 × 3 = 18 marks)

Section B

Answer **all** *questions.*
Each question carries 14 *marks.*

10. a) With the help of circuit diagram and associated wave forms explain a triagular wave generator using OP-AMPs.

Or

b) Explain the working of LED and laser diode with schematic diagrams. Compare the merits and demerits.

Turn over

11. a) Discuss the working of SR and JK flip-flops.

Or

b) Describe the functions of different types of registers in microprocessor.

($2 \times 14 = 28$ marks)

Section C

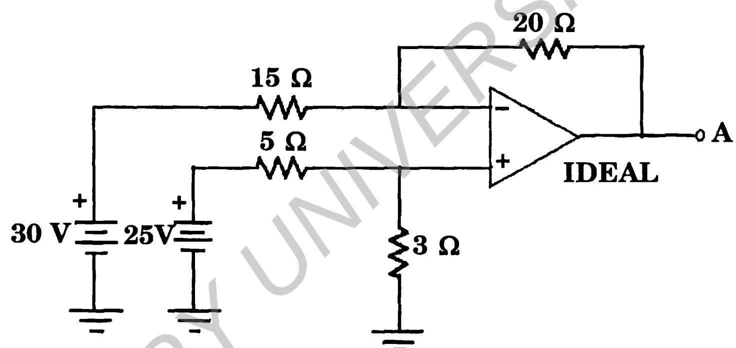
Answer any **four** *questions.*
Each question carries 6 *marks.*

12. Draw the truth table of flip-flop

13. Explain the working of Analog to Digital convertors.

14. Calculate the reflectivity of GaAs semiconductor laser $(\bar{n} = 3.6)$.

15. For the difference amplifier circuit shown, determine the output voltage at terminal A.



16. List the applications of electronic counters.

17. Differentiate microprocessor and microcontroller.

($4 \times 6 = 24$ marks)

D 93615 (Pages : 2) Name..............................

Reg. No..............................

FIRST SEMESTER P.G. DEGREE EXAMINATION, JANUARY 2021

(CCSS)

M.Sc. Radiation Physics

RPH 1C 05—BASIC OF ELECTRODYNAMICS

(2019 Admissions)

Time : Three Hours Maximum : 70 Marks

Section A

Answer any **six** *questions.*
Each question carries 3 *marks.*

1. Obtain the proof of the boundary conditions by the direct application of Maxwell's equation at the boundary between the media.
2. Discuss Coulomb gauge and Lorentz gauge. Discuss their advantages and disadvantages.
3. State Poynting's theorem and give its representation mathematically.
4. Discuss the scalar and vector potentials using Maxwell's equations.
5. Give a brief account of cavity resonators.
6. Derive the general transmission line equations.
7. What is cut-off wavelength in rectangular waveguides ? Derive the expression for cut-off wavelength for TM mode.
8. Give equation for power radiated by a moving point charge.
9. What is radiation resistance ? How is it related to radiated power and radiation efficiency ?

($6 \times 3 = 18$ marks)

Section B

Answer **all** *questions.*
Each question carries 14 *marks.*

10. (a) Derive the expression for electric and magnetic fields of a point charge in arbitrary motion. Explain the significance of various terms in the equations.

Or

(b) Express the Maxwell's equations for time varying fields in differential and integral forms in free space.

Turn over

11. (a) Discuss with necessary theory, the propagation of electromagnetic wave along a parallel plate transmission line and obtain expression for characteristic impedance and propagation velocity.

Or

(b) Express the total electromagnetic force on charge in a volume by using the Maxwell's stress tensor.

(2 × 14 = 28 marks)

Section C

Answer any **four** *questions.*
Each question carries 6 *marks.*

12. Derive the Jefimenko's equations from retarded potential equations. Discuss the advantages of those equations.

13. Find the charge and current distributions that would give rise to the potentials

$$V = 0,\ A = \begin{cases} \frac{\mu_0 k}{4c}(ct - |x|)^2 \hat{Z} & \text{for } |x| < ct \\ 0 & \text{for } |x| > ct \end{cases}$$

Where k is a constant and $c = \frac{1}{\sqrt{\epsilon_0 \mu_0}}$.

14. An open wire transmission line has the following parameters : R = 37 Ω/km; L = 0.6 mH/km; G = 1 μS/km and C = 0.04μF/km. Calculate the characteristic impedance, attenuation constant in Np/km and the phase constant in deg/km., at a frequency of 1 kHz.

15. A rectangular wave guide has dimensions 3 cm. × 5 cm. and has a 10 GHz signal propagated in it. Determine the guide wavelength, cut-off wavelength and the characteristic impedance for TE_{10} mode.

16. Prove that a plane electromagnetic wave propagates with the velocity of light.

17. Derive Abraham Lorentz formula for radiation reaction force.

(4 × 6 = 24 marks)

D 93614 (Pages : 2) Name.............................

Reg. No...............................

FIRST SEMESTER P.G. DEGREE EXAMINATION, JANUARY 2021

(CCSS)

M.Sc. Radiation Physics

RPH 1C 04—INTRODUCTORY NUCLEAR PHYSICS

(2019 Admissions)

Time : Three Hours Maximum : 70 Marks

Section A

Answer any **six** *questions.*
Each question carries 3 *marks.*

1. Write the important properties of liquid drop model of nuclei.
2. Correlate binding energy per nucleon and fission reaction.
3. Write four factor formula and explain the terms.
4. Explain Fermi-Kurie plot.
5. What you mean by criticality for nuclear reactor geometrics ?
6. What is resonance ? What information do we get about the compound nucleus from it ?
7. What are the main features of nuclear forces ?
8. Deuteron has no excited S state. Why ?
9. Explain lethargy. What is its importance ?

(6 × 3 = 18 marks)

Section B

Answer **all** *questions.*
Each question carries 14 *marks.*

10. (a) Explain the partial wave analysis of lower energy Newton-Proton scattering and obtain the scattering cross-section.

Or

(b) Explain the nuclear fusion reaction undergoing at the interior of the sun. Describe briefly about any two fusion reactors.

11. (a) Explain the collective model of the nucleus. What are magic numbers ? Explain its significance.

Or

(b) Explain the basic theory of β decay. Also explain the violation of parity conservation in β decay.

(2 × 14 = 28 marks)

Section C

Answer any **four** *questions.*
Each question carries 6 *marks.*

12. Calculate the Binding energy and binding energy per nucleon for the nucleus ${}^{64}_{28}Ni$.

13. Using the liquid drop model find the expression for the most stable isobar for given odd A. Find the stable atom with A = 77. Given a_3 = 0.58 MeV and a_4 = 19.3 MeV.

14. Calculate the Q-value of the nuclear reaction ${}^{3}_{1}H + {}^{2}_{1}H \rightarrow {}^{4}_{2}He + {}^{1}_{0}n$. What is the nature of the reaction ? M[^{3}H] = 3.0169982 M[^{2}H] = 2.0147361 M[^{4}He] = 4.0038727 M[n] = 1.0089932 a.m.u.

15. Explain stripping and pick up reactions.

16. A sample contain 4.00 Mg of RaE. If the half-life is 5.0 days and the average energy of the β particles emitted is 0.34 MeV, at what rate in watts does the sample emit energy ?

17. A cubical nuclear reactor has neutron multiplication factor 2.8 and diffusion length 30 cm. Calculate the Buckling factor and hence the critical volume of the core.

(4 × 6 = 24 marks)

D 93612 (Pages : 2) Name.............................

Reg. No.............................

FIRST SEMESTER P.G. DEGREE EXAMINATION, JANUARY 2021

(CCSS)

M.Sc. Radiation Physics

RPH 1C 02—CLASSICAL MECHANICS

(2019 Admissions)

Time : Three Hours Maximum : 70 Marks

Section A

Answer any **six** *questions.*
Each question carries 3 *marks.*

1. State and explain the D'Alemberts principle.
2. What are constraints ? Give two examples.
3. Obtain the Lagrangian function for an Atwood's machine.
4. How the values of eccentricity determine the shape of the orbit in a central force problem ?
5. Find out whether the transformation $P = q$ and $Q = -p$ is canonical or not.
6. Show that the generalized momentum corresponding to a cyclic co-ordinate is conserved.
7. What are action-angle variables ? Mention its advantage.
8. Obtain the physical significance of Hamilton's characteristic function.
9. Prove that the Poisson bracket of two integrals of motion is itself an integral of motion.

($6 \times 3 = 18$ marks)

Section B

Answer **all** *questions.*
Each question carries 14 *marks.*

10. (a) State Hamilton's principle. Derive Lagrange's equation from Hamilton's principle.

Or

(b) Discuss the Kepler problem as a motion under inverse square force. Obtain the expression for orbit of motion under inverse square force law.

11. (a) What are action-angle variables ? Deduce the Kepler problem using Hamilton Jacobi formulation using action angle variables.

Or

(b) Derive the Hamilton Jacobi equation. Solve the one-dimensional harmonic oscillator problem by Hamilton Jacobi method.

($2 \times 14 = 28$ marks)

Turn over

Section C

Answer any **four** *questions.*
Each question carries 6 *marks.*

12. Use Lagrange's equations to obtain the equation of motion of a compound pendulum. Also find the period of oscillation of the pendulum.

13. Explain how a two body central force problem can be effectively reduced to a one body problem by the concept of reduced mass.

14. Obtain the Hamiltonian function of the system having a Lagrangian $L = \frac{1}{2} m_1 \dot{q}_1^2 + \frac{1}{2} m_2 \dot{q}_2^2 - K q_1^2$. Also determine the conserved quantity of the system using this Lagrangian.

15. Show that the transformation $Q = \log\left(\frac{\sin p}{q}\right)$ and $P = q \cot p$ is canonical.

16. Find the Poisson's bracket of $\left[\vec{L}_x, \vec{L}_y\right]$ and $\left[\vec{L}_x, \vec{L}_z\right]$ where $\vec{L}_x, \vec{L}_y$ and $\vec{L}_z$ are angular momentum components.

17. Show that if a co-ordinate corresponding to a rotation is cyclic, the system remains invariant under such a co-ordinate and angular momentum is conserved.

(4 × 6 = 24 marks)

D 93611 **(Pages : 2)** Name.............................

Reg. No..............................

FIRST SEMESTER P.G. DEGREE EXAMINATION, JANUARY 2021

(CCSS)

M.Sc. Radiation Physics

RPH 1C 01—MATHEMATICAL METHODS IN PHYSICS

(2019 Admissions)

Time : Three Hours Maximum : 70 Marks

Section A

Answer any **six** *questions.*
Each question carries 3 *marks.*

1. Obtain the expression for the Curl operator in terms of Spherical Polar Co-ordinates.
2. Show that every square matrix can be expressed uniquely as the sum of a Hermitian and a skew Hermitian matrix.
3. Show that the expression $A(i, j, k)$ is a tensor if its inner product with an arbitrary tensor B^{jk} is a tensor.
4. If A is a unitary matrix shows that A^{-1} is also unitary ?
5. Explain Hermitian operator with its properties.
6. Show that $\beta(l,m) = \beta(m,l)$.
7. Evaluate $J_{-1/2}(x) = \sqrt{\frac{2}{\pi x}} \cos x$.
8. Write the expression of Laguerre polynomial and hence obtain the value of $L_2(x)$.
9. By using convolution theorem find Laplace transform of $\int_0^t e^x \sin(t-x)\, dx$.

(6 × 3 = 18 marks)

Section B

Answer **all** *questions.*
Each question carries 14 *marks.*

10. (a) Find the general solution for Bessel's equation $x^2 \frac{d^2y}{dx^2} + x\frac{dy}{dx} + \left(x^2 - n^2\right) y = 0$ and hence prove $\sqrt{\left(\frac{1}{2}\pi x\right)}\, J_{3/2}(x) = \frac{\sin x}{x} - \cos x$.

Or

(b) Solve the three-dimensional Laplace equation in cylindrical co-ordinate using variable separable method.

11. (a) Deduce the expression for the Gradient, Divergent and Curl operators in cylindrical co-ordinates.

Or

(b) (i) Obtain the Fourier series of a triangular wave and show that the differential of a triangular wave gives a square wave.

(ii) Obtain the Parseval's identity of Fourier series.

($2 \times 14 = 28$ marks)

Section C

Answer any **four** *questions.*
Each question carries 6 *marks.*

12. The matrix A is defined as $A = \begin{bmatrix} 1 & 2 & -3 \\ 0 & 3 & 2 \\ 0 & 0 & -2 \end{bmatrix}$. Find the eigen values of $3A^3 + 5A^2 - 6A + 2I$.

13. Prove that $\nabla^2 \left(\frac{1}{r}\right) = 0$ where $r^2 = x^2 + y^2 + z^2$.

14. Obtain the relation between Beta and Gamma function as $\beta(l, m) = \frac{\Gamma l \, \Gamma m}{\Gamma (l+m)}$.

15. Find the Laplace transform $f(t)$ defined as $f(t) = \begin{Bmatrix} t^2, & \text{when } 0 < t < 2 \\ t-1, & \text{when } 2 < t < 3 \\ 7 & \text{when } t > 3 \end{Bmatrix}$.

16. Show that $\int_{-1}^{1} \left(1 - x^2\right) P_m' P_n' \, dx = \begin{Bmatrix} 0 & \text{when } m \neq n \\ \frac{2n(n+1)}{2n+1} & \text{when } m = n \end{Bmatrix}$ where dashes denotes differentiation w.r.t. "x".

17. Solve the following equation $\frac{\partial^2 z}{\partial x^2} - 2\frac{\partial z}{\partial x} + \frac{\partial z}{\partial y} = 0$ by the method of separation of variables.

($4 \times 6 = 24$ marks)