Reg. No.

# VI Semester B.Sc.4/B.Sc.3 Degree Examination, September/October - 2022
## PHYSICS (Optional)
### Paper - I
### (Repeater/Regular)

**Time : 3 Hours**                                           **Maximum Marks : 80**

*Instructions to Candidates :*   1.   Student can use calculator to solve problems.

2.   Write intermediate steps.

## PART - I

**Answer any Ten of the following questions.**                    (10×2=20)

1. a)   What is meant by unit cell?

   b)   Write any two properties of free electrons in metal.

   c)   Distinguish between intrinsic and extrinsic semiconductor.

   d)   Mention any two uses of super conductivity.

   e)   Write any two properties of r - rays.

   f)   Mention semi - empirical mass formula.

   g)   What is meant by secondary energy source?

   h)   What is declination (f)?

   i)   Write the truth table of NAND gate.

   j)   Convert $(1010)_2$ binary to decimal.

   k)   Calculate the interplanar spacing for (3,2,2) plane in a simple cubic lattice, where lattice constant is $4×10^{-10}$m.

   l)   If the solar attitude angle at a place is $45°20'$ calculate the value of zenith angle.

## PART - II

**Answer any Four of the following questions.**                    (4×5=20)

2.   Explain x-ray diffraction by powder crystal method.

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3.    What is the transition temperature? Mention any three applications of super conductivity.

4.    Explain nucler fission on the basis of liquid drop model.

5.    Describe Angstrom pyrheliometer.

6.    Prove the Boolean expression.

$$(A+B+C).(A+B) = A+B.$$

7.    Protons are accelerated in cyclotron with dees of radius 0.4 m and frequecny of the alternating potential is 10 Mega cycle per second at 10,000 volts. Calculate the

   a)    Speed of proton and

   b)    Kinetic energy of proton (Given - applied field $B = 0.66$ weber/metre$^2$).

## PART - III

**Answer any Four of the following questions.**                    **$(4 \times 10 = 40)$**

8.    Give Debye's theory of specific heat - capacity of a solid.

9.    What is Hall effect? Derive an expression for Hall coefficient. Mention any two applications of Hall effect.

10.   Describe the construction and working of a linear accelerator. Derive the expression for the length of $n^{th}$ tube.

11.   Explain tidal energy. Mention advantages and disadvantages of tidal energy.

12.   Construct the basic gates using NAND gate and write the truth tables.

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## VI Semester B.Sc. Degree Examination, September/October - 2022
### PHYSICS (OPTIONAL)
### Paper - II
### (Repeater/Regular)

**Time : 3 Hours**          **Maximum Marks : 80**

*Instructions to Candidates :*    1)   *USe calculators for calculations.*
                                   2)   *Write intermediate steps.*

### PART - I

**Answer any Ten questions.**            **(10×2=20)**

1. a) Define Fourier transform.

   b) Find the Laplace transform of $e^{at}$.

   c) What is PIN - diode?

   d) Mention the applications of optical fibre.

   e) What is modulation?

   f) What are key words in C-language.

   g) What is D-layer.

   h) Draw the neat symbol of Op-amp.

   i) Mention applications of IC-555 timer.

   j) Write a C - program to print "Good morning".

   k) An optical fibre has following R1.
   $n_1 = 1.5$ and $n_2 = 1.45$ calculate critical angle.

   l) Calculate the modulation factor for AM wave if $V_{max} = 4V$ and $V_{min} = 2V$.

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## PART - II

**Answer any Four of the following.**        **(4×5=20)**

2.   Find the Laplace transform of $f(t) = t^2$ using transform derivative.

3.   Distinguish between step index and graded index optical fibre.

4.   Explain space wave propagation.

5.   Explain the function of various pins of IC-7400 NAND - gate.

6.   Write a C - program to convert Fahrenheit to centigrade using the relation $C = (F - 32)/1.8$.

7.   An audio signal of 5KHz is used to amplitude modulate of 600 KHz. Find.

     a)    Side band frequency.

     b)    Band width.

## PART - III

**Answer any Four of the following.**        **(4×10=40)**

8.   State and explain basic properties of Laplace transform.

9.   Classify optical fibre based on refractive index profile. Hence describe them with typical core and cladding diameter, refractive index profile and mode propagation sketches.

10.   a)   Explain basic data types used in C-language.

     b)   Write a C - program to find largest of three numbers.

11.   What is amplitude modulation? Derive expression for amplitude modulation.

12.   a)   What is an Op-amplifier? Whta are ideal properties of an Op-amplifier?

     b)   Explain the working of summing amplifier using Op-amp.

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**VI Semester B.Sc.3./B.Sc.4. Degree Examination, September/October - 2022**
**MATHEMATICS (OPTIONAL)**
**Differential Equations**
**Paper - I**
**(Repeater/Regulars)**
**(w.e.f. 2016-17)**

Time : 3 Hours                                                                 Maximum Marks : 80

*Instructions to Candidates :*     *Answer all parts.*

## PART -A

Answer any **Ten** of the following.                                          (10×2=20)

1.   a.   Solve for y, $\dfrac{dx}{dt} + wy = 0; \dfrac{dy}{dt} - wx = 0$.

    b.   Solve $\dfrac{dx}{1+y} = \dfrac{dy}{1+x} = \dfrac{dz}{z}$.

    c.   Solve $dx + dy + (x + y + z + 1)dz = 0$.

    d.   Define singular and irregular singular point at $x = x_0$ for the equation $y'' + P(x)y' + Q(x)y = 0$.

    e.   Show that x = 0 is an regular singular point of $x^2 y'' + xy' + \dfrac{(x^2 - 1)}{4} y = 0$.

    f.   With usual notation prove that $P_3(x) = \dfrac{1}{2}(5x^3 - 3x)$.

    g.   Prove that $\sum P_n(x) = \dfrac{1}{\sqrt{2 - 2x}}$.

    h.   Form the partial differential equation by eliminating arbitrary constants a and b from $az + b = a^2 x + y$.

    i.   Find the complete integral of $p(q - \cot y) = \tan x$.

    j.   Solve $q(p^2 z + q^2) = 4$.

    k.   Solve $(D^3 - 3D^2 D' + 3DD'^2 - D'^3)z = 0$.

    l.   Find the particular integral of $(4D^2 - 4DD' + D'^2)z = e^{x+y}$.

                                                                              **P.T.O.**

## PART - B

Answer any **Four** of the following.                                        (4×5=20)

2. Solve for x, $\dfrac{dx}{dt} + \dfrac{dy}{dt} - 2y = 2\cos t - 7\sin t$; $\dfrac{dx}{dt} - \dfrac{dy}{dt} + 2x = 4\cos t - 3\sin t$.

3. Solve $\dfrac{dx}{x^2} = \dfrac{dy}{y^2} = \dfrac{dz}{nxy}$.

4. Find the power series solution at x = 0 for $\left(1 - x^2\right)y'' + 2xy' - y = 0$.

5. Prove that $\left(1 - 2xz + z^2\right)^{-\frac{1}{2}} = \sum z^n P_n(x)$.

6. Find the singular integral of $z = px + qy + c\sqrt{1 + p^2 + q^2}$.

7. Solve $\dfrac{\partial^2 z}{\partial x^2} + \dfrac{\partial^2 z}{\partial x \partial y} - 2\dfrac{\partial^2 z}{\partial y^2} = \cos(2x + y)$.

## PART - C

Answer any **Four** of the following.                                        (4×10=40)

8.  a   Derive the condition for integrability of the equation $Pdx + Qdy + Rdz = 0$, where P, Q and R are functions of x,y,z.

    b.  Solve $\left(e^x y + e^z\right)dx + \left(e^y z + e^x\right)dy + \left(e^y - e^x y - e^y z\right)dz = 0$.

9.  a   Find the power series solution at x = 0 for $\left(1 - x^2\right)y'' + 2y = 0$.

    b.  Solve on series for $4xy'' + 2(1 - x)y' - y = 0$ by Frobenius method at x = 0.

10. a   Prove that $nP_n = (2n-1)xP_{n-1} - (n-1)P_{n-2}, \forall n \geq 2$.

    b.  Prove that $\displaystyle\int_{-1}^{1} \left[P_n(x)\right]^2 dx = \dfrac{2}{2n+1}$, when m = n.

11. a   Explain the method of solving for linear partial differential equation of first order of the form $Pp + Qq = R$, where P, Q and R are the functions of x,y,z.

    b.  Solve $(y + z)p + (z + x)q = x + y$.

12. a   Explain charpit's method for solving the partial differential equation $F(x, y, z, p, q) = 0$.

    b.  Solve $p = (qy + z)^2$ by charpit's method.

## VI Semester B.Sc.3./B.Sc.4. Degree Examination, September/October - 2022
## MATHEMATICS (OPTIONAL)
### Complex Analysis and Ring Theory
### Paper - II
### (Regular & Repeater w.e.f. 2016-17)

**Time : 3 Hours**                                                                                      **Maximum Marks : 80**

*Instructions to Candidates :*          *Answer all parts.*

### PART - A

Answer any **Ten** of the following.                                                                    (10×2=20)

1.    a.    Show that $f(z) = \bar{z}$ is continuous but not analytic at $z = 0$.

      b.    Prove that an analytic function with constant real part is constant.

      c.    Define harmonic function and show that $x^2 - y^2$ is harmonic.

      d.    Evaluate $\int_c \dfrac{1}{z - z_0} dz$, where $c : |z - z_0| = r$.

      e.    State Morera's theorem.

      f.    Expand $f(z) = e^z$ in the form of Taylor's series about $z = 0$.

      g.    Find the residue of $f(z) = \dfrac{z^2}{z^2 + a^2}$ at the pole $z = ai$.

      h.    State Cauchy's inequality.

      i.    Define :
            i.    Zero's.
            ii.   Singular point of an analytic function.

      j.    State Jordan's lemma.

      k.    Define
            i.    Principle ideal and
            ii.   Maximal ideal.

      l.    In a ring $(R, +, \cdot)$ prove that $a(-b) = (-a)b \,\forall\, a, b \in R$.

### PART - B

Answer any **Four** of the following.                                                                   (4×5=20)

2.    State and prove necessary condition for f(z) to be analytic.

**P.T.O.**

3. If f(z) is analytic, then prove that $\left[\dfrac{\partial^2}{\partial x^2}+\dfrac{\partial^2}{\partial y^2}\right]|f(z)|^2 = 4|f'(z)|^2$.

4. Show that $u(x, y) = e^x(x\cos y - y\sin y)$ is harmonic and find f(z) by Milne - Thomson method.

5. State and prove Liouvilles theorem.

6. Prove that $\displaystyle\int_0^{2\pi} \dfrac{1}{3+2\cos\theta}d\theta = \dfrac{2\pi}{\sqrt{5}}$ by using contour integration.

7. Show that the set of all matrices of the form $M = \left\{\begin{bmatrix} a & b \\ 0 & 0 \end{bmatrix}\forall a,b \in R\right\}$ is non commutative ring wihtout unity w.r.t addition and multiplication of matrices.

## PART-C

Answer any **Four** of the following. (4×10=40)

8. a State and prove cauchy's theorem for simply connected regions.

   b. Show that $f(z) = \dfrac{x^3(1+i)-y^3(1-i)}{x^2+y^2}, z \neq 0$ and f(0) = 0 satisfy C-R equations at z = 0 but f(z) is not analytic at z = 0.

9. a. State and prove cauchy's integral formula.

   b. Evaluate $\displaystyle\int_c \dfrac{z-\cos z}{\left(z-\frac{\pi}{2}\right)^3}dz$, where 'C' is a simple closed curve containing $z = \dfrac{\pi}{2}$.

10. a State and prove Taylor's theorem.

    b. Expand $f(z) = \dfrac{1}{z(z-1)(z-2)}$ in the form of series valid for the regions
    i. $|z| < 1$
    ii. $1 < |z| < 2$.

11. a State and prove cauchy's residue theorem.

    b. Evaluate $\displaystyle\int_0^\infty \dfrac{1}{(x^2+1)(x^2+4)}dx$, by using contour integration.

12. a Define Kernel of homomorphism. If $f : R \to R'$ be a homomorphism of R to $R'$ with kernel K, then prove that
    i. K is subring of R.
    ii. K is an ideal of R.

    b. Find the principle ideal of ring R if $R = \{0,1,2,3,4,5\}$ with respect to addition modulo 6.

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**VI Semester B.Sc.3./B.Sc.4. Degree Examination, September/October - 2022**
**MATHEMATICS (OPTIONAL)**
Topology and Laplace Transforms
Paper - III
(Regular and Repeaters w.e.f. 2016-17)

Time : 3 Hours                                    Maximum Marks : 80

*Instructions to Candidates :*     *Answer ALL parts.*

### PART-A

1.  Answer any **Ten** of the following.                    (10×2=20)

    a.   Write the discrete and indiscrete topology an a set X = {a,b,c}.

    b.   Let X = {1,2,3} and $T = \{X, \phi, \{1\}, \{2\}, \{1,2\}, \{2,3\}\}$ be a topology on X. If A = {1,3} find $\overline{A}$.

    c.   Show that (R,U) is a $T_2$ - space.

    d.   Define interior and exterior point of A in (X,T).

    e.   Define base and sub base of topology.

    f.   Find $L(\cos^2 3t)$.

    g.   Find $L\left(\frac{\sin t}{t}\right)$.

    h.   Evaluate $L^{-1}\left[\frac{(1+2s)^2}{s^4}\right]$.

    i.   Evaluate $L^{-1}\left[\frac{S+1}{(S+2)^5}\right]$.

    j.   Show that $L[f'(t)] = SF(S) - f(0)$ where f(t) is continuous function.

    k.   Solve $y'' + 16y = 0$ given y(0) = 0, $y'(0) = 2$.

    l.   Define Heaviside function $H(t-a)$ and find its Laplace transform.

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## PART - B

Answer any **Four** of the following. (4×5=20)

2. In a topological space (X,T) if $A, B \subset X$ then prove that

   i. If $A \subset B$ then $\overline{A} \subset \overline{B}$.

   ii. $\overline{A \cup B} = \overline{A} \cup \overline{B}$.

3. Prove that a non - empty subset A of X is open if and only if its neighbourhood of each of its points.

4. Find Laplace transform of the function $f(t) = \begin{cases} 2 & for\, 0 < t < 3 \\ t & for\, t > 3 \end{cases}$.

5. If f(t) is periodic function of period T>0 then prove that $L\{f(t)\} = \dfrac{1}{1-e^{-ST}} \int\limits_0^T e^{-st} . f(t) dt$.

6. Find $L\{f(t)\}$ where $f(t) = e^{2t} . \cos^2 t + t . \cos 2t$.

7. Solve $\dfrac{d^2 y}{dt^2} + 9y = 25 e^{4t}$ given y(0) =3, $y'(0) = 7$ by using Laplace transform.

## PART - C

Answer any **Four** of the following. (4×10=40)

8. a. Let A be a subset of a topological space (X,T). Then prove that $\overline{A} = A \cup d(A)$.

   b. In a topological space (X,T) of A and B are subsets of X then prove that

   i. $A \subset B \Rightarrow A^o \subset B^o$.

   ii. $(A \cap B)^o \Rightarrow A^o \cap B^o$.

9. a. Prove that every $T_2$ space is $T_1$ space but the converse is not true.

   b. If X = {a,b,c} and $T = \{X, \phi, \{a\}, \{a,c\}\{c\}, \{a,b\}\}$ is topology on X then prove that the set $B = \{\phi, \{a\}, \{c\}, \{a,b\}\}$ is base for T.

**10.** **a.** State and prove second shifting property.

    **b.** Find

        i.    $L(\sin 5t.\cos 3t)$.

        ii.    $L(t.\cosh at)$.

**11.** **a.** If $L(f(t)) = F(S)$ then prove that $L\left[t^n.f(t)\right] = (-1)^n.\dfrac{d^n}{ds^n}\left[F(s)\right]$.

    **b.** Find $L\left[\dfrac{e^{-at}-e^{-bt}}{t}\right]$.

**12.** **a.** State and prove convolution theorem.

    **b.** Using convolution theorem find $L^{-1}\left[\dfrac{1}{(S+2)(S+4)}\right]$.

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**VI Semester B.Sc.3./B.Sc. 4 Degree Examination, September/October - 2022**
**CHEMISTRY (OPTIONAL)**
**Paper - I**

Time : 3 Hours

Maximum Marks : 80

***Instructions to Candidates :***
1. *All questions are compulsory.*
2. *Answer all question in the same answer book.*
3. *Draw neat diagram and give equations wherever necessary.*

## SECTION - A

Answer **any Ten** of the following.                                 (10×2=20)

1.
   a) Calculate the stability constant ($K^1$) of the complex ion $\left[Ag(NH_3)_2\right]^+$ whose dissociation constant is $6\times10^{-8}$.

   b) What are chelates? Give an example.

   c) Mention the factors affecting 10 Dq.

   d) Give the structure of Ferrocene.

   e) What is mutarotation?

   f) Give the structure of fructosazone.

   g) What do you mean by electrophoresis.

   h) Write the importance of vitamin -A, $B_{12}$ and E.

   i) Give Einstein photo electric equation and explain the terms in it.

   j) Define de-Broglie hypothesis.

   k) State Frank condon principle.

   l) Write the selection rule for electronic spectrum.

## SECTION - B

Answer **any Four** of the following.                                 (4×5=20)

2. Write a note on structure and bonding in zeise's salt.

3. Calculate crystal field stabilization energy (CFSE) for high spin and low spin $d^5$ octahedral complex. Mention which of the above complex shows Jahn - Teller distortion.

4. Explain Bergmann synthesis of a Dipeptide.

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5. Give the constitution of citral.

6. Deduce Einstein photo electric equation.

7. How do you determine molar mass of macromolecules by viscometry method.

## SECTION - C

Answer **any Four** of the following.                    (4×10=40)

8. a) Discuss 18 - electron rule with respect to $[Fe(CO)_5]$ and $[Ni(CO)_5]$.

   b) Describe the calculation of magnetic moment using Gouy's method.

9. a) Give the synthesis of $\alpha$ - terpineol.

   b) Using zwitter ionic structure of glycine, explain acid - base properties of amino acids.

10. a) Explain the concept of potential energy curve for bonding and anti bonding molecular orbitals.

    b) Describe the classification of polymers. Based on source, structure and formation.

11. a) Discuss the primary and secondary structure of proteins.

    b) What is dipole moment? Explain the measurement of dipole moment by temperature variation method.

12. a) How will you account for the purple colour of $[Ti(H_2O)_6]^{+3}$ ?

    b) Explain the synthesis of Vitamin - A by Vandrop etal method.

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## VI Semester B.Sc.3./B.Sc.4. Degree Examination, September/October - 2022
## CHEMISTRY (OPTIONAL)
### Paper - II
### (Repeater/Regulars)

Time : 3 Hours                                           Maximum Marks : 80

*Instructions to Candidates :*     *1.   All questions are compulsory.*
*2.   Answer all question in the same answer book.*
*3.   Draw neat diagram and give equation wherever necessary.*

### SECTION - A

**Answer any Ten of the following.**                              (10×2=20)

1.  a)   Write any two factors affecting the $R_f$ value.

    b)   Mention the principle of electrogravimetry analysis.

    c)   Name the micro and macro nutrients present in the soil.

    d)   State selection rule for d-d transitions.

    e)   What are antihistamine drugs? give an example.

    f)   What are Anionic detergents? Give an example.

    g)   What happens ketoximes treated with an acid? Give an example.

    h)   Mention one advantage and structure of TMS.

    i)   State Grothus - Draper Law.

    j)   What is reversible and irreversible cell?

    k)   Construct the cell for the reaction $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$. And indicate which one is anode and cathode.

    l)   Write the conditions of standard cell.

### SECTION - B

**Answer any Four of the following.**                              (4×5=20)

2.   Give brief account of paper chromatography.

3.   Explain the electronic spectrum of $[Ti(H_2O)_6]^{3+}$ complexion.

4.   Write the synthesis and use of Novocaine.

5.   Write the mechanism of Benzillic acid rearrangement reaction.

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6. Write the construction of hydrogen electrode.

7. Explain with a suitable example.

   a) Photo chemical inhibition.

   b) Photosensitization.

## SECTION - C

**Answer any Four of the following.** (4×10=40)

8. a) Explain principle and working of flame - photometry. Write two limitations of flame photometry.

   b) Explain the determination of Nitrogen present in the soil by alkaline permanganate method.

9. a) Explain the manufacture of soaps by hydrolyser process.

   b) Explain the following :

   i) Nuclear shielding and deshielding.

   ii) Spin - Spin - coupling.

10. a) Write electrolytic concentration cell without transfer with salt Bridge.

    b) Define quantum efficiency. Mention any two reasons for high and low quantum efficiency with an example.

11. a) Explain the estimation of copper present in the given solution by electrogravimetric method.

    b) Give the synthesis and use of chloroquine.

12. a) Calculate the e.m.f. of the following cell at 25°C

    $Zn(s) / Zn^{2+}(0.1m) / /Cu^{2+}(1.75M) / Cu(s)$.

    Given :

    $E° Zn^{2+} / Zn = -0.76V$ ·

    $E° Cu^{2+} / Cu = +0.34V$ ·

    b) i) Write the Ideal characteristics of drugs.

    ii) Write Types of electrodes.