First Semester M.Sc., Degree Examinations

May / June 2022

(CBSC)

PHYSICS

Paper PHYH – 1.4 : ELECTRONICS

Time: 3 hrs] [Max.Marks: 75

Note : 1. Answer all the questions.
2. All questions carry equal marks.

1. a) Explain the working of an Op-amp in open loop and closed loop configurations.
   b) Explain the working of an op-amp as an integrator with a circuit diagram. Draw the integrator output waveform for any chosen input waveform. (7+8)

OR

2. a) Explain with a circuit diagram, the functioning of op amp triangular wave generator.
   b) What is a comparator? Explain its operation when a known dc voltage is connected to the non-inverting terminal. Draw the relevant wave forms. (7+8)
3. a) Derive an expression for the transfer function for an op amp based first order low pass filter. Hence discuss the frequency response and the phase response behaviour for the same.
   b) List out the distinguishing features of narrow and wide band filters. (11+4)

OR

4. a) Describe with an appropriate circuit, the functioning of op amp based second order high pass filter.
   b) Describe the design considerations for a filter of the above type for a cut-off frequency of 4 kHz.
5. a) Simplify the following Boolean expressions. (8+7)
   i) $A.B.C + \bar{A} + A.\bar{B}.C$
   ii) $\bar{A}.\bar{B}.\bar{C} + \bar{A}.\bar{B}.C + \bar{A}.\bar{C}$
   b) How is the basic logic gates realised in terms of the universal NAND gate: Describe with relevant diagrams.

OR

(6+9)

Contd...2

6. a) Explain the functioning of RS and JK Flip flop. Explain their differences.
   b) How is a Boolean expression simplified using the K-map? Illustrate using a three input example. (8+7)

7. a) With the help of a block schematic, explain the functioning of a synchronous counter.
   b) Draw the relevant timing diagram. (9+6)

OR

8. a) What is ROM? Explain different types of ROM.
   b) Explain how address decoding happens in memory devices. (8+7)

9. a) Explain the functioning of an R-2R Analog to Digital converter.
   b) For a R-2R A/D converter working on a 8V dc. find the output when the input is
      i) 0 0 1 ii) 1 0 0 iii) 1 1 1 (9+6)

OR

10. Describe the working of a 3-bit Successive approximation ADC. Explain its uses and advantages. (15)

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First Semester M.Sc., Degree Examinations

May / June 2022

(CBSC New Scheme)

PHYSICS

PHYH 1.2 : Classical Mechanics

Time: 3 hrs] [Max.Marks: 75

Note : 1. Answer all questions.
2. All questions carries equal marks.

1. a) Explain the classification of constraints with suitable examples.
   b) Derive the Lagrange's equation of motion using the D'Alembert's principle. **(6+9)**

OR

2. a) Derive a general expression for the kinetic energy in generalized coordinates.
   b) Obtain the Lagrangian of a free particle in rectangular Cartesian coordinate system. **(8+7)**
3. a) Explain the equation of motion for equivalent one body problem.
   b) Describe the Kepler's laws of motion. **(7+8)**

OR

4. a) What is differential scattering cross section? Explain.
   b) Explain the Rutherford scattering phenomenon of alpha particles. **(5+10)**
5. a) Explain configuration space, phase space and state space.
   b) Obtain the Hamilton's equations of motion and write down the comments on them. **(6+9)**

OR

6. a) What are Poisson brackets? Write down the properties of Poisson brackets.
   b) Solve the harmonic oscillator problem by taking the generating function $F_1 = (1/2)\, mwq^2 \cot Q$ **(9+6)**
7. a) Derive Hamilton's equations of motion from variational principle.
   b) Obtain the solution for one dimensional harmonic oscillator using Hamilton-Jacobi technique. **(8+7)**

OR

Contd...2

8. a) Write down the Hamilton's equations in terms of Poisson bracket.
   b) Describe briefly Action-Angle variables in systems of one degree of freedom.
   c) Show that the transformation $q=\sqrt{2P}\ \sin Q \quad p=\sqrt{2P}\ \cos Q$ is canonical.

(5+5+5)

9. a) Derive the Euler's equation of motion for rigid body moving in an arbitrary direction.
   b) Write a note on the Inertia tensor and discuss the importance of moment of inertia about the principle axes. (7+8)

OR

10. a) Explain the terms velocity and streamline velocity of fluids and setup the equation of motion for flow of imperfect fluids.
   b) Derive the Euler's equation of motion for a perfect fluid. (8+7)

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QP CODE 15123

First Semester B.Sc., Degree Examinations

SEPTEMBER/OCTOBER 2022

PHYSICS

(Semester Scheme)

(2019 – 20 onwards)

SSA 710: PAPER – I: MECHANICS AND PROPERTIES OF MATTER

[Max. Marks: 50

Time: 3hrs.]

Instructions to the candidates:

1. *This question paper consists of* ***THREE*** *sections* ***A, B, C.***
2. *Answer* ***SEVEN*** *questions in* ***Section – A, SIX*** *questions in* ***Section – B*** *and* ***FOUR*** *questions in* ***Section – C.***
3. *Draw neat labeled diagrams wherever necessary.*
4. *Take necessary data from tables.*
5. *Symbols have their usual meanings*
6. *Usage of* ***Scientific Calculator*** *is allowed.*

SECTION – A

7 x 2 = 14 Marks

I. Answer any SEVEN questions:

1. Write a note on areal velocity.
2. Is earth an inertial frame? Explain.
3. Write a note on multistage rockets.
4. Derive the relation between angular momentum and torque.
5. State Kepler's laws of planetary motion.
6. State parallel and perpendicular axes theorems.
7. State and explain Hooke's law.
8. Explain surface tension on the basis of molecular theory.
9. Distinguish between streamline and turbulent flow.

Contd..... 2

SECTION – B

II. *Answer any SIX questions:* 6 x 4 = 24 Marks

10. Derive an expression for radical and transverse components acceleration of a particle moving in a plane.
11. Prove that a frame of reference moving with a constant velocity with respect to an inertial frame is also an inertial frame.
12. a) What is the principle of rocket motion?
    b) Obtain the expressions for instantaneous and final velocities of a rocket neglecting the earth's gravity. (1 + 3)
13. Derive an expression for gravitational potential and field at a point outside a thin spherical shell.
14. Derive an expression for moment of inertia of a rectangular lamina about an axis passing through its centre and perpendicular to its plane.
15. Obtain an expression for couple per unit twist for cylinder fixed at one end and twisted at the other end.
16. Show that the excess pressure acting on the curved surface of a liquid is given by $P = T\left(\frac{1}{r_1} + \frac{1}{r_2}\right)$ where r_1 and r_2 are the radii of curvature and T the surface tension of the liquid.
17. Give the necessary theory for Poiseuille's method o determining the co-efficient of viscosity of a liquid.

SECTION – C

III. *Answer any FOUR of the following questions:* 4 x 3 = 12 Marks

18. The position vector of a point is given by $\vec{r} = \left(\frac{1}{3}t^3 - 2t\right)\hat{i} + t^2\hat{j}$. Find the velocity and acceleration of the point at $t = 3\,\text{sec}$. The distance is measured in metres.
19. A steel ball of radius $2\times10^{-3}\,m$ falls in a vertical column of cartor oil. The coefficient of viscosity of cartor oil is $0.7\,Nsm^{-2}$ and its density is $0.98\times10^{3}\,Kgm^{-3}$. The density of steel is $7.8\times10^{3}\,Kgm^{-3}$ and $g = 9.8\,ms^{-2}$. Find its terminal velocity.
20. The excess of pressure inside a soap bubble of radius 1 cm is 1.5mm of oil of density $800\,kg/m^3$. Calculate the surface tension of soap solution.
21. A steel wire of radius 1 mm is bent into an arc of a circle of radius 50 cm. Calculate bending moment. Young's modulus of steel is $20\times10^{10}\,N/m^2$.

Contd..... 3

22. A rocket of mass 5000 kg is fired vertically upward from a place at the equator with a velocity of 1200 m/sec. If the angular velocity of earth is 7.3×10^{-5} rad/sec, calculate the Coriolis force acting on it.

23. A circular disc of mass 0.5 Kg and radius 0.1 m is making 60 rpm about an axis passing through its centre and perpendicular to its plane. Find the kinetic energy of the disc.

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Contd..... 4

First Semester B.Sc., Degree Examinations

SEPTEMBER/OCTOBER 2022

PHYSICS

(Semester Scheme)

(2014 – 18 old syllabus)

SSA 710: PAPER – I: MECHANICS, GRAVITATION, ROTATIONAL MOTION AND PROPERTIES OF MATTER

Time: 3hrs.] *[Max. Marks: 50*

Instructions to the candidates:

1. *This question paper consists of THREE sections A, B, C.*
2. *Answer SEVEN questions in Section – A, SIX questions in Section – B and FOUR questions in Section – C.*
3. *Draw neat labeled diagrams wherever necessary.*
4. *Take necessary data from tables.*
5. *Symbols have their usual meanings*
6. *Usage of Scientific Calculator is allowed.*

SECTION – A

IV. Answer any SEVEN questions: 7 x 2 = 14 Marks

1. State and explain Hooke's law.
2. State any two Kepler's law of planetary motion.
3. Define Central force? Write its characteristics.
4. Define vector product of the vectors with an example.
5. State and prove parallel axes theorem of moment of Inertia.
6. What are inertial and non – inertial frames?
7. What is conservative force? Give an example for it.
8. What are streamline motion and turbulent motion?
9. Mention any two applications of Bernoulli's theorem.

SECTION – B

V. Answer any SIX questions: 6 x 4 = 24 Marks

10. What is Coriolis force? Write an expression for it. Discuss any one effect of Coriolis force.

Contd..... 5

11. Derive an expression for moment of inertia of a solid sphere about its diameter and also an axis parallel to diameter but tangent to surface of sphere.
12. Obtain the relation between the elastic constants for an isotropic solid.
13. Derive an expression for final velocities of two bodies subjected to elastic head on collision.
14. Obtain the expression for radial and transverse components of velocity and acceleration of a particle moving in a plane.
15. State and prove work – energy theorem.
16. a) What is the principle of rocket motion?
    b) Obtain the expression for instantaneous and final velocities of a rocket neglecting the earth's gravity.
17. Give the theory of compound pendulum.

SECTION – C

VI. ***Answer any FOUR of the following questions:*** 4 x 3 = 12 Marks

18. A rocket of mass 4900 Kg is fired vertically upward from a place at the equator with the velocity $1400\,m/\text{sec}$. If the angular velocity of the earth is $7.3\times10^{-5}\,rad/s$. Calculate the Coriolis force acting on it.
19. A steel wire of radius 1 mm is bent into an arc of a circle of radius 50 cm. Calculate bending moment $q = 20\times10^{10}\,N/m^2$.
20. A circular disc of mass 0.5 Kg and radius $0.1m$ is making 60 revolutions per minute about an axis passing through its centre and perpendiculars to its plane. Calculate its Kinetic energy.
21. Calculate the velocity with which a planet has to be launched from the surface of earth so that it escapes from the gravitational influence of earth. Radius of earth $= 6400Km$.
22. Calculate the pressure inside a drop of mercury of radius $2.5\times10^{-3}m$. at room temperature. What is t he excess pressure inside the drop? Given, surface tension of mercury is $472\times10^{-3}\,N/m$ and the atmospheric pressure is $1.01\times10^{5}\,N/m^2$.
23. A horizontal force of 100N is required to move a metal plate of area $4m^2$ with a velocity $0.14ms^{-1}$. When it rests on a layer of a liquid of thickness $4\times10^{-3}m$. Calculate the coefficient of viscosity of the liquid.

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Q.P. Code No.73603(N)

First Semester M.Sc., Degree Examinations

May / June 2022

(CBSC New Scheme)

PHYSICS

Paper PHYH – 1.3 : Classical Electrodynamics

Time: 3 hrs] *[Max.Marks: 75*

Note : Answer all the questions.
All question carry equal marks.

1. a) Obtaining Poisson and Laplace Equation satisfied by the electrostatic potential.
   b) Arrive at the Multipole expansion of electrostatic potential and explain the meaning of each term. **(6+9)**

OR

2. a) State and prove uniqueness theorems for electrostatic potential.
   b) Explain method of images with an example. **(6+9)**
3. a) State and Explain Ampere's law in magnetostatics. Deduce it from Biot Savart law.
   b) Explain magnetization of matter. **(10+5)**

OR

4. a) Using Ampere's circuital law, find the magnetic field due to a thin long solenoid carrying steady current.
   b) If $\vec{E}$ is an electrostatic field show that $\vec{\nabla} . \vec{E} = \frac{s}{\infty}$ **(10+5)**
5. a) Explain the contribution of Maxwell in Modifying Ampere's law.
   b) Obtain Maxwell's equations in vacuum and in material medium thus arrive at velocity of light in vacuum and refractive index of the medium. **(5+10)**

OR

6. a) Discuss the propagation of electromagnetic waves in conducting medium. Explain the concept of skin depth.
   b) Obtain an expression for Faraday's law in differential form. **(10+5)**
7. a) Obtain Maxwell's equation in terms of scalar and vector potentials of electromagnetic field ? Express them in the Lorentz gauge.
   b) Show that under gauge transformation of potentials electric and magnetic field are invariant. **(10+5)**

OR

Contd...2

8. a) Derive the amplitude of transmission and reflection when the electric vector of the incident plane wave is perpendicular to the plane of incidence.
   b) Explain the implications of Fresnel's laws. (10+5)

9. a) What are Lienard – Wiechart potentials obtain expressions for them.
   b) State continuity equation, Lorentz guage condition in co-variant form. (10+5)

OR

10. a) Discuss the covariant formulation of electrodynamics.
    b) Write a note on invariants of electromagnetic field. (10+5)

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First Semester B.Sc., Degree Examinations

May / June 2022

(CBCS NEP Scheme 2021-22 onwards)

Subject Discipline : PHYSICS

NSA0210 : Mechanics and Properties of Matter

Time: 2 hrs.] [Max.Marks:60

Instructions to the candidates :

1. *The question paper consists of FOUR Sections A, B, C and D.*
2. *Answer ALL questions in Section-A, any FIVE questions in Section-B, any THREE questions in Section-C, and TWO questions in Section-D.*
3. *Write neat and labeled diagrams wherever necessary.*
4. *Symbols have their usual meaning.*
5. *Usage of scientific calculator is allowed.*
6. *Section - A should be answered in the first page of the answer booklet only.*

SECTION - A

1. ***Answer ALL questions :*** ***10X 1= 10 Marks***

i. A simple pendulum completes 20 oscillations in 25 s. The time is measured with a stop watch of least count 0.1s. The error in the measurement of time is

A) 1.6% B) 1.2%
C) 0.8% D) 0.4%

ii. The number of significant figures in 0.06900 is

A) 4 B) 5
C) 2 D) 3

iii. Action and reaction forces

A) act on the same body B) are equal and act in the same direction
C) cancel each other D) act on two different bodies

iv. Which of the following is an example for non-conservative force?

A) Central force B) Gravitational force C) Coulomb force D) frictional force

Contd...2

v. The moment of inertia of a body does not depend upon its

A) Mass B) Mass distribution
C) Angular velocity D) Axis of rotation.

vi. An example of a central force is

A) Gravitational force B) Strong nuclear force
C) Weak nuclear force D) None of these

vii. According to Hook's law of elasticity, if stress is increased, the ratio of stress to strain.

A) Increases B) Decreases
C) Becomes zero D) Remains constant

viii. The time period of a compound pendulum of radius of gyration about K about its centre of gravity and length h is given by the expression

A) $T = 2\pi\sqrt{K + h) / gh}$ B) $T = 2\pi\sqrt{(K^2 + h^2) / gh}$

C) $T = 2\pi\sqrt{(K^2 + h) / gh}$ D) $T = 2\pi\sqrt{K^2 + h^2 / gh^2}$

ix. The rotational kinetic energy of a body is E and its moment of inertia is I. Its angular momentum is

A) EI B) $\sqrt{E I}$
C) $\sqrt{2EI}$ D) E / I

x. A force F is given by $F = at + bt^2$ where t is time. What are the dimensions of a and b ?

A) $[MLT^3]$ and $[MLT^4]$ B) $[ML^{-1}T^3]$ and $[ML^2T^4]$
C) $[MLT^1]$ and $[MLT^0]$ D) $[MLT^4]$ and $[MLT^{-4}]$

SECTION - B

Answer any FIVE of the following. : ***5X 3= 15 Marks***

2. Two bodies of masses 100 g and 300g have position vectors $2\hat{\imath} + 4j + 14\hat{k}$ and $-6\hat{\imath} + 4\hat{\jmath} - 2\hat{k}$. Find the position vector of the centre of mass.

Contd...3

3. A spherical ball contracts in volume by 0.1% when subjected to a uniform normal pressure of 100 atmospheres. Calculate the bulk modulus of the material of the ball. Take 1 atmosphere = 10^5 Nm^{-2}.

4. The surface tension of soap solution is 0.07 Nm^{-1}. How much work is required to form a bubble of 1 cm radius from this solution?

5. Derive Stoke's law using the method of dimensions.

6. Define angle of contact of a liquid on a solid surface. What are the factors on which angle of contact depends?

7. If in a wire of Young's modulus Y, longitudinal strain X is produced, calculate the work done per unit volume of the wire.

8. Define Poisson ratio. Mention its theoretical limits. Write any one formula connecting Poisson ratio with elastic module.

9. State Kepler's laws of motion.

SECTION - C

Answer any THREE questions from the following. *3X 5= 15 Marks*

10. Show that accelerated frame is a non-inertial frame.

11. What is a pseudo force? Give an example. Write the expression for force on a particle in a rotating frame of reference and comment on the types of forces in it.

12. Define escape velocity. Obtain an expression for it.

13. Derive the expression for time period of a torsional pendulum.

14. Define (i) Streamline flow (ii) Turbulent flow and (ii) Co-efficient of viscosity. Also state and explain the equation of continuity.

SECTION - D

2X 10= 20 Marks

Answer the following: :

15. a) Derive an expression for Moment of inertia of solid cylinder about an axis through its centre and perpendicular to its length.

OR

Contd...4

b) What is a cantilever? Give the theory of single cantilever.

16. a) Derive the expression for instantaneous and final velocity of a rocket taking the effect of earth's gravity

OR

b) Define surface tension.

Obtain the expression for excess pressure inside a curved liquid surface.

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Second Semester B.Sc., Degree Examination

SEPTEMBER/OCTOBER 2022

(Semester Scheme NEP 2021 onwards)

PHYSICS

PAPER II: NSB 0210 : ELECTRICITY AND MEGNETISM

Time: 2 hrs] [Max. Marks: 60

Instructions to the candidates:

1. *This question paper consists of **FOUR** sections **A, B, C & D**.*
2. *Answer **all** questions (MCQ type) in **Section – A**, **FIVE** questions in **Section – B** and **THREE** questions in **Section – C** and **TWO** in **Section – D.***
3. *Symbols have their usual meanings.*
4. *Draw neat labeled, diagrams wherever necessary.*
5. *Usage of **Scientific Calculator** is allowed.*
6. ***Section – A** should be answered in the first page of answer booklet.*

SECTION – A

I. Answer all questions: $10 \times 1 = 10$

1. The unit of electric field is

   a) newton/coulomb b) newton-coulomb
   c) coulomb/newton d) newton

2. For the application of Gauss law, the necessary condition is

   a) Charge distribution
   b) Uniform Charge distribution and symmetrical closed surface
   c) Symmetrical surface
   d) None of the above

3. The electric quadrupole moment of linear quadrupole is given by

   a) $Q_d = 2qd$ b) $Q_d = qd$ c) $Q_d = 2qd^2$ d) $Q = 0$

Contd..... 2

4. Dielectric materials do not have

   a) Protons b) neutrons c) bound charges d) free electrons

5. What is the basic property of electrical conducting materials?

   a) Allows the passage of current through the materials
   b) Blocks the passage of current through the materials
   c) Leaks the current through the materials
   d) Reverses the direction of current in the materials.

6. The force on a moving charge in a uniform magnetic field is

   a) $\vec{F} = q\left(\vec{v} \times \vec{B}\right)$ b) $\vec{F} = B\left(\vec{v} \times \vec{q}\right)$

   c) $\vec{F} = v\left(\vec{q} \times \vec{B}\right)$ d) $\vec{F} = eE$

7. The value power factor in pure inductive circuit.

   a) Infinite b) Zero
   c) Always positive d) Finite value other than zero

8. The Poynting's vector for an electromagnetic wave represents

   a) Electric field b) Magnetic field
   c) Electric current density d) Electromagnetic energy density

9. Which of the following parameter is used to assess the magnetic property of the material?

   a) Magnetic flux density b) Susceptibility
   c) Magnetic dipole moment d) Electric quadrupole moment

10. The alternating current is given by $I = 1.5\sin(100\pi t)$, the $r\,m\,s$ value of current will be

    a) 1.0606 A b) 1.5 A
    c) 0.75 A d) 100 A

SECTION – B

II. Answer any FIVE of the following: $5 \times 3 = 15$

11. State and explain Coulomb's law.
12. Explain the significance of Gauss law.

Contd..... 3

13. Distinguish between conductors and insulators.
14. Prove that charges reside only on surface of charged conductor.
15. An electric lamp marked 100 v dc consumes a current of 10A. it is connected to a 200 V, 50 Hz ac mains. Calculate the inductance of the choke required.
16. Write the characteristics of Electromagnetic waves.
17. Define magnetic moment. Obtain the expression for magnetic moment of revolving electron.
18. Define self – induction and mutual induction. Write the relation between them.

SECTION – C

III. Answer any THREE of the following: $3 \times 5 = 15$

19. State Gauss law in electrostatics. Derive the electric field due to uniformly charged straight conductor using Gauss law.
20. Define electric potential. Derive the relation between electric potential and electric field.
21. Define capacitance. Obtain an expression for energy stored in a capacitor.
22. Give the comparison between series LCR resonance and parallel LCR resonance.
23. Explain the origin of dia, para and ferro magnetism on the basis of the electronic structure.

SECTION – D

IV. Answer the following: $2 \times 10 = 20$

24. a) Define electric dipole. Obtain an expression for electric potential and electric field at a point due to an electric dipole. (10)

OR

a) State and prove Ampere's law for arbitrary closed path.

b) A solenoid has length 2 m and diameter 0.05m. it has 1000 turns each. Calculate flux density at its centre when a current of 2 A flows through it. (6 + 4)

Contd..... 4

25. a) Derive any two Maxwell's field equations.

b) Evaluate the velocity of electromagnetic wave in free space.

Given: $\epsilon_0 = 8.854 \times 10^{-12} \frac{F}{m}$ and $\mu_0 = 4\pi \times 10^{-7}\ H/m$ (7 + 3)

OR

a) Derive an expression for an instantaneous growth and decay of current in a L – R circuit fed with direct emf.

b) Define time constant for C – R circuit and write the expression for it. (8 + 2)

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Third Semester B.Sc., Degree Examinations

SEPTEMBER/OCTOBER 2022

(Semester Scheme)

PHYSICS

(2019 – 20 onwards)

SSC 710: PAPER – III: OPTICS AND ELECTROSTATICS

Time: 3hrs.] [Max. Marks: 50

Instructions to the candidates:

1. *This question paper consists of **THREE** sections **A, B & C**.*
2. *Answer **SEVEN** questions in **Section – A**, **SIX** questions in **Section – B** and **FOUR** questions in **Section – C**.*
3. *Draw neat labeled, diagrams wherever necessary.*
4. *Take necessary data from tables.*
5. *Symbols have their usual meanings*
6. *Usage of **Scientific Calculator** is allowed.*

SECTION – A

I. Answer SEVEN questions: 7 x 2 = 14 Marks

1. State and explain Fermat's principle.
2. What are aberrations? Mention the types of monochromatic aberrations.
3. Explain propagation of light using Huygen's Principle.
4. What are coherent sources of light? Mention the conditions for sustained interference pattern.
5. Give a comparison of zone plate and a convex lens.
6. Briefly explain Faraday effects.
7. Explain the concept of scalar and vector fields with physical examples.
8. Define electric potential. Write relation between electric field and potential.
9. Give a brief account of para and ferro electric materials.

Contd.....2

SECTION – B

II. Answer any SIX questions: 6 x 4 = 24 Marks

10. Derive the condition for achromatism of two thin converging lenses not in contact.
11. Explain the construction and working of Ramsden's eye piece and hence obtain the expression for its equivalent focal length.
12. Derive lens maker's formula on the basis of wave theory of light.
13. Derive expression for fringe width in the case of interference at an air wedge.
14. What are half period zones? Derive an expression for radii of Fresnel's half period zones.
15. Give the Fresnel's theory of optical activity.
16. State Gauss theorem. Find electric field near the surface of a charged conductor using Gauss theorem.
17. Derive an expression for electric field intensity at a point due to an electric dipole.

SECTION – C

III. Answer any FOUR questions: 4 x 3 = 12 Marks

18. It is required to make a converging achromatic lens combination of focal length $0.3m$ from two lenses of dispersive powers 0.02 and 0.03. Find the focal length of the lenses.
19. A biprism is kept at a distance of $5cm$ in front of slit and the distance between the virtual sources is $0.05cm$. Find the fringe width observed at a distance $0.75m$ from the biprism. Wavelength of light is $5890\times10^{-10}m$.
20. When the movable mirror of Michelson's interferometer is moved through $0.02mm$, a shift of 65 fringes is observed. Calculate the wavelength of light used.
21. Find the number of lines a grating should have to resolve in the first order doublet having a wavelength difference $0.6nm$ at $589.3nm$.
22. Calculate the thickness of a half wave plate from the following data $n_0 = 1.54$, $n_e = 1.55$ and wavelength $= 600nm$.
23. Find the value of $\vec{\nabla}\left(\frac{1}{r}\right)$, where $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$.

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Contd.....3

QP CODE 15323

Third Semester B.Sc., Degree Examinations

SEPTEMBER/OCTOBER 2022

PHYSICS

(Semester Scheme) (2014-18 old syllabus)

SSC 710: PAPER – III: OPTICS AND ELECTROSTATICS

[Max. Marks: 50

Time: 3hrs.]

Instructions to the candidates:

1. *This question paper consists of **THREE** sections **A, B & C.***
2. *Answer **SEVEN** questions in **Section – A**, **SIX** questions in **Section – B** and **FOUR** questions in **Section – C.***
3. *Draw neat labeled, diagrams wherever necessary.*
4. *Take necessary data from tables.*
5. *Symbols have their usual meanings*
6. *Usage of **Scientific Calculator** is allowed.*

SECTION – A

7 x 2 = 14 Marks

IV. Answer SEVEN questions:

1. Show that $E = -\nabla V$ in electrostatics.
2. Mention any two methods to minimizing spherical aberration.
3. State and explain Fermat's principle of least time.
4. Explain why the Newton's Ring's are circular in shape.
5. Give a brief explanation of types of dielectric polarization.
6. Show that divergence of curl of a vector $\vec{A}$ is zero.
7. Explain kerr effect.
8. Compare Grating and Prisma spectra.
9. Draw a neat diagram of Ramsden's eye piece.

Con!d.....4

SECTION – B

V. *Answer any SIX questions:* 6 x 4 = 24 Marks

10. Discuss the theory of interference at a thin film due to reflected light.
11. What is Achromatisation? Obtain the expression for achromatic condition of two this lenses not in contact.
12. Explain the production and detection of linearly, elliptically and circularly polarized light.
13. What are half period zones? Obtain expression for radii and area of half period zones.
14. State Gauss law in electrostatics. Derive the expression for Coulomb's law from Gauss law.
15. Obtain an expression for electric field in polar coordinates at a point due to an electric dipole.
16. Derive the Snell's law of refraction using Fermat's principle.
17. Give the theory of plane transmission grating in case of Normal incidence.

SECTION – C

VI. *Answer any FOUR questions:* 4 x 3 = 12 Marks

18. In a Newton's ring experiment, the diameter of the 15^{th} ring was found to be $0.590cm$ and that of the 5^{th} ring was $0.336cm$. If the radius of the plano-convex lens is $100cm$, calculate the wavelength of light used.
19. Find the number of lines a grating should have to resolve the first order doubt having a wavelength difference $0.6nm$ at $589.3nm$.
20. A solution of camphor in alcohol in a tube $20cm$ long is found to rotate the plane of vibration of light by 27°. What is the mass of camphor in unit volume of solution? Specific rotation of camphor is 54°.
21. Two their lenses of focal length $10cm$ and $8cm$ are kept in position of least spherical aberration. Find the distance of principle points for the systems.
22. Prove that electric field is $E = -grad\ \varphi$
23. A capacitor consists of two metallic discs each 1 metre in diameter placed parallel to each other at a distance of $4mm$. The potential between the plates is 10,000V, calculate the energy stored by the capacitor.

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Third Year B.Sc., Degree Examinations

November / December 2022

(Directorate of Distance Education)

PHYSICS

DSC210: Paper III : Spectroscopy, Wave Mechanics, Statistical Mechanics, Relativity and Astro Physics

Time: 3 hrs.] [Max.Marks:75/85

Instruction to the Candidates :

1. Students who have attended 25 Marks IA scheme will have to answer for total of 75 marks.
2. Students who have attended 15 Marks IA scheme will have to answer for total of 85 marks.
3. Section –E is compulsory for 85 marks scheme only.

SECTION - A

I. *Answer ALL questions :* *10 X 1= 10 Marks*

1. Why optical pumping cannot be used in gas lasers ?
2. Write the significance of Pauli's exclusion principle.
3. Define light year.
4. Does all the molecule exhibit pure rotational spectrum ?
5. Explain the presence of unmodified lines in the Compton scattering.
6. Why X – rays are also known as white X radiation ?
7. What are Cathode rays ?
8. Why length contraction is not observed in daily life ?
9. Write the operator equivalent of linear momentum.
10. Name the particle which obeys Bose – Einstein's statistics.

SECTION - B

II. *Answer any FIVE of the following.* *5X 3= 15 Marks*

11. Compute the energy of the lowest three levels for an electron in a square well potential of width $3\ A^0$.
12. Explain the effect of reduced mass of nucleus on the atomic spectra.

Contd…2

13. Explain space quantization and spinning of electron.
14. Write a note on Minkowski's space time continuum.
15. Find the temperature at which the average energy of the molecule of a perfect gas would be equal to the lowest energy of the electron ? K 1.38×10^{-23} J/K.
16. Derive Bragg's law for X – rays.
17. Define Parsec. Explain Hertzsprung – Russell diagram.

SECTION - C

III. ***Answer any FIVE of the following.*** ***5X6= 30 Marks***

18. What is Zeeman Effect ? Derive an expression for Zeeman shift based on classical theory of Zeeman Effect. **6 Marks**
19. What is time dilation ? Starting from Lorentz transformation equation derive equations for relativistic addition of velocities. Hence prove that no material particle can move with a velocity greater than that of light. **6 Marks**
20. What is thermodynamic probability ? Derive Fermi Dirac distribution function. **6 Marks**
21. a) Set up time independent Schrodinger's wave equation.
    b) Explain X – ray continuous spectrum and its origin. Account for Duane Hunt rule. **3+3 Marks**
22. a) Give the theory of pure rotational spectrum.
    b) Monochromatic X – rays of wavelength 0.2 A^0 undergoes. Compton effect from a carbon block. Calculate the wavelength scattered through
    a) 45^0 and b) 135^0. **6+4 Marks**
23. a) State and explain Heisenberg's uncertainty principle.
    b) Find the expectation value of momentum of a particle where it is described by a function $= \sqrt{\frac{2}{L}} \sin\frac{n\pi}{L} x$ for $0 < x < L$ and 0 elsewhere. **2+4 Marks**
24. a) Show that the non existence of the electron in the nucleus from Heisenberg's uncertainty principle.
    b) The half width of the gain profile of a He – Ne laser material 2×10^{-3} nm. If the length of the cavity is 30 cm, how many longitudinal modes can be excited ? The emission wavelength of He-Ne laser is $6328A^0$. **3+3 Marks**

Contd...3

Q.P. Code No.50821

SECTION - D

2X10=20 Marks

IV. *Answer any TWO of the following.*

25. a) Establish mathematically Einstein's mass energy relationship. Explain physical significance and mention two nuclear phenomena supporting this relation.

b) Calculate the length and orientation of a rod of length 5 meters in a frame of reference which is moving with a velocity 0.6 c in a direction making an angle with the rod. **6+4 Marks**

26. a) Mention the characteristics of matter waves. Describe with necessary theory Davisson and Germer experiment which establishes the wave nature of matter.

b) An electron of energy 50 eV is moving in a plane right to a uniform magnetic field of 10^{-2} tesla. **6+4 Marks**

Calculate the radius of the orbit.

27. a) Give the quantum theory of Raman effect.

b) Explain the construction and working of ruby laser with energy level diagram. **5+5 Marks**

28. a) Explain the life cycle of a star.

b) Calculate the apparent brightness of the star centauri of luminosity 8.2×10^{4} L_s which is at a distance of 4.22 light years from the earth.

c) Calculate the rotational kinetic energy of a neutron star of mass 1.5 M_s, radius 1.25 R_s and frequency 40 rps. **4+3+3 Marks**

SECTION - E

V. *Compulsory question for 85 marks scheme only. Long answer questions.*

1X10=10 Marks

Answer any ONE of the following.

29. a) Obtain the Schrodinger's wave equation for a particle in one dimensional box and solve it to obtain the energy eigen values. Also represent the first three wave function in a graph.

b) The wavelength of L_α X– ray line of platinum (atomic number = 78) is 1.321 A^0. An unknown substance emits L_α X – ray of wavelength 4.174A^0. Calculate the atomic number of the unknown substance. B = 7.4 for L_α lines. **6+4 Marks**

Contd...4

30. a) What is Zeeman effect ? Give the quantum theory of Normal Zeeman effect.

b) Find the thermodynamic probability for the macro state (3, 2) and (1, 4). There are two compartments a and b ? The compartment a has three cells whereas b has four cells. Five fermions are distributed in these compartments.

6+4 Marks

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Third Semester B.Sc., Degree Examinations

April /May 2022

(Semester Scheme 2014-15 onwards)

PHYSICS

SSC710 : Paper – III : Optics and Electrostatics

Time: 3 hrs.] [Max.Marks:50

Instruction to the Candidates :

1. This question paper consists of THREE Sections A, B, and C.
2. Answer SEVEN questions in Section – A, SIX questions in Section – B and FOUR questions in Section –C.
3. Draw neat labelled diagrams wherever necessary.
4. Take necessary data from tables.
5. Symbols have their usual meanings.
6. Usage of Scientific Calculator is allowed.

SECTION - A

I. Answer any SEVEN questions : **7X2=14**

1. State Stoke's theorem and gauss – divergence theorem.
2. Explain Faraday's effect.
3. Explain Huygen's wave theory of light.
4. Give the comparison between zone plate and convex lens.
5. Define electric dipole and dipole moment.
6. If $\phi(x, y, z) = 3x^3y - y^2z^2$ find $\nabla\phi$ at (1, -2, 1)
7. Give the comparison of Ramsden's eye piece and Huyzen's eyepiece
8. What is spherical aberration ? Explain.
9. Write a brief note on Lloyd's style mirror.

SECTION - B

II. Answer any SIX questions. **6X4=24**

10. Give the theory of Newton's Rings.
11. Explain Fresnel's diffraction at a straight edge and intensity distribution with diagrams.

Contd...4

12. Obtain the condition for achromatism, when two thin lenses are separated by a finite distance.
13. Write the statement of Fermat's principle and derive the Snell's law of refraction using Fermat's principles.
14. Explain the production and detection of linearly, circularly and elliptically polarized light
15. Derive the expression for loss of energy due to sharing of charges between two conductors.
16. Obtain an expression for electric field and potential due to an electric dipole.
17. Give the theory of plane transmission grating in case of normal incidence.

SECTION - C

III. Answer any FOUR questions: **4X3=12**

18. Light of wavelength 589.3 nm from a narrow slit in incident on a double slit. The screen its plated 2m away and the width of 25 fringes on the screen in measured as 0.02m. Calculate the slit separation.
19. Two spectral lines with average wavelength 6000 A^0 are resolved in second order by a grating having 500 lines per cm. The least width of the grating is 2 cm. Find the difference in wave length of the lines.
20. A sugar solution in a tube 20 cm long produces a optical rotation of 13^0 with light of wavelength 60000 A^0 find the strength of ten solution. Given specific rotation of sugar is 65^0.
21. Two thin lenses of focal length 10 cm and 8cm are kept in position of least spherical aberration. Find the distance of principle points for the system.
22. Prove that and grad $\phi = 0$ where ϕ is a scalar function.
23. The distance between proton and electron in hydrogen atom is 5.3×10^{-11} m. Calculate ten magnitude of electric force between them.

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Q.P.Code No. 15323

Third Semester B.Sc., Degree Examinations

April /May 2022

(Semester Scheme 2014-15 Before)

PHYSICS

SSC710 : Paper – III : Optics and Electrostatics

Time: 3 hrs.] [Max.Marks:50

Instruction to the Candidates :

1. This question paper consists of FOUR Sections A, B, C and D.
2. Answer ALL questions in Section – A, FIVE questions in Section – B and SIX questions in Section –C and FOUR questions from Part – D.
3. Draw neat labelled diagrams wherever necessary.
4. Take necessary data from tables.
5. Symbols have their usual meanings.

SECTION - A

I. Answer ALL questions : **4X1=4**

1. What are coherent sources?
2. What is pupil of an optical instrument?
3. Define optical activity
4. State Gauss law of electrostatics.

SECTION – B

II. Answer any FIVE questions. **5X2=10**

5. Explain wave theory of light.
6. Define principal refractive indices for ordinary and extraordinary rays.
7. Mention the types of wave fronts used in Fresnel and Fraunh offer diffraction.
8. What are Kerr and Faradays Effects?
9. Write the physical significance of gradient of scalar function and curl of vector function.
10. Explain briefly para and ferro electric materials.

Contd...6

SECTION - C

III. Answer any SIX questions: 6X4=24

11. State the Fermat's principle of extremum path. Deduce the laws of refraction from Fermat's principle
12. Give the construction of Huygen's eye piece and derive the expression for its equivalent focal length.
13. Give the theory of Newton's rings for the case of reflected light.
14. Describe the construction and working of a Michelson's interferometer.
15. Explain the Fresnel diffraction at a straight edge and obtain the expression for maxima and minima.
16. Explain the Huygens construction for ordinary and extraordinary wave fronts when the optic axis is in the plane of incidence and inclined to the crystal surface.
17. State the Gauss law. Deduce the expression for the electric field near a charged conductor and force per unit area of its surface from Gauss law.
18. Derive an expression for electric field at any point due to an electric dipole.

SECTION - D

IV. Answer any FOUR questions: 4X3=12

19. Two thin convex lenses having focal lengths 0.05m and 0.02m are coaxial and separated by a distance of 0.03 m. find the equivalent focal lengths and positions of principal points.
20. The fringes of equal thickness are formed when two glass plates are kept over each other with a small gap in between. If a parallel beam of light of wavelength 6000 A^0 is used and fringe separation is 3 mm. what is the angle between the plates.
21. In a plane transmission grating the angle of diffraction for second order maxima for wavelength 5×10^{-5}cm is 30^0. Calculate the number of lines in one cm of grating surface.
22. Plane polarised light is incident on a piece of quartz cut parallel to the optic axis. Find the least thickness for which the ordinary and extra ordinary rays combine to form plane polarised light. Given $\lambda = 5000A^0$, $n_E = 1.5553$ and $n_0 = 1.5442$.
23. Find gradient of $|\vec{r}| = \sqrt{x^2 + y^2 z^2}$

Contd...7

Third Semester B.Sc., Degree Examinations

April /May 2022

(Semester Scheme 2014-15 onwards)

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I. Answer any SEVEN questions : **7X2=14**

1. State Stoke's theorem and gauss – divergence theorem.
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3. Explain Huygen's wave theory of light.
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5. Define electric dipole and dipole moment.
6. If $\phi(x, y, z) = 3x^3y - y^2z^2$ find $\nabla\phi$ at (1, -2, 1)
7. Give the comparison of Ramsden's eye piece and Huyzen's eyepiece
8. What is spherical aberration ? Explain.
9. Write a brief note on Lloyd's style mirror.

SECTION - B

II. Answer any SIX questions. **6X4=24**

10. Give the theory of Newton's Rings.
11. Explain Fresnel's diffraction at a straight edge and intensity distribution with diagrams.

Contd...4

12. Obtain the condition for achromatism, when two thin lenses are separated by a finite distance.
13. Write the statement of Fermat's principle and derive the Snell's law of refraction using Fermat's principles.
14. Explain the production and detection of linearly, circularly and elliptically polarized light
15. Derive the expression for loss of energy due to sharing of charges between two conductors.
16. Obtain an expression for electric field and potential due to an electric dipole.
17. Give the theory of plane transmission grating in case of normal incidence.

SECTION - C

III. Answer any FOUR questions: **4X3=12**

18. Light of wavelength 589.3 nm from a narrow slit in incident on a double slit. The screen its plated 2m away and the width of 25 fringes on the screen in measured as 0.02m. Calculate the slit separation.
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20. A sugar solution in a tube 20 cm long produces a optical rotation of 13^0 with light of wavelength 60000 A^0 find the strength of ten solution. Given specific rotation of sugar is 65^0.
21. Two thin lenses of focal length 10 cm and 8cm are kept in position of least spherical aberration. Find the distance of principle points for the system.
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23. The distance between proton and electron in hydrogen atom is 5.3×10^{-11} m. Calculate ten magnitude of electric force between them.

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Q.P.Code No. 15323

Third Semester B.Sc., Degree Examinations

April /May 2022

(Semester Scheme 2014-15 Before)

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SECTION - A

4X1=4

I. Answer ALL questions :

1. What are coherent sources?
2. What is pupil of an optical instrument?
3. Define optical activity
4. State Gauss law of electrostatics.

SECTION – B

5X2=10

II. Answer any FIVE questions.

5. Explain wave theory of light.
6. Define principal refractive indices for ordinary and extraordinary rays.
7. Mention the types of wave fronts used in Fresnel and Fraunh offer diffraction.
8. What are Kerr and Faradays Effects?
9. Write the physical significance of gradient of scalar function and curl of vector function.
10. Explain briefly para and ferro electric materials.

Contd...6

Q.P.Code No. 15323

SECTION - C

III. Answer any SIX questions: **6X4=24**

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18. Derive an expression for electric field at any point due to an electric dipole.

SECTION - D

IV. Answer any FOUR questions: **4X3=12**

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23. Find gradient of $|\vec{r}| = \sqrt{x^2 + y^2 z^2}$

Contd...7

Third Semester B.Sc., Degree Examinations

April /May 2022

(Semester Scheme 2014-15 onwards)

PHYSICS

SSC710 : Paper – III : Optics and Electrostatics

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7. Give the comparison of Ramsden's eye piece and Huyzen's eyepiece
8. What is spherical aberration ? Explain.
9. Write a brief note on Lloyd's style mirror.

SECTION - B

II. Answer any SIX questions. **6X4=24**

10. Give the theory of Newton's Rings.
11. Explain Fresnel's diffraction at a straight edge and intensity distribution with diagrams.

Contd...4

12. Obtain the condition for achromatism, when two thin lenses are separated by a finite distance.
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16. Obtain an expression for electric field and potential due to an electric dipole.
17. Give the theory of plane transmission grating in case of normal incidence.

SECTION - C

III. *Answer any FOUR questions:* **4X3=12**

18. Light of wavelength 589.3 nm from a narrow slit in incident on a double slit. The screen its plated 2m away and the width of 25 fringes on the screen in measured as 0.02m. Calculate the slit separation.
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Third Semester B.Sc., Degree Examinations

April /May 2022

(Semester Scheme 2014-15 Before)

PHYSICS

SSC710 : Paper – III : Optics and Electrostatics

Time: 3 hrs.] [Max.Marks:50

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1. This question paper consists of FOUR Sections A, B, C and D.
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5. Symbols have their usual meanings.

SECTION - A

I. Answer ALL questions : 4X1=4

1. What are coherent sources?
2. What is pupil of an optical instrument?
3. Define optical activity
4. State Gauss law of electrostatics.

SECTION – B

II. Answer any FIVE questions. 5X2=10

5. Explain wave theory of light.
6. Define principal refractive indices for ordinary and extraordinary rays.
7. Mention the types of wave fronts used in Fresnel and Fraunh offer diffraction.
8. What are Kerr and Faradays Effects?
9. Write the physical significance of gradient of scalar function and curl of vector function.
10. Explain briefly para and ferro electric materials.

Contd...6

SECTION - C

III. Answer any SIX questions: 6X4=24

11. State the Fermat's principle of extremum path. Deduce the laws of refraction from Fermat's principle
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13. Give the theory of Newton's rings for the case of reflected light.
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18. Derive an expression for electric field at any point due to an electric dipole.

SECTION - D

IV. Answer any FOUR questions: 4X3=12

19. Two thin convex lenses having focal lengths 0.05m and 0.02m are coaxial and separated by a distance of 0.03 m. find the equivalent focal lengths and positions of principal points.
20. The fringes of equal thickness are formed when two glass plates are kept over each other with a small gap in between. If a parallel beam of light of wavelength 6000 A^0 is used and fringe separation is 3 mm. what is the angle between the plates.
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23. Find gradient of $|\vec{r}| = \sqrt{x^2 + y^2 z^2}$

Contd...7

Third Semester M.Sc., Degree Examinations

May / June 2022

(CBSC Scheme)

PHYSICS

Paper PHYS 3.4.2: Nuclear Physics – I

Time: 3 hrs] *[Max.Marks: 75*

Note : Answer the following questions.

1. a) What are the assumptions made in the derivation of Bethe-Bloch formula for energy loss of heavy charged particles in matter? What are the conclusions drawn from the Bethe-Bloch formula?

   b) Compare the collision and radiation loss for beta particles of energy 2.25 MeV in gold and copper media. **(9+6)**

OR

2. a) Calculate the range of beta particles of end-point energy 0.54 and 0.746 MeV in Al.

   b) Distinguish between the interaction mechanisms of γ -rays and beta particles with matter. Explain in briefly Compton Scattering process. **(5+10)**

3. a) Give an account of various radiation dose scales employed for the evaluation of radiation effects on human tissue.

   b) Among the nuclear radiations α, β and γ - rays, which radiations are the most dangerous to human beings and why? **(12+3)**

OR

4. a) Explain the characteristics of good radiation shielding materials with suitable examples. What are the materials, which are commonly used as radiation shields in radiation environments?

   b) Give the relationships between photon and energy fluence. **(9+6)**

5. a) Draw the block diagram of scintillation detector spectrometer and explain the role of each module in it.

   b) What is photomultiplier tube? Explain its working procedure with a neat sketch. **(10+5)**

OR

Contd...2

6. a) What are the characteristics of good scintillators ? Why is NaI (Tl) scintillation crystal enclosed in an aluminum enclosure?

   b) With neat energy band diagram, discuss the scintillation mechanism in an inorganic scintillator taking NaI (Tl) as an example. **(6+8)**

7. a) Discuss the principle and working of Li ion drifted silicon detector.

   b) Write a brief note on surface barrier detector. **(9+6)**

OR

8. a) Discuss the principle and working of Li ion drifted germanium detector.

   b) Write a short note of thermoluminescence detectors. **(9+6)**

9. a) Explain the principle and working of single channel analyser in brief.

   b) Can we take the output of a detector directly to a linear pulse amplifier? What is the role of pre-amplifier in γ-ray/X-ray spectrometer? Briefly explain the various types of pre-amplifier. **(5+10)**

OR

10. a) Discuss the construction and working of flash type analog-to-digital converter.

    b) Compare and contrast single channel analyser and multichannel analyser. **(9+6)**

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Q.P. Code No.73651(N)

Third Semester M.Sc., Degree Examinations

May / June 2022

(CBSC Scheme)

PHYSICS

Paper PHYH : 3.1 Atomic and Molecular Spectroscopy

Time: 3 hrs] *[Max.Marks: 75*

Note : 1) Answer all the questions.
2) All questions carry equal marks.

1. a) Obtain the expression for term shift due to spin-orbit and quantum relativistic correction for a hydrogen like ion with atomic number Z.

   b) Wavelength of first Balmer line of hydrogen is 656nm. Then what is the wavelength of corresponding line for a hydrogenic atom with Z=6. **(12+3)**

OR

2. a) Explain in detail how to obtain the spectroscopic terms for the case of a two valence electron system with the help of L-S coupling.

   b) What is Normal Zeeman effect? Obtain the expression for term shift using quantum considerations. **(8+7)**

3. a) What is broadening of spectral lines. Explain the different causes for it.

   b) Explain the main causes for hyperfine splitting of spectral lines. **(9+6)**

OR

4. a) Explain the fine structure of characteristic X rays. Obtain regular and irregular doublet laws.

   b) Write down the hyperfine splitting diagram for the transitions: $^2P_{3/2}$ to $^2S_{1/2}$ and $^2P_{1/2}$ to $^2S_{1/2}$ in case of Caesium atom with nuclear spin of 7/2 and specify the number of transition lines. **(8+7)**

5. a) List out the molecules which are microwave active and explain the condition for the activity of the molecule.

   b) Explain the non rigid rotator and the spectra associated with it. Explain to calculate the bond length by taking in to account of selection rule for possible transition. **(6+9)**

OR

Contd...2

6. a) Describe with neat diagram explain the principle, construction and working of NMR spectrometer.

   b) Explain the concept of Morse oscillator function and sketch the continuous spectra beyond the point of dissociation. (9+6)

7. a) Explain the difference between dispersive and FT Raman spectra, discuss the rotational Raman spectra and locate the Raman lines.

   b) How is Raman effect both complementary and supplementary to the infrared phenomenon? (10+5)

OR

8. a) Discuss the significance of the Franck Condon principle.

   b) Discuss the electronic spectra of diatomic molecule. (7+8)

9. a) Discuss with neat diagram, the mechanism of fluorescence on the basis of Jablonski diagram

   b) Discuss the role of the rate equation in lasing action, show that the lasing action is possible in three level laser system with proper rate equation. (7+8)

OR

10. a) Discuss the stability, accuracy and clock characterization methods using Allan deviation.

    b) Distinguish between Mechanical Clock, Quartz clock and Atomic Clock. (10+5)

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Third Semester M.Sc., Degree Examinations

May / June 2022

(CBSC Scheme)

PHYSICS

Paper PHYH : 3.2 : Quantum Mechanics - II

Time: 3 hrs] [Max.Marks: 75

Note : 1) Answer all the questions.
2) All questions carry equal marks.

1. a) Outline the Schrodinger, Heisenberg and interaction picture in quantum dynamics.

   b) Define a density matrix. List its properties. **(9+6)**

OR

2. a) Discuss the time evolution of a two – level system in a constant magnetic field.

   b) Arrive at the general form of density matrix of a spin $\frac{1}{2}$ particle. Using it, distinguish between pure, mixed states of spin $-\frac{1}{2}$ systems. **(8+7)**

OR

3. a) Outline Einstein's derivation of Planck's radiation law.

   b) Distinguish between sudden and adiabatic approximation. Give examples. **(9+6)**

OR

4. a) Discuss the time dependent perturbation theory in the first order.

   b) Arrive at Fermi – Golden rule and outline its significance. **(9+6)**

OR

5. a) Define the meaning of the terms

   (i) Scattering amplitude.

   (ii) Differential scattering cross section

   (iii) Total scattering cross section

   b) Arrive at the relation between differential cross section and scattering amplitude.

   c) Show that scattering cross section has units of area. **(6+6+3)**

OR

Contd...2

6. a) Derive an expression for the scattering amplitude in the Born approximation.
   b) Write a note on optical theorem.
   c) If $\frac{d\sigma}{d\Omega} (a + b \cos\theta)$, obtain the total cross section. (7+5+3)

OR

7. a) Obtain equations of continuity and expression for probability density and probability current density. Comment on negative probability density.
   b) Write the Klein – Gordon equation for charged particle moving in an electromagnetic field. (10+5)

OR

8. a) Show that the spin of an electron is a natural consequences of Dirac theory.
   b) Write an note Dirac hole theory. (12+3)

OR

9. a) Discuss the need for quantum field theory.
   b) Arrive at Euler – Lagrange equation for the classical field. (5+10)

OR

10. a) Outline the second quantization of Schrodinger equation.
    b) Write a note on quantization of electromagnetic waves. (9+6)

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Fourth Semester B.Sc., Degree Examinations

April /May 2022

(Semester Scheme – 2019 onwards)

PHYSICS

SSD710 : Paper – IV : Electricity and Electromagnetic Theory

Time: 3 hrs.] [Max.Marks:50

Instruction to the Candidates :

1. This question paper consists of THREE Sections A, B, and C.
2. Answer SEVEN questions in Section – A, SIX questions in Section – B and FOUR questions in Section –C.
3. Draw neat and labelled diagrams wherever necessary.
4. Take necessary data from tables.
5. Symbols used have their usual meanings.
6. Usage of Scientific Calculator is allowed.

SECTION - A

I. Answer any SEVEN questions. **7X2=14**

1. Write short note on bladder resistor.
2. Give the condition for oscillation and expression for frequency in series LCR circuit fed with direct emit.
3. Give any four comparisons between a series and parallel resonance in LCR networks.
4. Define the term power factor and mention its significance.
5. State and explain Norton's theorem.
6. Explain the voltage regulation action of Zener diode in case of input voltage variation.
7. Give the block diagram of construction of a CRO.
8. What is meant by Lorentz force? Explain.
9. Show that E and B components are perpendicular to each other in electromagnetic waves.

SECTION - B

II. Answer any SIX questions. **6X4=24**

10. Obtain an expression for growth of current in series LR circuit fed with direct emf and define its time constant.

Contd...2

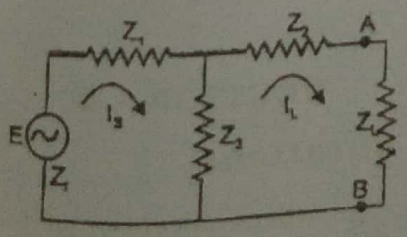
Q.P.Code No. 15423

11. Obtain the expressions for current and impedance in a series CR circuit fed with alternating emf using j - notation.
12. State and Prove Maximum power transfer theorem for DC circuit.
13. Derive an expression for cut-off frequency of a high pass RC filter. Give any two applications of frequency filters.
14. Discuss the theory of Ballistic galvanometer.
15. Define Ampere's circuital law. Apply it to calculate magnetic field due to a long solenoid.
16. What is meant by displacement current? Obtain an expression for displacement current density of charging or discharging of a capacitor.
17. Explain the working action of R-C fitter and π - section filter in the case of rectifiers.

SECTION – C

III. Answer any FOUR questions. **4X3=12**

18. A 200 ohm resistor and a 1 microfarad capacitor are connected in series across a 120 volts (rms) and 60 Hz power line. What is the impedance, rms current and phase lag of the circuit ?
19. A series resonant circuit having an inductor 1.01 Henry, a capacitor 20 microfarad and a resistor 70 ohms is connected to 100 Volt (rms) power source. At what frequency of the applied emf, the circuit will resonate with maximum response ? Also give a measurement of quality of the resonance of in the circuit.
20. Convert the linear network shown in figure having $Z_1 = 2$ ohm, $Z_2 = 4$ ohm, $Z_3 = 3$ ohm, $Z_L = 5$ ohm and $E = 10$ volts into a Thevenin's equivalent circuit and determine the power delivered to the load.



Contd...3

21. In a Desauty's AC bridge connected to an alternating power source of 12 volts (rms) and frequency 50 Hertz, two arms have resistors of value 35 ohms and 70 ohms. Determine the unknown capacitance connected in one of the capacitance arm when the bridge is balanced with the other capacitance arm having a capacitance 2 microfarad.

22. In the Bohr model of Hydrogen atom the electron circulates around the nucleus in a path of radius 5.1×10^{-11} meter at a frequency of 6.8×10^{15} revolutions / second. Calculate the equivalent magnetic dipole moment due to current loop of electron.

23. Calculate the velocity of electromagnetic wave in a given medium having dielectric constant 2 and permeability 2.5.
(given : $\epsilon_0 = 8.854 \times 10^{-12}$ µ/m, $\mu_0 = 4\pi\ 10^{-7}$ H/m)

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Contd...4

Q.P.Code No. 15423

Fourth Semester B.Sc., Degree Examinations

April /May 2022

(Semester Scheme – 2014-15 onwards)

PHYSICS

SSD710 : Paper – IV : Electricity and Electromagnetic Theory

[Max.Marks:50

Time: 3 hrs.]

Instruction to the Candidates :

1. This question paper consists of THREE Sections A, B, and C.
2. Answer SEVEN questions in Section – A, SIX questions in Section – B and FOUR questions in Section –C.
3. Draw neat and labelled diagrams wherever necessary.
4. Take necessary data from tables.
5. Symbols used have their usual meanings.

SECTION - A

I. Answer any SEVEN questions. **7X2=14**

1. What are band pass and band stop fillers ?
2. Define the terms i) band width and ii) Quality factor.
3. Explain skin effect.
4. Write a short note on Hertz's experiment to prove the existence of EM-waves.
5. Explain the role of capacitor in an RC -filter.
6. Define the terms: (i) transient current, (ii). Bleeder resister
7. Write any two difference between series and parallel resonance.
8. Define ripple factor. Mention its value for half wave rectifier.
9. Write the Norton's procedure to analyses a linear network involving de-sources only.

SECTION - B

II. Answer any SIX questions. **6X4=24**

10. Obtain the expression for growth of charge in RC-series during circuit fed with DC source hence define time constant.
11. Obtain the expression for current and impedance in LCR series circuit using j –operator method.

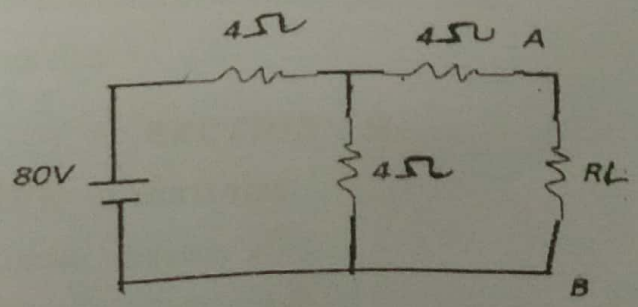
Contd...5

12. State the Ampere's circuital law use it to calculate the magnetic field at a point inside a current carrying long solenoid.
13. Using Maxwell's equations show that light waves are electromagnetic wave nature.
14. Give the theory of ballistic galvanometer.
15. State maximum power transfer theorem under DC – condition. Prove this theorem for a simple circuit fed only with DC sources.
16. Explain the construction and working of Zener diode as voltage regulator.
17. i) Describe the time base circuit of CRO
    ii) Explain the measurement of voltage and frequency using a CRO. 2+2

SECTION – C

III. Answer any FOUR questions. **4X3=12**

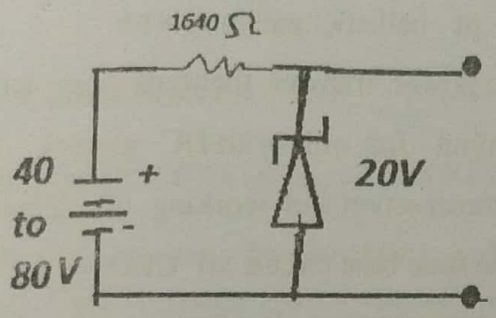
18. In an LR circuit the transient current attains one third of its final steady value in 5 sec. If the total resistance in the circuit 2Ω, then calculate the inductance of the circuit ?
19. An AC voltage is represented by $V(t) = 150$ milivolt $\times \text{Sin}2\pi\,(50\,t - \frac{\pi}{6})$ .Calculate its peak , rms and mean voltages.
20. Draw the Thevenen's equivalent circuit for the following circuit.



21. The vector potential is given by $\vec{A}\ (\vec{r}, t) = y \cos(\omega t)\,\hat{\imath} + x \sin(\omega t)\,\hat{\jmath}$. Find the magnetic field $\vec{B}$ at point $(2, 4, 7)$
22. A particle of charge 10 μC having velocity $8 \times 10^6\ \hat{\imath}$ m/sec enters a combined electric field $2 \times 10^6\ \hat{\jmath}$. N/C and magnetic field 0.4 $\hat{k}$ tesla. What is the force acting on it ?

Contd...6

23. A voltage regulator circuit as shown in following figure. The Zeener diode has a break down voltage of 20V. What are the minimum and maximum Zeener currents ?



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Fourth Semester B.Sc., Degree Examinations

April /May 2022

(Semester Scheme – Before 2014-15)

PHYSICS

SSD710 : Paper – IV : Electricity and Electromagnetism Theory

Time: 3 hrs.] [Max.Marks:50

Instruction to the Candidates :

1. This question paper consists of FOUR Sections A, B, C and D.
2. Answer ALL questions in Section – A, FIVE questions in Section – B and SIX questions in Section –C Four question for Section D.
3. Draw neat and labelled diagrams wherever necessary.
4. Take necessary data from tables.
5. Symbols used have their usual meanings.
6. Usage of Scientific Calculator is allowed.

SECTION – A

I. **Answer ALL questions.** **1X4=4**

1. What is the significance of pointing vector ?
2. What is a Zener diode ?
3. Write any two characteristics of electromagnetic waves.
4. What is a low pass filter ?

SECTION - B

II. **Answer any FIVE questions.** **5X2=10**

5. What is a Watt - meter ? Explain it.
6. Derive the expression for RMS value of a sinusoidal AC.
7. Draw the block diagram of CRO and label its parts.
8. Design time constant of series of L-R circuit and write expression for it.
9. What is the significance of displacement current ?
10. Derive the expression for magnetic field inside the solenoid by using Ampere's law.

Contd...8

Q.P.Code No. 15423

SECTION – C

III. Answer any SIX questions. **6X4=24**

11. State and prove maximum power transfer theorem.
12. Write the theory of Ballistic galvanometer (B.G.).
13. Discuss the AC response of series L-R circuit using j parameter. Obtain expressions for current and impedance.
14. Set up Maxwell's fourth equation. $\vec{\nabla} \times \vec{H} = \vec{J} + \frac{\partial \vec{D}}{2t}$
15. Derive an expression for the growth of current in an CR series circuit fed with the direct emf.
16. Discuss the construction and working of half wave rectifier. Derive the expression for efficiency of a half wave rectifier.
17. Explain current loop a magnetic dipole
18. State and prove pointing theorem.

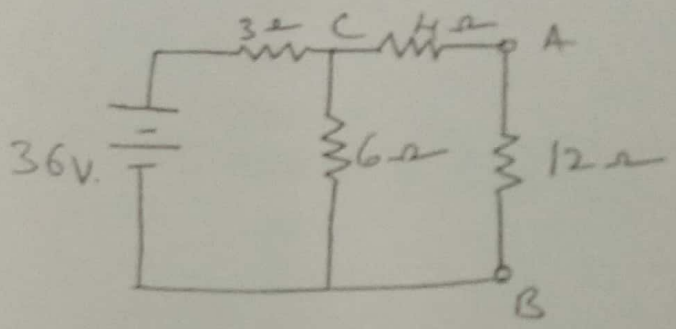
SECTION – D

IV. Answer any FOUR questions. **4X3=12**

19. A solenoid having an air core and 10 cm long has 100 turns and its area of cross section $5cm^2$ find self inductance of the coil.
20. Estimate the value of permittivity of force space from the knowledge of velocity of electromagnetic waves in free space, given absolute permeability of free space $4\pi \times 10^{-7}$ HM^{-1}.
21. A capacitor of 50 μF and inductance of 0.2025 H are connected in series. If the resistance of circuit is negligible, find the frequency at which resonance occurs.
22. Calculate the force acting on a wire of length 0.1m in which current of 8A is following if the wire is kept at an angle of 30^0 to the direction of the magnetic field.
23. A full wave rectifier supplies DC to a load 1 kΩ. If AC voltage applied to the diodes 200-0-200 V. Calculate overage DC current and average DC voltage.

Contd...9

24. Using Norton's theorem, calculate the current flowing through the 12Ω resistors as shown in fig.



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Fourth Semester B.Sc., Degree Examinations

SEPTEMBER/OCTOBER 2022

PHYSICS

(Semester Scheme) (2019 – 20 onwards)

SSD 710: PAPER – IV: ELECTRICITY AND ELECTROMAGNETIC THEORY

Time: 3 hrs.] *[Max. Marks: 50*

Instructions to the candidates:

1. *This question paper consists of THREE sections A, B & C.*
2. *Answer SEVEN questions in Section – A, SIX questions in Section – B and FOUR questions in Section – C.*
3. *Draw neat labeled, diagrams wherever necessary.*
4. *Take necessary data from tables.*
5. *Symbols have their usual meanings*
6. *Usage of Scientific Calculator is allowed.*

SECTION – A

I. Answer SEVEN questions: 7 x 2 = 14 Marks

1. Explain the term time constant during charging and discharging of RC circuit.
2. What is the Q factor in the LCR circuit? How it depends on R?
3. State and Explain Norton's theorem.
4. Write any two applications of Ballistic Galvanometer.
5. Derive the expression for the RMS value of a sinusoidal AC.
6. Briefly explain the working of watt hour meter.
7. Which one of the Maxwell's equations confirm the existence of positive and negative charges? Explain.
8. What is Lorentz force? Explain.
9. State and explain Pointing theorem.

SECTION – B

II. Answer any SIX questions: 6 x 4 = 24 Marks

10. Find the expression for the power consumed in an A.C circuit containing series LCR circuit and hence define power factor.

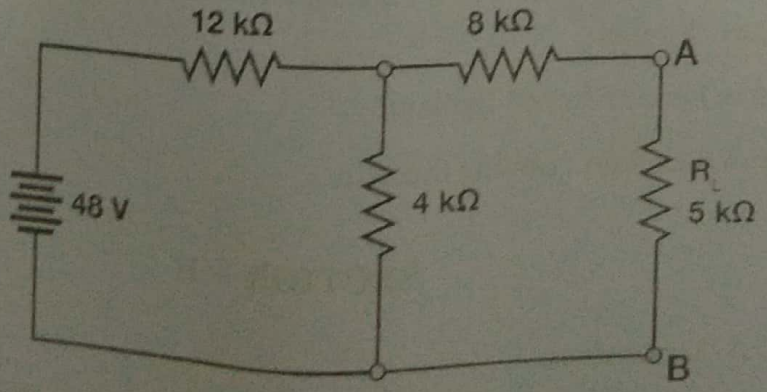
Contd.....2

11. What is Zener breakdown voltage? Explain the working of a zener diode as voltage regulator with neat circuit diagram.
12. Give the theory of Anderson's bridge and obtain the expression for the self-inductance using j notation.
13. State and prove Maximum power transfer theorem under DC condition.
14. A constant e.m.f. is applied to a circuit containing resistance and capacitance is series. Obtain the expression for the charge on capacitor and current during charging.
15. Derive the expression for cut-off frequency in a high pass RC filter. Mention the applications of frequency filters.
16. Prove that electromagnetic waves are transverse in nature.
17. State and explain Ampere's circuital law. Hence obtain an expression for the magnetic field due to straight long conductor.

SECTION – C

III. Answer any FOUR questions: 4 x 3 = 12 Marks

18. A series LCR circuit contains a coil with L = 2.25H, a capacitor having $C = \frac{50}{\pi}\mu f$ and a resistor with R = 50ohm, calculate the impedance. Phase difference between current and voltage (Given Frequency of AC is 50c.p.s).
19. A capacitor of capacitance $0.1\mu f$ is charged by a potential difference of 2 volts. It is then discharged through a ballistic galvanometer which gives a linear throw of 20cm on a scale at a distance of 1m form the mirror of the BG. Calculate the charge sensitivity of the galvanometer.
20. A coil has an inductance of 20H and resistance of 10ohm. It is connected to a 100v battery. How long will it take for the current to reach one half of the final value.
21. Find V_{TH}, R_{TH}, and the load current I_L flowing through the load resistor by *using Thevenin's theorem.*



Contd.....3

22. A solenoid is designed to produce a magnetic field of 0.027T at the Centre. It has a radius 1.4cm and length 40cm and wire carrying a maximum current of 12A What minimum number of turns per unit length must solenoid have?

23. Calculate the magnitude of the Poynting vetor at the surface of the sun. Determine the average solar energy incident on the earth when the sun radiates.

$3.8\times10^{20}W$. Given radius of the sun is $7\times10^{8}m$ and the distance between the earth and sun is $1.5\times10^{11}m$.

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Contd.....4

QP CODE 15423

Fourth Semester B.Sc., Degree Examinations

SEPTEMBER/OCTOBER 2022

PHYSICS

(Semester Scheme 2014 – 18 old syllabus)

SSD 710: PAPER – IV: ELECTRICITY AND ELECTROMAGNETIC THEORY

[Max. Marks: 50

Time: 3 hrs.]

Instructions to the candidates:

1. *This question paper consists of **THREE** sections **A, B & C.***
2. *Answer **SEVEN** questions in **Section – A**, **SIX** questions in **Section – B** and **FOUR** questions in **Section – C.***
3. *Draw neat labeled, diagrams wherever necessary.*
4. *Take necessary data from tables.*
5. *Symbols have their usual meanings*
6. *Usage of **Scientific Calculator** is allowed.*

SECTION – A

7 x 2 = 14 Marks

I. Answer SEVEN questions:

1. Explain the term time constant of RC Circuit.
2. Give any two differences between AC and DC.
3. Briefly explain the concept of skin effect.
4. Define Band pass and Band Stop filter.
5. State Norton's AC Statement.
6. Mention any two applications of Frequency Filters.
7. Define Rectifier. Why diodes are used in rectifier circuit?
8. How Ampere's law is different from Gauss law?
9. What is the significance of displacement current?

SECTION – B

6 x 4 = 24 Marks

II. Answer any SIX questions:

10. Derive an expression for charge variation in a RC Circuit during charging of a capacitor.

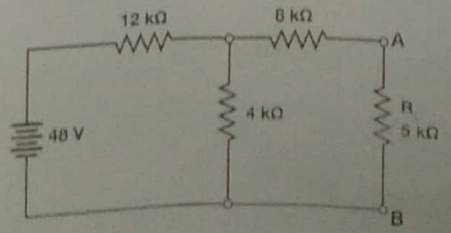
Contd.....5

11. Derive an expression for instantaneous current and impedance in a series LCR circuit fed with alternating emf using 'j' parameter.
12. State and prove maximum power transfer theorem using a simple DC circuit.
13. With a neat circuit diagram, explain the construction and working of full-wave rectifier and obtain an expression for ripple factor.
14. With neat labelled block diagram, explain the construction and working of CRO.
15. Explain the principles and methods of determining capacitance by absolute method and high resistance by leakage using BG.
16. Derive an expression for electromagnetic wave in free space and find velocity of electromagnetic waves.
17. State Ampere's circuital law. Calculate the magnetic field due to a long solenoid using Ampere's law.

SECTION – C

III. Answer any FOUR questions: 4 x 3 = 12 Marks

18. A solenoid has an inductor of 50 Henry and a resistance of 200Ω. It is connected to 120 Vbattery. How long will it take for the current to reach one half its final values.
19. Calculate the resonant frequency of a circuit in which a coil of inductance 0.9 Henry and a capacitor of $0.4\mu F$ are connected in series.
20. Find the cut – off frequency of low pass filter using capacitor of $4.7\mu F$ and resistance of $4.5K\Omega$.
21. Find the current through the R_L and hence potential difference across it by Thevinsing the following circuit.



22. A beam of proton in rocket charge $(e)=1.6\times10^{-19}C$ move at $3\times10^{5}\,m/s$ through a uniform magnetic field of magnitude 2 Tesla. That is directed along positive Z direction, the velocity lies in the XZ plane at an angle of 30° to the Z axis. Find the force on the proton.
23. Estimate the value of permittivity of free space from the knowledge of velocity of electromagnetic waves in free space. $\mu_0 = 4\pi\times10^{-7}\,Hm^{-1}$.

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Sixth Semester B.Sc., Degree Examinations

April /May 2022

(Semester Scheme) (2014-15 onwards)

PHYSICS

SSF611 : Paper VIII : Nuclear Physics and Non-Conventional Energy Sources

Time: 3 hrs.] [Max.Marks:50

Instruction to the Candidates :

1. This question paper consists of THREE Sections A, B, and C.
2. Draw neat and labelled diagrams wherever necessary.
3. Take necessary data from tables.
4. Symbols used have their usual meanings.
5. Usage of Scientific Calculator is allowed.

SECTION - A

I. Answer any SEVEN questions : **7X2=14**

1. What are mirror nuclei and Nuclear Isomers?
2. Explain the Prgton-Neutron hypothesis of nuclear structure.
3. Define the term nuclear cross section and give its unit.
4. Explain the principle of a scintillation detector.
5. Write the properties of neutrino.
6. Write the properties of nuclear forces.
7. What is a quark ? Mention their names.
8. Give the general classification of energy sources.
9. Explain the principle of working of solar street lighting system.

SECTION - B

II. Answer any SIX questions. **6X4=24**

10. State the law of Successive disintegration and obtain an expression for radioactive equilibrium.
11. Explain the principle, construction and working of GM counter.
12. With necessary theory explain the construction and working of a Betatron.

Contd...2

13. Obtain an expression for Q value of a nuclear reaction and hence for threshold energy of an endoergic reaction.
14. Write any four comparisons between a liquid drop and a nucleus. Write and explain the terms of semi-emperical mass formula.
15. Explain the source of stellar energy using proton-proton cycle & Carbon-Nitrogen cycle.
16. Discuss the attitude effect and latitude effect of cosmic rays with necessary diagrams.
17. Write brief short notes on tidal energy in sea and ocean thermal electric conversion.

SECTION – C

III. Answer any FOUR questions: **4X3=12**

18. Evaluate the age of the earth using the principle of radioactive dating. Given the half-lives and present relative abundances of U-238 and U-235 isotopes are 4.5×10^9 years, 99.3% and 7×10^8 years, 0.7% respectively.
19. The half-life of C-14 isotope is 5568 years. In how many years 128g of this isotope will reduce to lg?
20. Deuterons, the nucleus of heavy hydrogen, are accelerated in a cyclotron. Determine the frequency of the voltage source, if the value of magnetic field strength in the cyclotron makes 1.5 T and the mass of deuterons is 3.3×10^{-27} kg. Determine the cyclotron radius for particles, which leave the cyclotron with a kinetic energy of 16 MeV.
21. Find the energy needed to remove a neutron from Ca-42 (41.95877amu) to form Ca-41 (40.962278amu). Let the mass of neutron be 1.008665amu.
22. A Geiger Muller counter collects 10^7 electrons per discharge. The average current the circuit is 1.333×10^{-11}. Amperes. Find the counting rate per minute. Given: electron charge $e=1.6 \times 10^{-19}$ Coulomb.
23. How much U-235 mass is lost per day by a nuclear reactor operated at a 10 GW power level if each fission releases an energy of 200 MeV? Assume the average mass of a nucleon as 1.67×10^{-27} kg

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Sixth Semester B.Sc., Degree Examinations

April /May 2022

(Semester Scheme 2014-15 onwards)

PHYSICS

SSF610 : Paper – VII : Solid State Physics and Electronics

Time: 3 hrs.] [Max.Marks:50

Instruction to the Candidates :

1. This question paper consists of THREE Sections A, B, C.
2. Take necessary data from tables.
3. Symbols have their usual meanings.
4. Draw neat labelled diagrams wherever necessary.
5. Usage of Scientific Calculator is allowed.

SECTION - A

I. Answer any SEVEN questions : **7X2=14**

1. Explain the classification of solids on the basis of band theory of solids.
2. Give comparison of Compton effect and Raman effect.
3. What are the assumptions of quantum free electron theory of metals ?
4. Explain Meissner effect in superconductivity.
5. What are multivibrators ? Distinguish between different types of multivibrators.
6. Write a neat block diagram of monochrome TV receiver.
7. Construct AND gate and NOT gate using NAND gate.
8. Explain the formation of donor energy level in n – type semiconductor.
9. Explain the working of N channel PET.

SECTION - B

II. Answer any SIX questions. **6X4=24**

10. State Duane – Hunt law. Obtain the expression for shorter wavelength limit in continuous X – ray spectrum.
11. Give the Debye's theory of specific heat of solids and hence discuss the variation of specific heat at lower temperature.

Contd...2

12. Write a note on a) BCS theory of super conductors b) High temperature superconductors.
13. State Demorgan's theorems. Explain the operations of RS flip – flop with logic diagram of hence write the truth table for it.
14. Explain the virtual ground concept of OP-Amp. Obtain the expression for voltage gain when the Op-Amp is in inverting mode.
15. What is Hall effect? Give the theory of Hall effect.
16. What is transistor biasing ? Explain the voltage - divider method of biasing a transistor.
17. With neat block diagram, explain the working of AM super heterostyne radio receiver.

SECTION – C

III. *Answer any FOUR questions:* **4X3=12**

18. For the given Boolean expressions show that

    i) $(A+B)(A+\overline{B})(\overline{A}+C) = AC$ ii) $(\overline{A}+B+C)(\overline{A}+B+\overline{C}) = \overline{A}+B$

19. Calculate Fermi energy of free electrons in silver at ok.

    Given Density of silver = 10.5×10^3 kg/.m^3

    Atomic weight = 108 amu.

20. The K_α - x ray line of molybdenum has a wavelength of 0.7078 A^0. Calculate the wavelength of $K_\alpha - X$ ray line of Cu Given, At. No, of molybdenum = 42 and that of copper = 29 For $K_\alpha - X$ ray line, b = 1.
21. An n type semiconductor specimen has a Hall coefficient $R_H = 3.66 \times 10^{-11}$ m^3 / As. The conductivity of the specimen is found to be 112×10^7 / Ω-m. Calculate the concentration of electron and the electron mobility at room temperature.
22. The h – parameters of a transistor are $h_{ie} = 3$ kΩ , $h_{fe} = 50$ $h_{re} = 7.5 \times 10^{-4}$ and $h_{oe} = 20 \times 10^{-6}$ /Ω. If the load resistance is 1 kΩ calculate i) current gain ii) voltage gain and iii) input impedance.
23. The overall gain of a multistage amplifier is 150. When a negative feedback is used, the gain becomes 15. Find the fraction of the output feedback to the input.

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Sixth Semester B.Sc., Degree Examinations

SEPTEMBER/OCTOBER 2022

PHYSICS

(Semester Scheme) (2019 - 20 onwards)

SSF 611: PAPER – VIII: NUCLEAR AND PARTICLE PHYSICS

Time: 3 hrs.] [Max. Marks: 50

Instructions to the candidates:

1. *This question paper consists of **THREE** sections **A, B & C.***
2. *Answer **SEVEN** questions in **Section – A**, **SIX** questions in **Section – B** and **FOUR** questions in **Section – C.***
3. *Draw neat labeled, diagrams wherever necessary.*
4. *Take necessary data from tables.*
5. *Symbols have their usual meanings*
6. *Usage of **Scientific Calculator** is allowed.*

SECTION – A

I. Answer SEVEN questions: 7 x 2 = 14 Marks

1. Write a brief note on cosmic ray latitude effect.
2. Distinguish between nuclear fission and nuclear fusion.
3. Write a note on radio carbon dating.
4. Explain conservation of baryon number with an example.
5. List the analogies between a charged liquid drop and a nucleus in the ground state.
6. With necessary graphical representation, discuss the main features of the variation of binding energy per nucleon as a function of mass number A.
7. Write the quarks combination for proton and neutron.
8. What is Mossbauer effect? Mention any one of its applications.
9. What are primary and secondary energy sources? Give examples for each.

SECTION – B

II. Answer any SIX questions: 6 x 4 = 24 Marks

10. Discuss the theory of successive disintegration and explain secular radioactive.

Contd.....2

11. Write short notes on:
    a) Formation of cosmic ray shower b) Cherenkov radiation
12. Describe the construction of G.M. counter and explain its working as a particle detector.
13. Give an account of theory, construction and working of a betatron.
14. Derive four factor formula .
15. Explain the Yukawa's theory of nuclear force.
16. What is Q – value of nuclear reaction? Obtain the expression for the Q – value of a nuclear reaction.
17. With necessary diagram explain the solar hot water system.

SECTION – C

III. Answer any FOUR questions: 4 x 3 = 12 Marks

18. Using the empirical relation estimate the size of gold nucleus whose atomic mass number A is 197. (Assume the constant in the relation to be 1.3 fermi).
19. A cyclotron in which the flux density is 1.4 weber$/m^2$ is employed to accelerate protons. How rapidly should the electric field between the dees be reversed? Mass of the proton is $1.67\times10^{-27}Kg$.
20. Find the maximum kinetic energy of the emitted electrons when C – 15 decays via electron decay. Given masses of C – 15 and N – 15 are 15.01060u and 15.00011u (in atomic mass units) respectively. Rest mass of electron is $0.00055u$.
21. Using semiempirical mass formula prove that at low atomic mass number a stable nucleus has same number of protons and neutrons.
22. With the necessary justifications, state which type of fundamental interactions is primarily responsible for the following elementary particle reactions:

    i) $K^+ \rightarrow \mu^+ + \nu + \pi^0$

    ii) $p + \bar{p} \rightarrow \gamma + \gamma$

    iii) $K^- + p \rightarrow \Lambda + \pi^0$

23. A piece of wood from the ruins of ancient dwelling was found to have a C – 14 activity of 17 disintegrations per minute per gram of its carbon content. The C – 14 activity of living wood is 19 disintegrations per minute per gram. How long ago did the tree die from which the wood sample came?

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Contd.....3

Sixth Semester B.Sc., Degree Examinations

SEPTEMBER/OCTOBER 2022

PHYSICS

(Semester Scheme 2014 – 18 old syllabus)

SSF 611: PAPER – VIII: NUCLEAR PHYSICS AND NON – CONVENTIONAL ENERGY SOURCES

Time: 3 hrs.] [Max. Marks: 50

Instructions to the candidates:

1. *This question paper consists of **THREE** sections **A, B & C**.*
2. *Answer **SEVEN** questions in **Section – A**, **SIX** questions in **Section – B** and **FOUR** questions in **Section – C.***
3. *Draw neat labeled, diagrams wherever necessary.*
4. *Take necessary data from tables.*
5. *Symbols have their usual meanings*
6. *Usage of **Scientific Calculator** is allowed.*

SECTION – A

I. Answer SEVEN questions: 7 x 2 = 14 Marks

1. Write a brief note on cosmic ray east – west asymmetry effect.
2. Mention any four characteristic features of nuclear force.
3. Distinguish between nuclear fission and nuclear fusion.
4. Give a short account of electric quadrupole moment of a nucleus.
5. List the analogies between a charged liquid drop and a nucleus in the ground state.
6. What are the limitations of a linear accelerator?
7. Describe briefly any one method to harness the solar energy.
8. Write a note on radio carbon dating.
9. Explain conservation of Lepton number with an example.

SECTION – B

II. Answer any SIX questions: 6 x 4 = 24 Marks

10. What are cosmic ray showers? Discuss the theory of their formation.

Contd.....4

Physics

11. Describe the construction of G.M. counter and explain its working as particle detector.
12. Give an account of theory, construction and working of a betatron.
13. Discuss the theory of successive disintegration and explain transient radioactive equilibrium.
14. Derive Fermi four factor formula.
15. Explain the Yukawa's theory of nuclear force.
16. What is Q – value of nuclear reaction? Obtain the expression for the Q – value of a nuclear reaction.
17. With necessary diagrams explain the solar hot water system.

SECTION – C

III. Answer any FOUR questions: 4 x 3 = 12 Marks

18. A piece of wood from the ruins of ancient dwelling was found to have a C – 14 activity of 13 disintegrations per minute per gram of its carbon content. The C – 14 activity of living wood is 16 disintegrations per minute per gram. How long ago did the tree die from which the wood sample came?
19. Complete these nuclear reactions:
    i) ${}_3Li^6 + ? \rightarrow {}_4Be^7 + {}_0n^1$
    ii) ${}_{17}Cl^{35} + ? \rightarrow {}_{16}Be^{32} + {}_2He^4$
    iii) ${}_0n^1 + {}_8O^{16} \rightarrow ? + {}_2He^4$
20. A.G.M counter wire collects 10^8 electrons per discharge The average current in the circuit is $1.333\times10^{-11}\,amp$. Find the counting rate per minute.
21. A cyclotron in which the flux density is 1.4 weber$/m^2$ is employed to accelerate protons. How rapidly should the electric field between the dees be reversed? Mass of the proton is $1.67\times10^{-27}\,Kg$.
22. Find the maximum kinetic energy of the emitted electrons when C – 15 decays via electron decay. Given masses of C – 15 and N – 15 are 15.01060u and 15.00011u respectively. Mass of electron is $0.00055u$.
23. Giving simple reasoning, state which of interactions is primarily responsible for the following elementary particle reactions:
    i) $K^+ \rightarrow \mu^+ + \nu + \pi^0$
    ii) $p + \bar{p} \rightarrow \gamma + \gamma$
    iii) $K^- + p \rightarrow \Lambda + \pi^0$

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