NORTH MAHARASHTRA UNIVERSITY, JALGAON

QUESTION BANK

FOR

S. Y. B. Sc.

PHYSICS

(With effect from June, 2008)

Board of Studies in Physics, North Maharashtra University, Jalgaon.

Board of Studies in Physics, in its meeting held on 8th September 2008, has unanimously accepted the question bank prepared by subcommittees appointed by board as per resolution. Following members were present.

1. Prof. Dr. R. S. Patil (Chairman)
2. Prof. Dr. P. P. Patil
3. Prof. S. S. Sonawane
4. Prin. Dr. S. T. Pawar
5. Prof. Dr. S. K. Disawal
6. Prof. M. C. Patil

Pattern of Question Paper

Note: Attempt <u>ALL</u> Questions.

Q. 1 Objective type	(Answer **four** out of six)	8
Q. 2 Short answer type	(Answer **two** out of three)	8
Q. 3 a) Short answer type	(Answer **two** out of three)	6
b) Compulsory	(**two** marks question)	2
Q. 4 Short answer type	(Answer **two** out of three)	8
Q. 5 a) Long answer type		6
OR		
a) Long answer type		6
b) Compulsory	(**two** marks question)	2

   (Dr. R. S. Patil)   (Prof. S. A. Patil)

Chairman, BOS (Physics)   Dean, Science Faculty

S. Y. B. Sc. (Physics)
Question Bank

PHY 211 : MATHEMATICAL METHODS FOR PHYSICS

Committee Members:-

Dr. R. S. Patil   **Convener**, PSGVPM's ASC College Shahada Dist. Nandurbar.

Dr. H. K. Mahajan   Member, SSVPS's L.K.Dr.P.R.Ghogrey Science College, Dhule

Prof. S. M. Patil   Member, ASC College, Pachora

Dr. R. R. Ahire   Member, VVM's S G PATIL ASC College Sakri Dist. Dhule

Prof. A. A. Patil   Member, R C Patel   ASC College Shirpur Dist. Dhule

Dr. I. J. Patil   Member, PSGVPMS College, Shahada, Dist. Nandurbar.

PHY 211 : MATHEMATICAL METHODS FOR PHYSICS

CHAPTER 1 : COMPLEX ALGEBRA

TWO marks Questions

1) Define a complex number.

2) State De Moivre's theorem.

3) Enlist the fundamental operations on complex numbers.

4) What is an Argand diagram?

5) Define modulus and argument of a complex number.

6) Explain subtraction of two complex numbers.

7) State the polar form of a rectangular complex number.

8) Using Argand diagram explain addition of two complex numbers.

9) Using the Argand diagram explain substraction of two complex numbers.

10) If $(3+i)x + (1-i)y = 1+7i$, find x & y.

11) Why complex number, in general, multiple valued?

12) What do you meant by complex conjugate number?

13) If $\sqrt{x+iy}$ = a-ib, show that x = a^2-b^2 & y = -2ab.

14) Find the multiplication of $7 + 5i$ & $-2 + i$.

15) Find the value of $i + i2 + i3 + i4$.

16) Transform $z = 2\sqrt{3} +2i$ into the polar form.

17) Find x and y if, $3x + 2y + i(x+3y) = 6 + 8i$

18) Transform $z = 2\sqrt{3} +2i$ into exponential form.

19) State Euler's formula.

20) Represent $4 + 5i$ & $8 - 9i$ on Argand diagram.

THREE marks Questions

1) Find the value of $(1 + i)^8$.

2) Find p & q if, $2p + q + i(p + 2q) = 7 + 8i$

3) Using exponential form of $\sin\theta$ and $\cos\theta$ prove that, $\sin(\pi/2 - \theta) = \cos\theta$

4) Prove that $\cos^2\theta + \sin^2\theta = 1$.

5) Evaluate, $[\cos\pi/8 + i\sin\pi/8]^4$

6) Express $2e^{5\pi i/6}$ in rectangular form $x+iy$.

7) Evaluate $[\cos\pi/5 + i\sin\pi/5] [\cos2\pi/5 + i\sin2\pi/5]^2$

8) Find the square root of $8 + 6i$.

9) Show that, $e^{i\pi/2} = 1$.

10) If $p + i q = \dfrac{3+2i}{5-3i}$, find p & q.

11) Show that, $e^{i\pi} + 1 = 0$

FOUR marks Questions

1) Find all roots of $(-1)^{1/4}$

2) Using Argand diagram explain the division of two complex numbers.

3) Find cube roots of unity.

4) Explain polar form of complex number.

5) Express in the rectangular form, $(1 + i)^2 + (1 + i)^4$.

6) Show that, $\left(\dfrac{1}{2} + \dfrac{i\sqrt{3}}{2}\right)^6 = 1$

7) If $a+ib = \dfrac{1}{x+iy}$ show that, $(a^2 + b^2)(x^2 + y^2) = 1$

8) State and obtain Euler's formula.

9) Explain the fundamental mathematical operations on complex number.

10) Using Euler's formula, obtain the trigonometric functions, $\sin\theta$, $\cos\theta$, $\text{cosec}\theta$, $\sec\theta$.

11) Find the different values of sixth root of $z = 1 + \sqrt{3}\ i$.

12) Find all possible roots of $i^{1/3}$.

13) Using exponential form of $\sin\theta$ & $\cos\theta$, prove that a) $\sin3\theta = 3\sin\theta - 4\sin^3\theta$

14) Find the value of $(1 + i)^8 + (1 - i)^8$

15) Find the modulus & argument of $\dfrac{3+2i}{3-2i}$

16) Express $\dfrac{i}{(1-i)^2}$ in exponential form.

17) Using exponential form of $\sin\theta$ & $\cos\theta$, prove that $\cos3\theta = 4\cos^3\theta - 3\cos\theta$.

SIX marks Questions

1) Obtain the values of $\sin\theta$ and $\cos\theta$ using Euler's formula , hence prove that,

$\cos(\theta_1 + \theta_2) = \cos\theta_1 \cos\theta_2 - \sin\theta_1 \sin\theta_2$.

2) Obtain the values of $\sin\theta$ and $\cos\theta$ using Euler's formula , hence prove that,

$\sin(\theta_1 + \theta_2) = \sin\theta_1 \cos\theta_2 + \cos\theta_1 \sin\theta_2$.

3) State Euler's formula. Use it to obtain the trigonometric functions $\cos\theta$, $\sin\theta$, $\tan\theta$ and $\cot\theta$.

4) State De Moivre's theorem.Explain the exponential form for powers and roots of a complex number.

5) What is an Argand Diagram? Explain multiplication and division of two complex numbers using an Argand Diagram.

6) Find the different values of the fifth root of $1 + i\sqrt{3}$.

CHAPTER 2 : PARTIAL DIFFERENCIATION

TWO marks Questions

1) Define Partial Differentiation

2) Define total differential when a Physical quantity is function of only one variable.

3) What is the formula for total differential dF, if F=F(x, y)?.

4) If $F(x,y) = e^{\sin x} \cdot \tan xy$; Find F_x for $x = \pi/4$ & $y = 1$.

5) State the equation of represent the chain rule for obtaining differentiation of function

6) What is an implicit function?

7) State the relations between Cartesian and Polar co-ordinates.

8) If $F = X^2 - Y^2$ & $X = r\cos\theta$, $Y = r\sin\theta$; Find $(Fx)y$

9) If $F = X^2 - Y^2$ & $X = r\cos\theta$, $Y = r\sin\theta$; Find $(Fy)x$

10) If $F = X^2 - Y^2$ & $X = r\cos\theta$, $Y = r\sin\theta$; Find $(Fr)\theta$

11) If $F = X^2 - Y^2$ & $X = r\cos\theta$, $Y = r\sin\theta$; Find $(F_\theta)r$

12) If $F = X^2 - Y^2$ & $X = r\cos\theta$, $Y = r\sin\theta$; Find $(Fr)x$

13) If $F = X^2 - Y^2$ & $X = r\cos\theta$, $Y = r\sin\theta$; Find $(Fx)r$

14) If $F = X^2 - Y^2$ & $X = r\cos\theta$, $Y = r\sin\theta$; Find $(Fr)y$

15) If $F = X^2 - Y^2$ & $X = r\cos\theta$, $Y = r\sin\theta$; Find $(Fy)r$

16) If $F = X^2 - Y^2$ & $X = r\cos\theta$, $Y = r\sin\theta$; Find $(Fx)\theta$

17) If $F = X^2 - Y^2$ & $X = r\cos\theta$, $Y = r\sin\theta$; Find $(F_\theta)x$

18) If $F = X^2 - Y^2$ & $X = r\cos\theta$, $Y = r\sin\theta$; Find $(Fy)\theta$

19) If $F = X^2 - Y^2$ & $X = r\cos\theta$, $Y = r\sin\theta$; Find $(F_\theta)y$

20) If $F(x,y) = x^3 y - x y^3$; Find Fx and Fy.

21) If $F(x, y) = x^3 y^2 - e^{xy}$, find Fx.

THREE marks Questions

1) If $u = e^x \cos y$, verify that $(\partial^2 u / \partial x^2) + (\partial^2 u / \partial y^2) = 0$.

2) If $u = e^x \cos y$, verify that $\partial^2 u / \partial x \partial y = \partial^2 u / \partial y \partial x$.

3) Given $x + e^y = y$, find $\dfrac{dy}{dx}$.

4) If $f(x,y,z) = x^2 y^3 z$ & $x = \sin (u+v)$, $y = \cos (u+v)$, $z = e^{uv}$, find $\partial f / \partial u$ & $\partial f / \partial v$.

5) If $F(x,y) = x^3 y - e^{xy}$; find F_x , F_y.

6) If $F(x,y) = x^3 y - e^{xy}$; show that, $F_{xy} = F_{yx}$.

7) If $u = e^x$, verify that, $(\partial^2 u / \partial x^2) + (\partial^2 u / \partial y^2) = 0$.

8) If $F = \dfrac{x}{y}$, prove that $x\dfrac{\partial F}{\partial x} + y\dfrac{\partial F}{\partial y} = 0$.

FOUR marks Questions

1) Using the idea of total differentials find the approximate value of

$\sqrt{(5.98)^2 + (7.99)^2}$.

2) Using the idea of total differentials find the approximate value of

$\sqrt{(4.98)^2 + (3.03)^2}$.

3) Using the idea of total differentials find the approximate value of

$\sqrt{(12.013)^2 + (4.987)^2}$.

4) If $F = f(x,y) = x^2 - xy + 2y^2$, find Δf & df for $x = 2$, $y = -1$, $\Delta x = 0.01$ & $\Delta y = 0.02$

5) If $f(x,y) = x^2 + y^2$ where $x = r\cos\theta$ & $y = r\sin\theta$, find df/dr, & $df/d\theta$

6) If $F(x,y) = x^3 y^2 - e^{xy}$, Show that $F_{xy} = F_{yx}$.

7) If $F(x,y) = a \ln (x^2 + y^2)$ show that $F_{xx} + F_{yy} = 0$.

8) If $f = x^2 y + xy^2 - 2xy = 1$, show that $\dfrac{f_{xx}}{y} = \dfrac{f_{yy}}{x}$.

9) Find the approximate value of $\sqrt{(12.013)^2 + (4.987)^2}$.

10) Explain the term Partial Differentiation.

11) For a perfect gas, $PV = RT$ where R is the gas constant, if T changes from 400 to $402\,^0$ K and V changes from 5 m^3 to 5.05 m^3, find the approximate change in P.

12) Obtain the partial derivatives $\dfrac{\partial F}{\partial r}$ and $\dfrac{\partial F}{\partial \theta}$, if $F = x\,y$, where $x = r\cos\theta$ and

$y = r\sin\theta$.

13) Find the approximate value of $\sqrt{(5.98)^2 + (8.01)^2}$.

SIX marks Questions

1) If $y = e^{-i(\omega t - kx)}$, show that $\dfrac{\partial^2 y}{\partial x^2} = \dfrac{k^2}{\omega^2}\dfrac{\partial^2 y}{\partial t^2}$.

2) What do you meant by Total Differential? If $F(x,y) = x^2 + 2y^2$. Show that $\Delta F = dF$, Given : $x = 2$, $y = -1$, $\Delta x = -0.01$ and $\Delta y = 0.02$.

3) If $F = f(x, y)$, where $x = x(t)$ and $y = y(t)$, then obtain the equation to find out $\dfrac{dF}{dt}$.

4) The resistance R of a uniform wire of length ℓ and radius r with specific resistance of ρ is given by $R = \rho \ell / \pi r^2$. If the percentage errors in measurements of ℓ and **r** are 2 and 3 respectively, find the maximum possible relative and percentage errors in resistance.

5) The perfect gas equation is $PV = RT$, where the symbols have their usual meanings Show that $\left(\dfrac{\partial P}{\partial V}\right)_T \cdot \left(\dfrac{\partial V}{\partial T}\right)_P \cdot \left(\dfrac{\partial T}{\partial P}\right)_V = -1$.

6) van der Waal's equation of state is $\left(P + \dfrac{a}{V^2}\right)(V - b) = RT$, where the symbols have their usual meanings. Show that $\left(\dfrac{\partial P}{\partial V}\right)_T \cdot \left(\dfrac{\partial V}{\partial T}\right)_P \cdot \left(\dfrac{\partial T}{\partial P}\right)_V = -1$.

7) If $F(x,y) = a \ln(x^2 + y^2)$ show that $F_{xx} + F_{yy} = 0$ and $F_{xy} = F_{yx}$.

CHAPTER 3 : VECTOR ALGEBRA

TWO marks Questions

1) What are the scalar products of rectangular unit vectors **i, j** and **k**?

2) Write formula for **A . (B** x **C)**.

3) Define scalar product of two vectors.

4) Define vector product of two vectors.

5) State the geometrical interpretation of scalar triple product.

6) If **A** x **B** = **A** x **C,** is **B** = **C** necessarily? Explain.

7) Are the vector triple products **A** x **(B** x **C)** and **(A** x **B)** x **C** are equal? Explain.

8) If **A** = 3**i-j+k** and **B** = 2**i**+3**j**+**k** calculate **A .B.**

9) What can you say about **A,** if **A x (B** x **C)**=0 ? (Given: **A≠0, B ≠0, C≠0**)

10) What happens to the scalar triple product if the dot and cross are interchanged?

11) In which plane does the vector triple product lie? Explain.

12) If **A** = 3**i-j+k** And **B**=2**i-3j+4k** determine l**A**l and l**B**l.

13) If **A** = 3**i-j+k** determine unit vector along **A**.

14) Define the scalar triple product of three vectors.

15) If **A** x **B** = 0, what are possible conclusions thatcan be drawn regarding **A** and **B**?.

16) If **A . B** = 0, what are possible conclusions that can be drawn regarding **A** and **B**?.

17) Define the vector triple product of three vectors.

18) For non-zero vectors **A** and **B** if **A** x **B**=0 show that **A** is parallel to **B**.

19) Find the work done in moving an object along a vector **r** =**i**+2**j-k** if the applied force is **F**=2**i** + 2**j** + 4**k**.

20) What can you say about **A,** if **A .(B** x **C)**=0 ? (Given: **A≠0, B ≠0, C≠0**)

THREE marks Questions

1) Show that **A** ˙**(B** x **C)** = - **C . (B** x **A)**.

2) Show that the vectors **A**= **i** + 2**j** + 3**k** and **B** =2**i** + 4**j** + 6**k** are parallel to each other.

3) Determine the constant 'a' so that the vectors **A**=3**i**+2**j-ak** and **B**=2**i**+**j**+2**k** are perpendicular.

4) Prove that **A** ˙**(B** x **C)** = - **B. (A** x **C)**.

5) Prove that $\mathbf{A} \cdot (\mathbf{B} \times \mathbf{C}) = - \mathbf{A} \cdot (\mathbf{C} \times \mathbf{B})$.

6) Show that $\mathbf{A} \cdot (\mathbf{B} \times \mathbf{C}) = (\mathbf{A} \times \mathbf{B}) \cdot \mathbf{C}$

7) Find the angle between $\mathbf{A}=3\mathbf{i}+2\mathbf{j}-6\mathbf{k}$ and $\mathbf{B}=4\mathbf{i} -3\mathbf{j} +\mathbf{k}$.

8) If $\mathbf{A}=2\mathbf{i}-3\mathbf{j}+2\mathbf{k}$, $\mathbf{B}=\mathbf{i}+3\mathbf{j}-2\mathbf{k}$ and $\mathbf{C} =3\mathbf{i}-5\mathbf{j}+4\mathbf{k}$, find $\mathbf{A} \cdot (\mathbf{B} \times \mathbf{C})$.

FOUR marks Questions

1) Using the scalar triple products show that the vectors $\mathbf{A}= \mathbf{i}- \mathbf{j} + \mathbf{k}$, $\mathbf{B}=2\mathbf{i}-\mathbf{j}+4\mathbf{k}$ and $\mathbf{C}= \mathbf{i}-2\mathbf{j}-\mathbf{k}$ are co-planar.

2) Show that the vectors $\mathbf{A}=\mathbf{i}+3\mathbf{j}+\mathbf{k}, \mathbf{B}=2\mathbf{i}-\mathbf{j}-\mathbf{k}$ and $\mathbf{C}=7\mathbf{j}+3\mathbf{k}$ are co-planar.

3) If $\mathbf{A}=\mathbf{i} - 2\mathbf{j} + 2\mathbf{k}, \mathbf{B} = 3\mathbf{i} + \mathbf{j} - 2\mathbf{k}$ and $\mathbf{C} =2\mathbf{i} - \mathbf{j}- \mathbf{k},$find $(\mathbf{A} \times \mathbf{B}) \times (\mathbf{B} \times \mathbf{C})$.

4) Define the Scalar product of two vectors and express it in terms of its components.

5) Show that the vectors $\mathbf{A}=3\mathbf{i}+5\mathbf{j}+2\mathbf{k}$ and $\mathbf{B}=2\mathbf{i}+2\mathbf{j}-8\mathbf{k}$ are perpendicular to each other.

6) Show that, $\mathbf{A} \times (\mathbf{B} \times \mathbf{C}) + \mathbf{B} \times (\mathbf{C} \times \mathbf{A}) + \mathbf{C} \times (\mathbf{A} \times \mathbf{B}) = 0$.

7) If $\mathbf{A}=2\mathbf{i} +2\mathbf{j}-\mathbf{k}$ and $\mathbf{B}=6\mathbf{i}-3\mathbf{j}+2\mathbf{k}$ find angle θ between $\mathbf{A}$ and $\mathbf{B}$.

8) If $\mathbf{A}=2\mathbf{i} +2\mathbf{j}-\mathbf{k}$ and $\mathbf{B}=6\mathbf{i}-3\mathbf{j}+2\mathbf{k}$ find area of parallelogram whose sides are $\mathbf{A}$ and $\mathbf{B}$.

9) Obtain Scalar triple product of three vectors in the form of a determinant.

10) Find the volume of the parallelepiped whose edges are represented by $\mathbf{A}=2\mathbf{i}-3\mathbf{j}-\mathbf{k},$ $\mathbf{B}= \mathbf{i} + 2\mathbf{j} - \mathbf{k}$ and $\mathbf{C}= \mathbf{i} - 2\mathbf{j} + 3\mathbf{k}$.

11) Find the volume of the parallelepiped whose edges are given by $\mathbf{A} = 3 \mathbf{i} – \mathbf{j} + 2\mathbf{k},$ $\mathbf{B} = 2\mathbf{i} - 3\mathbf{j} + 4\mathbf{k}$ and $\mathbf{C} = \mathbf{i} + 2\mathbf{j} - \mathbf{k}$.

12) Show that, $(\mathbf{A} \times \mathbf{B}) \cdot (\mathbf{C} \times \mathbf{D}) = (\mathbf{A} \cdot \mathbf{C}) (\mathbf{D} \cdot \mathbf{B}) - (\mathbf{A} \cdot \mathbf{D}) (\mathbf{B} \cdot \mathbf{C})$.

13) Define the vector product of two vectors and express it in terms of its components.

14) Find the constant λ such that the vectors $\mathbf{A} = 2\mathbf{i} - \mathbf{j} + \mathbf{k}, \mathbf{B} = \mathbf{i} + 2\mathbf{j} - 3\mathbf{k}$ and $\mathbf{C} =3\mathbf{i} - 4 \mathbf{j} + \lambda \mathbf{k}$ are coplanar.

SIX marks Questions

1) Define Scalar triple product. Show how it can be expressed as a determinant.

2) What is scalar triple product? Explain its geometrical interpretation.

3) Show that, $\mathbf{A} \times (\mathbf{B} \times \mathbf{C}) = \mathbf{B} (\mathbf{A} \cdot \mathbf{C}) – \mathbf{C} (\mathbf{A} \cdot \mathbf{B})$

4) If $\mathbf{A}=\mathbf{i} - 2\mathbf{j} + 3\mathbf{k}, \mathbf{B} =\mathbf{i} +2\mathbf{j}-3\mathbf{k}$ and $\mathbf{C} = 2\mathbf{i} + 3\mathbf{j} + 4\mathbf{k},$ find $\mathbf{A} \cdot (\mathbf{B} \times \mathbf{C})$ and $\mathbf{A} \times (\mathbf{B} \times \mathbf{C})$.

5) Show that the scalar triple product represents the volume of parallelepiped, whose edges represents the given three vectors.

6)   If $\mathbf{A} = 3\mathbf{i} - \mathbf{j} + 2\mathbf{k}$, $\mathbf{B} = 2\mathbf{i} + \mathbf{j} - \mathbf{k}$ and $\mathbf{C} = \mathbf{i} - 2\mathbf{j} + 2\mathbf{k}$ determine $\mathbf{A} \times (\mathbf{B} \times \mathbf{C})$ and

$\mathbf{A} \cdot (\mathbf{B} \times \mathbf{C})$

CHAPTER 4 : VECTOR ANALYSIS

TWO marks Questions

1) Define vector field, Give two examples of each.

2) Define scalar field, Give two examples of each.

3) What do you mean by differentiation of vectors?.

4) Define del operator.

5) What do you mean by gradient of scalar field?

6) Define the divergence of a vector field.

7) Define the curl of vector field.

8) What do you meant by Solenoidal vector field?

9) What do you meant by irrotational vector field?

10) Define field. State two types of field.

11) What are the possible inferences if the divergence at a point is positive and zero?

12) Under what conditions the vector field is solenoidal and irrotational?.

13) Define Lamellar vector field.

14) What are the possible inferences if the divergence at a point is negative and zero?

15) Show that $\nabla^2 = \nabla \cdot \nabla$.

16) State the physical meaning of grad Φ.

17) State the values of position vector $\mathbf{r}$ and r.

18) State the three fundamental operations with ∇ which are of physical interest.

19) Define rotational vector Field.

20) What do you meant by directional derivative.

THREE marks Questions

1) Show that if $\mathbf{r}$ is position vector of a particle, d$\mathbf{r}$/dt is its velocity and d²$\mathbf{r}$/dt² is its acceleration.

2) If ϕ (x,y,z) = x²y + y²z +z²x, find $\nabla\phi$ at a point(1,3,-2).

3) If $\mathbf{r}$ is position vector, find ∇r.

4) Determine the constant 'a' so that the vector $\mathbf{A}$ = (x + y) $\mathbf{i}$ + (y -z)$\mathbf{j}$ +(x + az) $\mathbf{k}$ is solenoidal.

5) Show that $\nabla \cdot \nabla\phi = \nabla^2\phi$.

6) If **V** is a function of x, y, z then show that d **V** =(d**r** $\cdot$ ∇) **V**

7) If $\phi = 2x^3y^2z^2$ evaluate $\nabla \cdot \nabla\phi$

8) Prove that $\nabla \cdot \mathbf{r} = 3$ where **r** is position vector

FOUR marks Questions

1) Explain the terms i) scalar field ii) vector field give examples of each.

2) Explain the physical significance of gradient of scalar.

3) Explain the physical significance of the divergence of a vector.

4) Explain the physical significance of the curl of vector.

5) Find grad r where r is the distance of any point from the origin.

6) If $\mathbf{A} = x^2 z \, \mathbf{i} + xy^2z \, \mathbf{j} - 3yz^2 \, \mathbf{k}$ find curl **A** at the point(1,1,1)

7) Find the constant a, b and c so that a vector

$\mathbf{A} = (2x+y+az) \, \mathbf{i} + (bx+y+z)\mathbf{j} + (2x-cy+z) \, \mathbf{k}$ is irrotational.

8) If **r** is position vector find $\nabla \cdot \mathbf{r}$ and $\nabla \times \mathbf{r}$.

9) If **A** and **B** are irrotational, prove that **A**×**B** is solenoidal.

10) Show that $\nabla (1/ \mathbf{r}) = -\mathbf{r} / r^3$

11) Show that $\nabla^2 (1/r) = 0$.

12) Prove that $\nabla \times \nabla\phi = 0$.

13) Show that divcurl**A** = 0

14) If is **A** irrotational, prove that **A**× **r** is solenoidal where **r** is a position vector.

SIX marks Questions

1) Define gradϕ , div **V** and curl **V**.

2) Define gradient of a scalar field, explain its physical significance.

3) Define divergence of vector field, explain its physical significance.

4) Define curl of a vector field, explain its physical significance.

5) Show that, $\nabla \times (\phi\mathbf{A}) = \phi(\nabla\times\mathbf{A}) + (\nabla \phi)\times\mathbf{A}$

6) Show that $\nabla \cdot (\phi\mathbf{A}) = \phi(\nabla\cdot\mathbf{A}) + \mathbf{A} \cdot (\nabla \phi)$

CHAPTER 5 : VECTOR INTEGRATION

TWO marks Questions

1) Define line integral of a vector.

2) Define surface integral of a vector.

3) Define volume integral of a vector.

4) Define conservative vector field.

5) Define non conservative vector field.

6) Define circulation of a vector field.

7) State Gauss' divergence theorem.

8) State Stoke's theorem.

9) State Green's theorem in plane.

10) Write Green's first and second identities.

THREE marks Questions

1) Obtain Green's first identity using Gauss's theorem.

2) Obtain Green's second identity using Gauss's theorem.

3) Explain line integral of a vector.

4) Explain surface integral of a vector.

5) Explain volume integral of a vector.

FOUR marks Questions

1) Evaluate $\mathbf{A} \cdot \mathbf{dr}$ where $A = 3x^2\mathbf{i} + (2xz - y)\mathbf{j} + z\mathbf{k}$ along the curve $x = 2t^2$; $y = t$, and $z = 4t^2 - t$ from $t = 0$ to $t = 1$.

2) If $\mathbf{R} = (t - t^2)\mathbf{i} + 2t^2\mathbf{j} + 3t\mathbf{k}$, find $\int \mathbf{R}\, dt$.

3) If $\mathbf{F} = 3xy\,\mathbf{i} - y^2\mathbf{j}$, evaluate $\int_{C} \mathbf{F} \cdot \mathbf{dr}$ where C is the curve in the xy plane, $y = x^2$, from (0,0) to (1,2).

4) Find out the volume integral of the divergence of a vector $\mathbf{V} = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$ for the closed surface of a cylinder.

5) Show that, $\int_{S} \mathbf{r} \cdot \mathbf{dS} = 3V$, where $\mathbf{r}$ is position vector of any point on a closed surface and V is volume bounded by the closed surface.

6) Show that, $\int_S \mathbf{r} \cdot \mathbf{dS} = 4\pi,$ where S is surface of sphere of unit radius and centre at origin.

7) Use Green's theorem to evaluate $\int_C ((x^2 + xy) \, dx + (x^2 + y^2) \, dy$ where c is the square formed by the line $y = \pm 1, x = \pm 1$.

SIX marks Questions

1) Verify Gauss theorem for $\mathbf{F} = 4xz \, \mathbf{i} - y^2 \, \mathbf{j} + yz \, \mathbf{k}$ and S is surface of cube bounded by $x = 0, x = 1, y = 0, y = 1, z = 0, z = 1$.

2) If $\mathbf{A} = (2x + 3y^2) \, \mathbf{i} + 6y^2 \, \mathbf{j} - 10 \, xyz \, \mathbf{k}$, find the total work done in moving a particle in a force field given by $\mathbf{F} = 7xy \, \mathbf{i} + 2z \, \mathbf{j} + x \, \mathbf{k}$ along the curve $x = 2t^2$

3) Find the total work done in moving a particle in a force field given by $\mathbf{F} = 7xy \, \mathbf{i} + 2z \, \mathbf{j} + x \, \mathbf{k}$ along the curve $x = 2t^2, \ y = t,$ and $z = t^2 - 3t$ from $t = 0$ to $t = 1$.

4) If $\mathbf{A} = (x^2 + y) \, \mathbf{i} - 10yz \, \mathbf{j} - 8 \, xz^2 \, \mathbf{k}$, evaluate $\int_C \mathbf{A} \cdot \mathbf{dr}$ from (0,0,0) to (1,1,1) along the path $C : x = t, y = t^2, z = t^2$.

5) Verify Stokes theorem for $\mathbf{F} = x^2 \, \mathbf{i} - xy \, \mathbf{j}$ integrated around the square in the plane $z = 0$ and bounded by $x = 0, x = a, y = 0, y = a$.

S. Y. B. Sc. (Physics)

Question Bank

PHY 212 : (A) ELECTRONICS - I

Committee Members:-

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PHY 211 : (A) ELECTRONICS - I

CHAPTER : 1   P-N Junction

TWO marks Questions

1) What do you mean by a p-n junction diode?
2) What is a depletion layer?
3) What do you mean by a potential barrier?
4) Define zero external voltage.
5) Define the terms (a) Breakdown voltage and (b) Knee voltage.
6) Draw the equivalent circuit of Zener diode.
7) Draw the symbol of photo diode.
8) What is Zener breakdown?
9) Define the terms (a) Maximum power current and (b) Peak Inverse Voltage (PIV).
10) Why a junction diode offers very high resistance in reverse biased mode?.
11) Why a junction diode offers very low resistance in forward biased mode?.
12) What do you mean by photo diode?
13) How a Zener diode differs from an ordinary diode?
14) What do you mean by majority and minority current carriers in Transistors?
15) Draw the symbol of LED.
16) What do you mean by doping?
17) What type of material is used for manufacturing LED?
18) Draw the symbol of p-n junction diode.
19) Draw the circuit showing forward biasing of p-n junction diode.
20) Draw the circuit showing reverse biasing of p-n junction diode.

THREE marks Questions

1) Explain the majority and minority current carriers in p-type semiconductors.
2) Write a note on photodiode.
3) State the applications of diodes.
4) Give the uses of Zener diode.
5) Discuss the Avalanche breakdown.

FOUR marks Questions

1) Write a short note on LED.

2) Give the applications of LED.

3) Draw the characteristics of Zener diode and show the following parameters such as I_z, V_z and P_{zmax}.

4) Draw the circuit diagrams of forward and reverse biased pn junction diode.

5) With a neat diagram, explain the action of pn junction under forward bias.

6) With a neat diagram, explain the action of pn junction under reverse bias.

7) With a neat diagram, explain how depletion layer is formed?

8) Distinguish between forward and reverse biasing of pn junction diodes.

9) Explain the limitations in the operating condition of pn junction.

10) What is photodiode? Give its equivalent circuit.

11) Explain the terms (a) Forward current rating and (b) Power rating.

SIX marks Questions

1) Explain I-V characteristics of a pn junction with necessary diagram.

2) What is Zener diode? Give its typical I-V characteristics.

3) What is pn junction? Explain the formation of pn junction.

4) Discuss the behavior of a pn junction, under forward and reverse biasing.

CHAPTER : 2   Rectifiers and Filters

TWO marks Questions

1)   What is rectifier?

2)   What do you mean by rectification?

3)   What do you mean by ripples?

4)   Why do you need a rectifier?

5)   Do you get direct current from a rectifier?

6)   What is ripple factor?

7)   What is voltage regulation?

8)   Explain the need of filtering circuits in a power supply.

9)   Explain the necessity of voltage regulation.

10)   Do you connect more than one filter circuit also in series? Why?

11)   Draw the circuit diagram of series inductor filter.

12)   Draw the circuit diagram of capacitor filter.

13)   Draw the circuit diagram of ð filter.

14)   What is use of filter in a circuit?

THREE marks Questions

1)   What do you mean by filter circuit? State the types of filters.

2)   Why is full wave rectifier more useful than half wave rectifier?

3)   Explain how zener diode maintains constant voltage across the load.

4)   What is rectifier? State the types of rectifiers.

5)   Explain why the output of rectifier is to be stabilized?.

FOUR marks Questions

1)   Describe the action of the capacitor in filter circuit.

2)   Explain Zener diode as a voltage regulator.

3)   Derive an expression for ripple factor.

4)   Find the value of ripple factor for half wave rectifier.

5)   Find the value of ripple factor for full wave rectifier.

6)   With neat diagram explain series inductor filter

7) Explain the working of ð filter Circuit.

8) Why capacitor input filter is preferred over series inductor filter?

9) Show that ripple factor for full wave rectifier is 0.482.

10) Show that ripple factor for half wave rectifier is 1.21.

SIX marks Questions

1) Define ripple factor. Show that ripple factor for full wave rectifier is 0.482.

2) Define ripple factor. Show that ripple factor for half wave rectifier is 1.21.

3) What is Zener diode? Explain how it can be used for voltage regulation in power Supply.

4) Find the values of ripple factor for half wave and full wave rectifier.

5) In power supply filters are used. Why? What are different types of filters used in power supply? Explain working of any one type of filter.

CHAPTER : 3   Bipolar Junction Transistor

TWO marks Questions

1) Draw the symbols of pnp and npn Transistors.

2) Enlist the three transistor configurations.

3) Show by means of a diagram, how you normally connect external batteries in pnp / npn transistor.

4) Draw the circuit diagram of CE configuration of npn / pnp transistor.

5) Draw the circuit diagram of CB configuration of npn / pnp transistor.

6) Define the parameters α and β.

7) In CE configuration, $I_E = 1$ m A, $I_C = 0.95$ mA. Calculate the value of I_B.

8) In a transistor, $\beta = 100$ and $I_B = 10$ μA, find I_C.

9) Find α if $I_C = 0.95$ mA and $I_E = 1$ mA.

10) Why biasing is needed for transistor?

11) State different methods of biasing.

12) Draw the circuit diagram of fixed bias method.

13) State the requirements of biasing circuit.

14) What do you understand by stabilization of operating point?

15) Define stability factor.

16) Which two points are necessary to draw the d.c. load line?

17) What is the utility of d. c. load line?

18) Explain Q point on load line.

19) Draw the output characteristics of a transistor in CE configuration.

THREE marks Questions

1) Show by means of a diagram, how you normally connect external batteries in pnp transistor.

2) Show by means of a diagram, how you normally connect external batteries in npn transistor.

3) Explain CB configuration of transistor.

4) Explain CE configuration of transistor.

5) Explain CC configuration of transistor.

6) In CB configuration, the emitter current is 1.5 mA. Find the base and collector currents if $\alpha = 0.94$.

7) Draw the symbols of pnp and npn transistor. Explain the functions of emitter, base and collector.

8) In CE configuration, the emitter current is 1 mA. Find β if collector current is 0.95 A.

FOUR marks Questions

1) Explain the action of pnp transistor with neat diagram.

2) Explain the action of npn transistor with neat diagram.

3) Enlist the three transistor configurations. Explain any one of them.

4) Define β. Show that $\beta = (\alpha) / (1-\alpha)$.

5) Define α. Show that $\alpha = (\beta) / (1+\beta)$.

6) Define α. Show that it is always less than unity.

7) Draw input and output characteristics of npn transistor, in CE configuration.

8) Draw input and output characteristics of pnp transistor, in CE configuration.

9) Explain fixed biasing in case of pnp transistor. Draw the necessary diagram.

10) Explain fixed biasing in case of npn transistor. Draw the necessary diagram.

11) State the advantages and disadvantages of fixed biasing method of a transistor.

12) Write a short note on d. c. load line.

13) Write a note on operating point.

14) In a transistor, $\beta = 45$, the voltage across 5 KΩ resistance which is connected in the collector circuit is 5 V. Find the base current.

15) In a transistor, $\beta = 440$, $I_B = 68$ μA and $I_E = 30$ mA. Find α. Hence determine the collector current.

SIX marks Questions

1) Why transistor baising is necessary? Explain the working of pnp transistor.

2) Why transistor baising is necessary? Explain the working of npn transistor.

3) Define the parameters α and β. Obtain the relation between them.

4) With the help of a circuit diagram of CE configuration, explain the input and

output characteristics.

5)   What do you understand by d. c. load line? How will you construct it?

CHAPTER : 4   Transistor circuits

TWO marks Questions

1) What do you mean by an amplifier?

2) Define current gain and voltage gain.

3) Draw the frequency response characteristics of an amplifier.

4) Define band width of an amplifier.

5) Define cutoff frequencies.

6) What does a dc load line represents?

7) What is the necessity of an amplifier?

8) What does an ac load line represents?

9) What is the difference between ac and dc load lines?

10) What do you mean by feedback in amplifiers?

11) State the types of feedback.

12) State the advantages of negative feedback.

13) State clearly the difference between the regenerative and degenerative feedback.

14) What is Barkhausen's condition?

15) Which basic principle is used in LC Tank circuit oscillator?

16) What should be the input resistance of an ideal amplifier?

17) What should be the output resistance of an ideal amplifier?

THREE marks Questions

1) What should be the input resistance of an ideal amplifier? Why?

2) What should be the output resistance of an ideal amplifier? Why?

3) Describe the conversion efficiency of an ideal amplifier.

4) What is the main advantage of using CE amplifier?

5) State and explain the condition for sustained oscillation.

6) Why LC Tank circuit is called an oscillator?

7) Draw the circuit diagram of RC coupled amplifier.

FOUR marks Questions

1) Distinguish between regenerative and degenerative feedback.

2) Describe frequency response curve of an amplifier.

3) Explain saturation and cutoff points.

4) Explain how the operating point is located for CE amplifier.

5) Explain why LC circuit is called as a Tank circuit.

6) Distinguish LC Tank circuit oscillator and Hartley oscillator.

7) Explain Barkhausen's criterion for self sustained oscillations.

SIX marks Questions

1) With the help of neat diagram, explain the working of small signal single stage RC coupled CE amplifier.

2) Describe the frequency response curve of RC coupled CE amplifier.

3) Describe the Hartley oscillator. Obtain the resonant frequency of Hartley oscillator

4) What do you mean by feedback in amplifiers? Describe the types of feedback.

5) Describe the LC oscillator. Obtain the resonant frequency of LC oscillator

CHAPTER : 5   Number systems

TWO marks Questions

1) What do you meant by decimal number system?

2) What do you meant by binary number system?

3) Convert the given decimal number 15 into binary number.

4) What do you meant by 1's complement?

5) What do you meant by 2's complement?

6) What is Hexadecimal number system?

7) What is BCD code?

8) Convert the given binary numbers 1101 and 1110 into decimal numbers.

9) Convert $(0.75)_{10}$ into its binary equivalent.

10) Subtract the given binary number 1010 from 1101.

11) Convert $(29)_{10}$ into its binary equivalent.

12) State the radix for decimal and binary number systems.

13) Convert $(11)_2$ into its decimal equivalent.

14) Convert $(10)_2$ into its decimal equivalent.

15) Convert C2 into decimal number.

16) What do you mean by end around carry?

THREE marks Questions

1) Explain BCD code.

2) Explain binary number system in detail.

3) Explain Hexadecimal number system in detail.

4) Convert C5E3 into decimal number.

5) Explain 1's complement subtraction.

6) Explain 2's complement subtraction.

7) Subtract (0101) from (1111) by 2's complement method.

8) State 2's complement of 1010, 1110 and 1111.

FOUR marks Questions

1) Explain the conversion of decimal to binary number by taking a suitable example.

2) Explain the conversion of binary to decimal number by taking a suitable example.

3) Describe end around carry.

4) Convert the given decimal number (5.125) into its binary equivalent.

5) How would you convert decimal fraction into its binary equivalent? Explain.

6) What do you mean by 1's complement and 2's complement?

7) State 2's complements of 0011, 10100, 111001 and 10011.

8) Convert the given decimal number 63718 in to hexadecimal number.

9) Perform the following arithmetics: (a) (10010) - (01101) and (b) (111111111) – (110101011).

10) Convert the given binary number (0101.0010) into its decimal equivalent.

SIX marks Questions

1) Convert the following hexadecimal numbers into decimal numbers: (i) 7EB2, (ii) C5EC and (iii) 1B3D.

2) Explain the conversion of decimal to binary number by taking a suitable example.

3) Explain the conversion of binary to decimal number by taking a suitable example.

4) Explain the conversion of decimal number to hexadecimal number by taking a suitable example.

5) Explain the conversion of hexadecimal number to decimal number by taking a suitable example.

CHAPTER : 6   Digital Circuits

TWO marks Questions

1) Define Logic gate.

2) Enlist the basic Logic gates.

3) Give the symbol and logical expression of AND gate.

4) Give the symbol and logical expression of NOT gate.

5) Give the symbol and logical expression of OR gate.

6) Give the symbol and logical expression of NAND gate.

7) Give the symbol and logical expression of NOR gate.

8) Give the symbol and logical expression of Ex-OR gate.

9) State De-Morgan's first theorem.

10) State De-Morgan's second theorem.

11) What is multivibrator?

12) State the types of multivibrator.

13) What do you mean by Flip-Flops?

14) State the types of Flip-Flops.

15) Draw the symbols of AND and OR gates.

16) Draw the symbols of NOT and Ex-OR gates.

17) Draw the symbols of NAND and NOR gates.

18) State the logical expressions of of AND and OR gates.

19) State the logical expressions of NOT and Ex-OR gates.

20) State the logical expressions of NAND and NOR gates.

THREE marks Questions

1) Explain AND gate with logical expression. Write its truth table.

2) Explain OR gate with logical expression. Write its truth table.

3) Explain NOT gate with logical expression. Write its truth table.

4) Explain NAND gate with logical expression. Write its truth table.

5) Explain NOR gate with logical expression. Write its truth table.

6) Explain Ex-OR gate with logical expression. Write its truth table.

7) State and explain De-Morgans 1st theorem.

8)   Distinguish between astable and monostable multivibrators.

9)   State and explain De-Morgans 2nd theorem.

FOUR marks Questions

1)   Construct AND gate using NAND gate.

2)   Construct OR gate using NAND gate.

3)   Construct NOT gate using NAND gate.

4)   Explain the working of R-S FF.

5)   Explain the working of J-K FF.

6)   Explain the working of D FF.

7)   Distinguish between R-S FF and J-K FF.

8)   Define Logic gate. Explain with examples positive and negative logic.

9)   What do you mean by multivibrator? Define astable, monostable and bistable multivibrators.

10)   Calculate the frequency of astable multivibrator using transistor if $C_1=C_2=100$ pF and $R_1=R_2= 100$ KΩ.

SIX marks Questions

1)   Explain why NAND gate is called as universal building block.

2)   Explain why NOR gate is called as universal building block.

3)   Verify De Morgan's theorems.

4)   What do you mean by a multivibrator? Explain monostable multivibrator using transistors.

5)   What do you mean by a multivibrator? Explain astable multivibrator using transistors.

6)   What do you mean by a multivibrator? Explain bistable multivibrator using transistors.

7)   Draw the J-K FF using NAND gate and explain its working.

S. Y. B. Sc. (Physics)

Question Bank

PHY 212 : (B) INSTRUMENTATION - I

Committee Members:-

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PHY 211 : (B) INSTRUMENTATION – I

CHAPTER: 1 - BASIC PRINCIPLE OF MEASUREMENT

TWO marks Questions

1) Define accuracy.

2) What is precision?

3) What is standard? Enlist different types of standards.

4) Give difference between accuracy & precision.

5) What is an error?

6) Define linearity.

7) Define sensitivity.

8) Enlist different types of errors.

9) What do you mean by term calibration?

10) Define errors in measurements. How they are classified?

11) Specify accuracy of instrument in the form of percentage true value.

12) Describe terminal linearity.

13) Describe independent linearity.

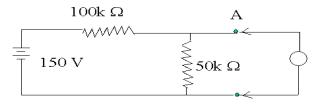### THREE marks Questions

1) What is absolute error, random error & instrumental error?

2) Distinguish between accuracy & precision.

3) What do you mean by term calibration? Classify calibration. Why recalibration is carried out?

4) What is an error? Enlist different types of errors.

5) What are standards? Give the classification of standards.

FOUR marks Questions

1) Define, i) accuracy & ii) precision. What is the difference between them?

2) Explain the terms: i) sensitivity, ii) linearity.

3) Explain in brief; a) Primary calibration, b) secondary calibration, c) Direct calibration, d) Indirect calibration.

4) What is an error? Explain different types of errors.

5) Define an accuracy and precision. Distinguish between accuracy & precision.

6) For the network find the voltage across the terminals AB by using voltmeter having sensitivity i) 1 KΩ / Volt , ii) 20 KΩ / Volt. **[Ans: - i) 30 V, 40%, ii) 48.38 V, 3.24%]**

7) What are the useful steps to be taken in calibration process?

8) Write a note on standards of measurement.

9) Draw the block diagram of functional elements of measurement system.

SIX marks Questions

1) What is calibration? What are the useful steps to be taken in calibration process?

2) State different types of errors & explain each in detail.

3) Explain accuracy & precision in detail.

CHAPTER: 2 - MEASUREMENT OF TEMPERATURE

TWO marks Questions

1) Define the term temperature?

2) What are different temperature scales?

3) State various temperature measurement methods.

4) On what principle non-electrical methods of temperature is based?.

5) On what principle constant volume thermometer works?.

6) What is operating range of constant volume thermometer?

7) State accuracy of constant volume thermometer.

8) On what principle vapour pressure thermometer works?.

9) Why electrical method for temperature measurement is more convenient?

10) Give the two main electrical methods for temperature measurement.

11) What is positive temperature coefficient of resistance?

12) What is negative temperature coefficient of resistance?

13) Up to what temperature the metallic resistance thermometers are very suitable in laboratory and industry. Why?

14) Illustrate resistance temperature characteristics of platinum.

15) What is thermistor? What kind of material is used for thermistor?

16) What makes thermistor an extremely sensitive device? Give its accuracy.

17) Write the expression for temperature-resistance characteristics of a thermistor. State meaning of each symbol.

18) Give the operating range of thermistor.

19) State disadvantages of thermistor?

20) How non-linearity of thermistor can be corrected?

21) What is thermocouple?

22) State the Seebeck effect.

23) State the Thomson effect.

24) State the Peltier effect.

25) Which method is used for the measurement of average temperature of large surface area? Give their types.

26) On what principle selective radiation pyrometer is based?.

27) Why practical total radiation pyrometers are sensitive to limited wavelength band?

THREE marks Questions

1) State working principle of different types of pressure thermometers. State their operating range.
2) Draw neat-labeled diagram of any one of pressure thermometer.
3) State desirable properties of a material used for metallic resistance thermometers.
4) Discuss advantages of platinum resistance thermometer.
5) Distinguish between platinum resistance thermometer and thermistor.
6) Draw neat-labeled diagram of platinum resistance thermometer.
7) State the applications of semiconductor Resistance Sensor.
8) Discuss advantages of Thermistor.
9) Write a note on law of intermediate temperature for thermocouples.
10) Write a note on law of intermediate metals for thermocouples.
11) Discuss advantages of pyrometers.

FOUR marks Questions

1) Explain construction and working of constant volume thermometer.
2) Explain construction and working of vapour pressure thermometer.
3) Platinum is most widely used material as metallic resistance element, Comment.
4) Explain platinum resistance thermometer for temperature measurement.
5) Write a note on electrical resistance thermometers.
6) Explain Siemen's three lead arrangement w.r.t. platinum resistance thermometers.
7) Discuss merits and demerits of platinum resistance thermometer?
8) A platinum resistance thermometer has a resistance of 140.5 Ω and 100.0 Ω at 100^0 C and 0^0C respectively. If its resistance becomes 355.9 Ω when it is in contact with a hot liquid, determine the temperature of the liquid. The temperature coefficient of platinum is 0.0039^0 C^{-1}. **(Ans: 652.30^{0}C)**
9) Explain construction and working of thermistor.
10) Draw various sizes and shapes of thermistors.
11) Write applications of thermistors.
12) For a certain thermistor, β=3140 K & the resistance at 27^oC is known to be 1050 Ω. The thermistor is used for temperature measurement & the resistance measured is as 2330 Ω. Find the measured temperature. **(Ans: 278.77k)**
13) A typical thermistor has 10 kΩ resistance for ice point and 250 Ω for steam point. Find value of β for the thermistor material. **(Ans: β = 3759k)**
14) A bridge consists of 10 kΩ resistances in each arm AB, BC, CD, and arm DA consist of a thermistor. Battery of 10 volts is connected across BD and a galvanometer having

resistance of 2 kΩ is connected across AC. If thermistor resistance changes to 40 kΩ, find current through galvanometer.   **(Ans : 0.2 mA)** (Hint:- Use Thevenin's theorem)

15) Explain construction and working of thermocouple.

16) Sketch thermoelectric response of copper-iron thermocouple. What is impact of neutral temperature region over thermocouple?

17) State basic principle of thermoelectric sensors.

18) Discuss the applications of pyrometers.

19) What are advantages and disadvantages of total radiation pyrometer?

SIX marks Questions

1) State various electrical methods for measurement of temperature. Explain principle, construction and working of platinum resistance thermometer.

2) Explain principle, construction and working of platinum resistance thermometer. Discuss its merits and demerits.

3) Explain principle, construction and working of thermistor. Why thermistors are at least 10 times sensitive than platinum resistance element?

4) What is thermistor? Draw its various sizes and shapes. What is its range of operation? State its advantages?

5) State working principle of thermocouple. Explain construction and working of thermocouple.

6) On what principle selective radiation pyrometer works?. Explain its construction, working and range.

7) What are the types of pyrometers? Explain in detail Ferry's total radiation pyrometer.

CHAPTER: 3 - MEASUREMENT OF PRESSURE

TWO marks Questions

1) What is shock tube?

2) Draw the diagram if frequency response tester.

3) What is Pirani gauge?

4) What are units for measurement of vacuum?

5) Define Torr and Micron.

6) What are pressure scales?

7) Define the following-
   a) Vacuum scale   b) Absolute scale   c) Gauge scale.

8) List various units of pressure used in practice.

9) State range of pressure measured by McLeod gauge.

10) Differentiate high pressure and low pressure.

11) Enlist material used in Manganin alloy.

12) Draw neat diagram of McLeod gauge.

13) State the principle of dead weight tester.

THREE marks Questions

1) Define gauge scale, absolute scale and vacuum scale.

2) Represent different pressure scale with suitable diagram.

3) Explain principle of thermal conductivity gauge.

4) Define pressure and give it different units.

5) Explain shock tube diagrammatically.

FOUR marks Questions

1) Describe frequency response tester.

2) Explain function of Dead weight tester.

3) Describe Pirani Gauge with suitable diagram.

4) Write note on high pressure transducer.

5) Write short note on McLeod gauge.

6) Describe high pressure measurement

7) Describe low pressure measurement using Pirani gauge.

8) Define various units of pressure and give their inter relation between them.

9) State the relation between Absolute pressure and Gauge pressure. Gauge pressure and Vacuum gauge.

SIX marks Questions

1) Explain the principle, construction and working of McLeod gauge with suitable diagram.
2) Explain the principle, construction and working of high pressure transducer with suitable diagram.
3) Describe standard dead weight tester for pressure calibration with suitable diagram.

CHAPTER: 4 - MEASUREMENT OF FLOW

TWO marks Questions

1) What is the importance of flow measurement?

2) Define rate of flow and total flow.

3) Enlist head type flow meter.

4) Enlist flow rate meter.

5) What are sources of error in head flow meter?

6) Give classification of flow meter.

7) Enlist flow measuring methods.

8) What are advantages of Rotameter?

9) What are advantages of Venturi Tube?

10) What are limitations of Rotameter?

11) What are limitations of Venturi Tube?

12) Explain the principle of Head flow meter?

13) What are advantages of Pitot tube?

14) What are limitations of Pitot tube?

15) Explain variable head meters.

16) State Bernoulli's theorem.

17) What are performance characteristics for flow measurement?

THREE marks Questions

1) Define flow. Enlist flow meters.

2) Which parameters are necessary to classify flow meters?

3) Write an expression for Bernoulli's theorem and explain each term in equation of theorem.

4) Give the construction features of Venturi Tube.

5) Draw the diagram to represent principle of Rotameter in;
a) Sharp edge configuration.
b) Alternative arrangement.

6) Distinguish between Venturi Tube and Rotameter.

7) What is the application of flow measurement?

FOUR marks Questions

1) Write note in brief on Venturi Tube.

2) Write note in brief on Pitot tube.

3) Write note in brief on Rotameter.

4) Write note on classification of flow meter.

5) What are limitations and advantages of Rotameter?

6) What are advantages and limitations of Venturi Tube?

7) What are advantages and limitations of Pitot Tube?

8) Derive the relation for Volume flow using Bernoulli's Theorem.

9) Derive flow equation for Rotameter.

10) Derive flow equation for Venturi Tube.

11) What are advantages of head flow meter over other flow meter?

12) State the applications of Pitot Tube.

SIX marks Questions

1) Explain the principle, construction and working of Rotameter.

2) Derive an expression for rate of flow using Bernoulli's theorem.

3) Explain the principle, construction and working of Venturi Tube.

4) Explain the principle, construction and working of Pitot Tube.

CHAPTER: 5 - MEASUREMENT OF MAGNETIC FIELD

TWO marks Questions

1) State the various methods to measure magnetic field that you have studied.

2) Give the principle of search coil method.

3) What is the magnetic flux when the coil is placed perpendicular to a magnetic induction?

4) Draw the constructional diagram for search coil method for measurement of magnetic field.

5) What happens when search coil is placed perpendicular to magnetic field and then removed quickly?

6) What kind of semiconductor material is used in a Hall Probe method for measurement of magnetic field?

7) Define Hall effect.

8) Why search coil method is used for the measurement of low magnetic field?

9) Give the definition of magnetic flux & its MKS units.

10) Give the definition of magnetic flux density & its unit.

11) Give the definition of magnetic field strength & its unit.

12) Give the definition of magnetic lines of force & its unit.

13) Give the definition of magnetic induction & its unit.

THREE marks Questions

1) What is search coil? How is it connected for measurement of magnetic field?

2) Explain Hall Effect.

3) Explain Hall Probe method for the measurement of magnetic field.

4) Define the following terms & its SI units: - i) Magnetic flux, ii) Magnetic flux density, and iii) Magnetic induction.

5) Give the definitions of the following terms & its unit: i) Magnetic field strength, ii) Magnetic flux density, and iii) Magnetic induction.

FOUR marks Questions

1) Explain the principle of search coil.

2) Show that, $\dfrac{BAN}{R} = K\theta(1 + \dfrac{1}{2}\lambda)$, Where all symbols have their usual meanings.

3) Explain the charge conduction mechanism through ballistic galvanometer in search coil method.

4) Explain Hall gauge method to measure the magnetic field.

5) Write short note on Search coil.

6) Write short note on Hall Probe OR Hall gauge meter.

7) Distinguish between magnetic field measurements by Search Coil & Hall Probe method.

8) Describe the method of Magnetic field measurement by Search coil method.

9) Describe the method of Magnetic field measurement by Hall Gauge Meter.

SIX marks Questions

1) State different methods for measurement of magnetic field. Describe Search coil method to measure magnetic field.
2) State different methods for measurement of magnetic field. Describe Hall Gauge method to measure magnetic field.
3) Describe different methods for measurement of magnetic field. Describe any one method to measure magnetic field.

CHAPTER: 6 - ACOUSTIC MEASUREMENTS

TWO marks Questions

1) What is microphone?

2) What is decibel?

3) Define sound pressure level?

4) Define sound power level.

5) Enlist sound pressure level in microbar for Rocket engine, threshold of pain and typewriter.

6) How the intensity of sound varies with distance?

7) Enlist different blocks of sound level meter.

8) What is the formula for SPL and meaning of each term?

9) What is the formula for PWL and meaning of each term? Give faint whisper power level.

10) Which are the factors to be considered for the selections of microphones?

11) State the principle of electrodynamic microphone.

12) What are the disadvantages of the electrodynamic microphone?

13) Why the Carbon microphones are not employed for accurate sound measurements?

14) What are p and p_{ref} in equation, $SPL = 20\log\dfrac{(p)}{(p_{ref})}$ dB? Give typical values of p_{ref}.

15) What are detrimental effects of the noise on man?

16) At what range of frequencies the ear is more responsive?

17) What are W and W_{ref} in equation, $PWL = 10\log\dfrac{(W)}{(W_{ref})}\quad dB$?

THREE marks Questions

1) Explain carbon granules type microphone?

2) Enlist different types of microphone. Explain any one of them.

3) Write characteristics of sound.

4) Explain decibel in detail.

5) Explain the term sound pressure level.

6) Explain the term sound power level.

7) Indicate the acoustical power levels of common sounds on PWL scale.

FOUR marks Questions

1) Draw a labeled diagram of sound level meter.

2) Explain sound pressure levels of common sounds pictorially.

3) Explain the characteristics of sound.

4) The sound pressure level measured at 9 m. from an automobile horn is 110 dB. Determine the sound pressure level at a distance of 18 m. from the horn.

(Ans – 104 dB)

5) Calculate the sound power level of symphony orchestra of 1 W. ($W_{ref} = 10^{-12}$ W).

(Ans - 120 dB)

6) Explain in detail the variations of intensity of sound with distance.

7) Draw a frequency response of sound level meter.

8) Calculate the in decibel, if the pressure of sound measured at 1 m. from unmuffled motor cycle was found to be 6 dynes / cm^2. (P ref = 2 x 10^{-4} dynes / cm^2).

(Ans - 89.54 dB)

9) Explain working of condenser microphone.

10) Explain the construction of carbon microphone.

11) Explain sound pressure level in detail.

12) Explain the construction of electrodynamic microphone.

SIX marks Questions

1) Explain the construction and working of electrodynamic microphone.

2) Explain the construction and working of carbon granules microphone.

3) Explain the construction and working of condenser type microphone.

4) Explain with a block diagram sound level meter.

S. Y. B. Sc. (Physics)

Question Bank

PHY 221 : OSCILLATIONS AND MATTER WAVES

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PHY 221 : OSCILLATIONS AND MATTER WAVES

Chapter 1 : FREE AND DAMPED OSCILLATIONS

Questions for 2 marks

1   What do you meant by free oscillations? Give suitable example.

2   What do you meant by damped oscillations? Give suitable example.

3   What do you meant by undamped oscillations? Give suitable example.

4   Define damping coefficient. Give its unit.

5   Define force constant. Give its unit.

6   State different forces acting on the system if it executes the damped oscillations.

7   Write down the differential equation of the damped oscillations. Explain the meaning of each term involved in it.

8   Show graphically the concept of over-damped motion, critically damped motion and damped harmonic motion.

9   Due to damping effect the frequency of oscillations decreases. Comment.

10 Write down an equation of damped oscillatory motion. How amplitude decreases?.

11 Define 'logarithmic decrement.'

12 Write the formula of log decrement. State the factors on which it depends.

13 Write down the equation of energy of the damped harmonic oscillator.

14 Define quality factor of a damped harmonic oscillator.

15 Draw the circuit diagram of damped oscillatory series LCR circuit.

16 Give the concept of restoring force with suitable example.

17 Give the concept of damping force with suitable example.

18 Show graphically the variation in Q factor according to the damping coefficient, R.

19 State the factors on which damping depend in the series LCR circuit.

Questions for 3 marks

1   Define the following terms: i) Undamped oscillations ii) Damped oscillations

2   Explain the terms: i) Force constant   ii) Damping coefficient

3	Define quality factor of a damped harmonic oscillator. Sketch the graph showing Q- factor varies in accordance with the damping coefficient, R.
4	Define 'logarithmic decrement.' It is found that in water medium the decrement factor is larger than in the air medium. Comment.
5	Draw the circuit diagram of damped oscillatory series LCR circuit. Write down the differential equation for the same.
6	Write down the differential equation of the damped oscillations. State only all the three cases.
7	By giving suitable formulae, compare the frequencies of undamped oscillations and damped oscillations. Give suitable examples.
8	The equation of critically damped motion of an oscillator is, $4\dfrac{d^2 y}{dt^2} = R\dfrac{dy}{dt} + 9y = 0$, Determine the value of R.
9	In a logarithmic decrement experiment, following observations were made: coefficient of damping =0.5 Ns/ m, mass of the oscillator =50 gm, and period = 0.25 S. Find the logarithmic decrement λ.
10	The equation of critically damped motion of an oscillator is, $3\dfrac{d^2 y}{dt^2} = R\dfrac{dy}{dt} + 48y = 0$. Determine the value of R.

Questions for 4 marks

1   Distinguish between damped oscillations and undamped oscillations.

2   What is logarithmic decrement? Give its physical significance.

3   Obtain an expression of logarithmic decrement.

4   Define Q factor of a damped harmonic oscillator. Give its formula. State the factors on which it depends.

5   Write down the differential equation of the damped oscillations. Also write its solution. Hence discuss the condition of critical damping.

6   Write down the differential equation of the damped oscillations. Also write its solution. Hence discuss the condition of over damped motion.

7   Write down the differential equation of the damped oscillations. Also write its

solution. Hence discuss the condition of damped harmonic motion.

8   Write down the differential equation of the damped oscillations. State all the three cases. Compare them graphically.

9   Define :-i) Undamped oscillations ii) Damped oscillations,

      iii) Decrement factor   iv) Q factor

10   Draw the circuit diagram of damped series LCR circuit. Set up the differential equation of the motion for the same.

11   Obtain an expression of Q factor for the damped oscillations.

12   The frequency of a damped oscillator of mass 5 gm is 2 Hz. If the coefficient of damping is 0.157 dyne.s/cm, what is its Q factor? Also determine the logarithmic decrement.

13   A damped harmonic oscillator of mass 0.5 kg is oscillating in a medium having coefficient of damping is 1.0 N.s/m. If the period of oscillations is 0.5 second, find the logarithmic decrement.

14   The restoring force per unit displacement of magnitude 7 N/m acts on an oscillator of mass 30 gm. The coefficient of damping is 0.5 Ns/m. Determine whether the motion is over damped or critically damped or damped oscillatory.

15   The restoring force per unit displacement of magnitude 2 N/m acts on an oscillator of mass 25 gm. The coefficient of damping is 1.0 Ns/m. Determine whether the motion is over damped or critically damped or damped oscillatory.

16   The equation of motion of damped oscillator is of the form,

$4\dfrac{d^2 y}{dt^2} = 20\dfrac{dy}{dt} + 25y = 0$ Determine the values of mass an oscillator, the

coefficient of damping and force constant. Also find the nature of the motion whether the motion is over damped or critically damped or damped oscillatory.

Questions for 6 marks

1   Set up the differential equation of damped harmonic oscillator. Hence obtain its solution.

2	Write down the differential equation of the damped oscillations. Also write its solution. Hence discuss any one case.
3	Set up the differential equation of damped harmonic oscillator. Also write its solution. Hence discuss the condition of damped harmonic motion.
4	Define logarithmic decrement. Give the physical significance of logarithmic decrement. Hence show that, $\lambda = RT/4m$
5	Set up the differential equation for the damped motion of series LCR circuit. Discuss the case, damped oscillatory motion. Hence find the frequency of the circuit.
6	Obtain an expression for the energy of a damped harmonic oscillator. What should be the energy of the oscillator, in the absence of damping?
7	Show that the average energy of a damped harmonic oscillator decreases exponentially as time increases.

Chapter 2 : Forced Oscillations

Questions for 2 marks

1   What do you mean by the forced vibrations?

2   What is resonance?

3   State the four types of resonance in forced oscillation.

4   State the differential equation of motion for the forced oscillations.

5   What is amplitude resonance?

6   What is sharpness of resonance?

7   Define bandwidth of power resonance curve.

8   Define half-width of resonance curve?

9   Define Quality factor.

10   What is the relation between quality factor & bandwidth.

11   Draw a series L-C-R circuit for forced oscillatory system.

12   Draw a curve of variation of amplitude resonance as a function of driving frequency.

13   State the differential equation of forced oscillations in series L-C-R circuit.

Questions for 3 marks

1   What is resonance? Explain any one type.

2   Explain Barton's pendulum to demonstrate mechanical pendulum.

3   Distinguish between forced oscillations & damped oscillations.

4   What is amplitude resonance in case of forced vibrations? State it's condition.

5   Define bandwidth. State the relation between bandwidth & half width.

6   Define Quality Factor. State the relation between quality factor & bandwidth.

7   The equation of forced vibration is expressed in the form

$4\dfrac{d^2y}{dt^2} + 2\dfrac{dy}{dt} + 12y = 30\sin 2t$, where the qualities are in S.I. units. If the motions stands from the origin , find a) Amplitude & b)Period.

8   An alternating emf of 200V is applied in series with circuit containing a resistance of 10Ω, an inductance of 20mH & a condenser of capacity 0.5μF. Calculate a) the resonant frequency b) Current at resonance & c) Q-value of

the circuit.

9 Draw a series L-C-R circuit for forced oscillatory system. State the differential equation for the electrical oscillations.

Questions for 4 marks

1 What is resonance? Explain any two types of resonance occuring in Physics.

2 Show that the average power absorbed by a forced oscillator is equal to the average power dissipated.

3 Explain mechanical resonance with suitable example.

4 What is amplitude resonance? Obtain its condition for amplitude resonance.

5 Define quality factor? Obtain its expressions in terms of bandwidth.

6 Using a power resonance curve show that bandwidth $\Delta q = \dfrac{R}{m}$

7 Obtain the differential equation of forced oscillations.

8 What is the sharpness of resonance? Hence show that $\Delta w = \dfrac{R}{2m}$

9 The equation of forced vibrations of a body is given as

$\dfrac{d^2 y}{dt^2} + 4 \dfrac{dy}{dt} + 8y = 20 \sin 2t$, where the quantities are in S.I. units. If the

motion starts from the origin, find, a)amplitude b)period & c)frequency of the steady state vibrations

10 The amplitude of forced oscillator increase from 0.005cm at very low frequencies to 1cm at the resonant angular frequency at 500rad/sec. Calculate its quality factor & bandwidth.

11 In case of the forced vibrator, the amplitude of vibrations increases from 2mm at very low frequencies to 100mm at the amplitude resonant angular frequency. What is the quality factor of the forced vibrator?

12 A damped harmonic oscillator has m=0.2kg,R=4m-s/m, k=80N/m. Suppose that this oscillator is driven by a force fsinqt, where F=2N, & q=30rad/sec. Determine a) the value of A & δ in the steady-state response given by y=Asin(qt - δ), b)energy dissipated against the damping forced in one cycle & c)the average power input.

13 A series LCR ckt with L=0.05H, c=50µF & R=10Ω is connected to an alternating supply at 230V & 50Hz.Find , a) the resonant frequency , b) current at resonance, c)Q-value of the ckt & d) the bandwidth.

14 The equation of forced vibration of a body is given as ,

$$\frac{d^2y}{dt^2} + 2\frac{dy}{dt} + 400y = 16\sin 2t$$,where the quantities are in S.I. units. If the motion stands from the origin find a) amplitude b) period & c)frequency of steady-state vibrations.

Questions for 6 marks

1 Set up the differential equation of forced oscillation & discuss its solution.

2 Derive an expression for amplitude of forced oscillations.

3 In case of forced vibrations show that the total average energy($\overline{E}$) of the system is constant.

4 An alternative emf is applied to a series LCR circuit. Setup the differential equation for the electrical oscillations. Considering its analogy with the mechanical system, find instantaneous value of charge & current.

5 In case of amplitude resonance, show that,

$$q = \sqrt{\frac{k}{m} - \frac{R^2}{2m^2}}$$. Hence show that, $A_{max} = \frac{F}{Rw}$

6 What is the half width of the resonance curve? Discuss sharpness of resonance curve.

CHAPTER 3 : MATTER WAVES

TWO marks Questions

1. What are matter waves?

2. What is wave particle duality?

3. Explain the de-Broglie's concept of matter waves.

4. Calculate the de-Broglie wavelength of an electron moving with velocity 10^7m/s.

5. Calculate the de-Broglie wavelength of neutron of energy 28.8eV. (Given mass of neutron= 1.67×10^{-27} Kg, Plank's constant=6.62×10^{-34} J.S).

6. What do you meant by group velocity?

7. Define phase velocity.

8. State the importance of Davisson and Germer Experiment.

9. Calculate the de-Broglie wavelength associated with electrons accelerated from rest by potential difference of 200V.

10. What are different forms of Heisenberg's uncertainty relation?

11. Give the statement of Heisenberg's uncertainty principle.

12. Deduce an expression for the de-Broglie wavelength 'λ' of moving particle.

13. Explain the term wave packet.

14. What do you mean by thought experiment?

15. Show that for particle moving with relativistic velocity, group velocity is equal to the particle velocity.

16. State various formulae for group velocity.

17. Show that de-Broglie wavelength $\lambda = h/mv$.

18. If the uncertainty in position of an electron is 4×10^{-10} m, calculate the uncertainty in its momentum.

19. If the uncertainty in the location of a particle is equal to its de-Broglie wave length, what is the uncertainty with velocity?

20. State different formulae for de-Broglie wave length.

21. State the time-energy uncertainty principle.

22. Draw the neat diagram of Davisson and Germer experimental set-up.

23 Find the expression of group velocity in the form of $v_g = \dfrac{dE}{dp}$

24 What are the conclusions of Davisson and Germer Experiment?

25 Discuss the importance of Heisenberg's uncertainty relation.

Questions for 3 marks

1 State and explain de-Broglie hypothesis of matter waves.

2 Show that the wavelength associated with electron accelerated from rest by potential difference of 'V' volts is given by, $\lambda = \dfrac{12.2}{\sqrt{V}}$

3 The velocity of ocean is $\sqrt{\dfrac{g\lambda}{2\pi}}$, Show that group velocity of these waves is half the phase velocity.

4 Obtain the relation, $v_g = w - \lambda \dfrac{dw}{dk}$, where v_g is the group velocity and w the phase velocity.

5 Deduce the uncertainty relation in the form, $\Delta E.\Delta t \geq h$ where the symbols have their usual meanings.

6 Deduce the uncertainty relation in the form, $\Delta L.\Delta \theta \geq h$ where the symbols have their usual meanings.

7 State and explain Heisenberg's uncertainty principle.

8 Show that the group velocity is always equal to the particle velocity.

9 Velocity of the ripple waves in a water tank is equal to $\sqrt{\dfrac{2\pi s}{\rho \lambda}}$, where 'S' is the surface tension, 'λ' is the wavelength and 'ρ' is the density of the liquid. Find out the group velocity.

10 Find out the wavelength of wave associated with a marble ball of mass 20gm moving with a velocity 30m/s.

11 Define the term: i) Phase velocity   ii) Wave packet   iii) Group velocity.

12 Calculate the energy in electron volt of an electron wave of de-Broglie wavelength 3×10^{-2}m. (Given Plank's constant=6.62×10^{-34} J.S).

13 Find the energy of neutron in eV whose de-Broglie wavelength is 1A^o. (Given mass of neutron= 1.674×10^{-27} Kg, Plank's constant=6.60×10^{-34} J.S).

14. Using de-Broglie hypothesis, calculate the wavelength associated with an electron with K.E. of 100 eV. (Given mass of electron= 9.1×10^{-31} Kg, Plank's constant=6.625×10^{-34} J.S).

Questions for 4 marks

1. Velocity of light in a dispersive medium is equal to $\sqrt{\mu/k}$,where μ is refractive index. What is the group velocity?

2. Deduce an expression for the de-Broglie wavelength 'λ' of the moving particle.

3. Deduce the expression for the de-Broglie wavelength in the form of
$$\lambda = \frac{h}{\sqrt{2mev}}$$

4. Derive uncertainty relation $\Delta x.\Delta p \geq h$

5. Estimate the size of the atom using uncertainty relation.

6. Show that uncertainty relation does not allow presence of electrons in the nucleus.

7. Derive the relation between group velocity and particle velocity.

8. Write note on de-Broglie hypothesis of matter waves.

9. Obtain the relation between group velocity and phase velocity.

10. Explain the wave particle duality.

11. Describe the Davisson and Germer Experiment to prove that electrons posses wave nature.

12. Explain one of the applications of Heisenberg's uncertainty principle.

13. Find the de-Broglie wavelength of a electron having 5keV energy.

14. Discuss the phase velocity and group velocity.

15. Write note on particle and wave aspect of matter.

16. Illustrate Heisenberg's uncertainty relation by thought experiment.

17. Define group velocity and show that the expression of group velocity is,
$$v_g = w + k\frac{dw}{dk}$$

18. Write note on wave group.

19. State de-Broglie hypothesis of matter waves. Show that the de-Broglie

wavelength is $\lambda = h/mv$.

20 Using the Heisenberg's uncertainty principle, show that electron cannot be a particle inside the nucleus.

Questions for 6 marks

1 Discuss the wave particle duality. Derive an expression for the de-Broglie wavelength.

2 What is the de-Broglie hypothesis? Show that the wavelength λ associated with an electron of mass m and kinetic energy E is given by $\lambda = \dfrac{h}{\sqrt{2mE}}$

3 State and explain Heisenberg's uncertainty principle and show that $\Delta x.\Delta p_x \geq h$

4 Describe in detail, Davisson and Germer experiment and explain its result.

5 State and establish Heisenberg's uncertainty relation by thought experiment.

6 Obtain an expression for the ground state energy of H-atom using Heisenberg's uncertainty principle.

7 What do you mean by wave velocity and group velocity? Show that the group velocity is always equal to the particle velocity.

8 Establish different forms of Heisenberg's uncertainty relation from position-momentum uncertainty relation

9 Obtain the relations, $v_g = w - \lambda \dfrac{dw}{dk}$ and $v_g = w + k \dfrac{dw}{dk}$, where v_g is the group velocity and w the phase velocity.

Chapter 4 : Wave Mechanics

Questions for 2 marks

1. Prove that $\psi\psi^*$ is always a positive and real quantity?

2. State condition for the normalization of the wave function.

3. Define probability density.

4. Write Schrödinger time dependent and time independent equation?

5. Sketch probability curves and wave function curve for n=2 & n=3 .

6. Write the solution for the Schrödinger equation for the particle moving in one dimensional rigid box.

7. Write simple form of wave function & express it in terms of exponential function.

8. What is mean by wave function ψ?

9. What is Eigen value equation?

10. Can $\psi\psi^*$ be an imaginary? Explain.

11. Define Hamiltonian operator.

12. For a particle in a box state the potential energy when it is inside box & out side the box?

13. Write the expression for $\hat{H}$ & $\hat{E}$ of the equation $\hat{H}\psi = \hat{E}\psi$.

14. What is Schrödinger wave equation?

15. State what will be the probability for large quantum number n ?

Questions for 3 marks

1. Show that ψ=sin x is acceptable wave function.

2. X, P & E are the dynamical variable in classical mechanics states their corresponding operator in quantum mechanics.

3. What is meant by eigen function & eigen values?

4. The wave function for a particle confined to move in a line of length 'L' only is given as $Y = A\sin(n\pi x / L)$, find out the value of normalization constant A?

5. Show that the wave function $\psi = Ae^{ikx}$ for a free particle can not be normalized.

6. Calculate the ground state energy of an electron in a one dimensional rigid box of length $3\times10^{-10\,m}$

7. Sketch ψ & ψ^2 for the state n=1, n=2 & n=3 of a particle in one dimensional box.

Questions for 4 marks

1   Give the physical significance of wave function ψ.

2   Give the condition of a well behaved wave function for n=1, n=2, n=3. Sketch the nature of probability curve & wave function curve

3   Show that energy of particle inside the box is quantized.

4   Obtain the Schrödinger equation for a particle in a rigid box.

5   Starting from Schrödinger time dependent equation set up the time independent equation.

6   Set up the Schrödinger time independent equation.

7   Show that wave functions are different for different values of quantum number n.

8   Show that the energy of a particle in a box is directly proportional to square of the quantum number n.

9   An electron is constrained to move between two rigid wall separated by 1.0×10^{-9}m, calculate the energies of lowest states (m = 9.1×10^{-31} Kg).

10   A particle is confined between rigid walls separated by a distance a. What is the probability that it will be found within a distance a/3 of one wall (i)n=1 (ii)n=2.

11   Starting with wave function $\psi = \sin \sqrt{2mE/h^2}$ x   obtain the normalized wave function.

Questions for 6 marks

1   Obtain Schrödinger's time dependent wave equation for the free particle moving along X- axis . What is eigen value equation?

2   Apply Schrödinger equation for motion of a particle in 1- Dimensional rigid box and Show that the energy is quantized ?

3   Set up Schrödinger time dependent equation .What is the condition that the wave function ψ to be well behaved?

4   Show that the wave function ψ for a particle in a one dimensional rigid box is square integrable. Hence write the normalized wave function in the first three quantum states.

S. Y. B. Sc. (Physics)

Question Bank

PHY 222 : APPLIED PHYSICS - I

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PHY 222 : APPLIED PHYSICS – I

CHAPTER 1 : Geometrical optics

TWO marks Questions

1) Name the phenomena which can be studied with the help of geometrical optics.

2) What do you mean by aberration? Give names of different aberrations.

3) Give the different types of chromatic aberrations.

4) Define spherical aberration. Name any two methods to reduce spherical aberration.

5) Draw the ray diagram to explain axial chromatic aberration.

6) State the two conditions for achromatism.

7) Draw the ray diagram to calculate equivalent focal length of two thin lenses separated by a distance.

8) Define power of a lens? Give its unit.

9) Calculate the power of combination of two thin lenses each of focal length 10cm and placed 10cm apart.

10) What do you mean by lateral chromatic aberration?

11) What do you mean by achromatism & achromatic doublet?

12) What do you mean by thin lens? On which factors the deviation produced by a thin lens depends?

13) Two thin lens in a contact forming an achromatic converging doublet of focal length 30cm have their dispersive power in the ratio 1:2.Calculate their focal lengths.

14) Represent lateral spherical aberration diagrammatically.

15) Represent axial chromatic aberration diagrammatically.

THREE marks Questions

1) What are causes of chromatic aberration?

2) Explain any two methods of minimizing the spherical aberration?

3) What do you mean by equivalent length? Give the expression for equivalent focal length of two thin lenses separated by a distance in air.

4) At what distance the two lenses and focal length +12cm and +15cm are to be kept so that the spherical aberration reduces to a minimum? What should be the

distance to make the combination achromatic?.

5) What are the assumptions in studying the formation of image by lens?. Define aberration.

6) What do you mean by geometrical optics? Give the postulates in study of geometrical optics.

FOUR marks Questions

1) What do you meant by power and lens? Obtain an expression for power of a system of lenses separated by a distance 'x'.

2) Two thin lenses of focal length 10 cm and 20 cm are placed 5cm apart. Calculate the power of their combination.

3) Discuss spherical aberration in detail and name any four methods to minimize spherical aberration.

4) Two lenses of focal length 100 cm and 100/3 cm are co-axially kept at distance 200/3 cm apart. Find the focal length of the combination.

5) Describe longitudinal chromatic aberration? How it can be minimized?

6) Two lenses form an achromatic doublet of focal length 60 cm. The focal length of one lens is 12 cm and its dispersive power of second lens.

7) Compare spherical aberration and chromatic aberration?

8) Explain Achromatism? Give the conditions for achromatism when lenses are in contact and separated by a distance 'x'.

9) Obtain an expression for deviation produced by a thin lens.

10) Dispersion power of crown & flint glasses are 0.0163 and 0.0243 respectively, design achromatic contact doublet of focal length 50cm.

SIX marks Questions

1) Two thin lenses of focal lengths f_1 and f_2 are separated by a distance x. Prove that the focal length 'f' of the combination is given by $1/f = 1/f_1 + 1/f_2 - x/f_1f_2$.

2) What is spherical aberration? Give its types. Explain how spherical aberration is minimized?

3) What do you mean by chromatic aberration? What is achromatism and achromatic doublet? Give the two conditions for achromatism.

4) Derive the formula for equivalent focal length of system of two thin lenses in

contact?

5) Define aberration, chromatic aberration   What do you mean by longitudinal and lateral chromatic aberration. Explain how it can be minimized?

6) i) Explain axial spherical aberration diagrammatically ii) Can you have an achromatic combination of convex and concave lenses of same focal length and same material. If yes how? If no why?

CHAPTER 2 : Interference and Diffraction

TWO marks Questions

1) Interference in thin films occurs by-

   a) Division of wavelength b) Division of wave front

   c) Division of amplitude d) None of these

2) To get bright fringes (Constructive interference) in the reflected part, the path difference must be-

   a) Odd multiple of $\lambda/2$ b) Even multiple of $\lambda/2$

   c) Odd multiple of λ d) None of these

3) An extremely thin film when seen in white light, it appears in the reflected part-

   a) Dark b) Bright

   c) Equally bright d) Coloured

4) The Diameter D_n of the nth dark Newton's ring is given by the formula-

   a) $Dn^2 = (2n+1)\lambda R$ b) $Dn^2 = 4\lambda Rn$

   c) $Dn^2 = 2(2n+1)\lambda R$ d) $Dn = 4\lambda Rn$

5) The bending of waves at the corners is called-

   a) Interference b) Diffraction

   c) Polarization d) None of these

6) Interference fringes are generally of –

   a) equal width b) unequal width

   c) None of these

7) Write the wavelength formula for Newton's ring.

8) The optical path difference in a wedge-shaped film is –

   a) $\mu t \cos(\beta + \gamma)$ b) $2\mu t \cos(\beta + \gamma) + \lambda/2$

   c) $2\mu t \cos(\beta + \gamma) - 3\lambda/4$ d) $2\mu t \cos(\beta + \gamma) - \lambda/2$

9) Interference in Newton' ring experiment based on the principle –

   a) Division of Amplitude b) Division of wave front

   c) Path of light d) None of these

10) On taking Cylindrical Lens instead of spherical Lens in Newton's ring experiment,

then the shape of fringes is –

a) Circular

b) Straight lines perpendicular to the tangent

c) Parallel to tangent but straight lines of varying width

d) None of these

11) Two waves of intensities 9:1 interfere to form fringes. The ratio of maximum and minimum intensities is –

    a) 10:8   b) 9:1   c) 4:1   d) 2:1

12) Interference is possible-

    a) Only by longitudinal waves

    b) Only by transverse waves

    c) Both by longitudinal and transverse waves

    d) None of these

13) The essential condition for Fraunhoffer class diffraction is that-

    a) The incident wave front must be plane

    b) The incident wave front must be spherical

    c) Both the incident and diffracted wave fronts be plane

    d) All the above

14) The correct statement is –

    a) In the phenomenon of diffraction, waves obtained from the coherent light sources superpose.

    b) In the diffraction pattern, the intensity of light at each minima is zero

    c) In the diffraction pattern, the intensity of light at each maxima is the same

    d) In the diffraction pattern, fringes are not of equal width.

15) The Fraunhoffer diffraction due to a single slit can be seen if the slit width is-

    a) 10^{-5} cm   b) 10^{4} cm   c) 1 cm   d) 1 m

16) The condition of minima in the diffraction pattern due to a single slit (width e) is

a) $(e + d) \sin\theta = n\lambda$ b) $e \sin\theta = n\lambda$ c) $e \sin\theta = 1/ n\lambda$

17) The expression for the area of a half period zone is

     a) $\pi b/\lambda$ b) $\pi b\lambda$ c) $\lambda/\pi b$ d) $2\pi b\lambda$

18) The shape of the fringes obtained in a wedge-shaped film is-

     a) circular   b) elliptical   c) straight   d) curved

19) Diffraction of light is observed when the size of obstacle is

     a) very large   b) very small   c) comparable with wavelength of light   d) howsoever large or small

20) The condition of maxima in two slit diffraction is

     a) $a \sin\theta = n\lambda$ b) $(a+b) \sin\theta = n\lambda$ c) $(a+b) \sin\theta = \lambda/n$ d) $a \sin\theta = \lambda/n$

21) Give only the formula of diameter D_n of the nth dark Newton's ring?

22) A grating has 5000 lines per cm. Find the wavelength for n=1 and $\sin\theta = 1$?

23) Give the formula to obtain the maximum number of spectrum by a grating?

24) Give the condition of minima in the diffraction pattern due to a single slit ?

25) Give the condition of maxima in the diffraction pattern due to a single slit ?

26) A grating has 15000 lines per inch. What is its grating element?

27) Write down the condition of formation of spectrum by a grating?

28) What is the total angular width of central maxima in diffraction due to a single slit?

29) What is diffraction?

30) What will be the order of spectrum for normal incidence ($\theta =90^0$) of parallel beam of light of wavelength 5000 A^0 on a grating having 7000 lines per cm?

31) What should be the minimum number of lines per cm on a grating to be used in second order with light of wavelength 5000 A^0?

32) What will be e_{min} in the equation $e\sin\theta = n\lambda$, if $(\sin\theta)_{max}$=1 and n=2

33) Explain the symbol used in the equation $e\sin\theta = n\lambda$?

34) What is interference?

35) What is constructive & destructive interference?

THREE marks Questions

1) What is diffraction of light? Name the type of diffraction.

2) Distinguish between Fresnel and Fraunhoffer diffraction?

3) Due to interference of two waves, the energy becomes zero at some points, Is this energy is dissipated? Explain in short.

4) What are the differences between Newton's ring and Wedge-film fringes?

5) Two light waves of equal intensity interfere. How many times is the intensity at a bright fringe as compared to the intensity of other wave?

6) What are the conditions to obtain interference of light?

7) Write down only the conditions for the constructive and destructive interference in the reflected and transmitted parts due to a film of thickness t and refractive index μ ?

8) Write down the Stoke's law?

9) Draw the ray diagram of experimental setup to obtain Newton's ring.

10) Write down the expression for the area of a half period zone for- a) plane wave front b) spherical wave front? Explain the meaning of the symbols used.

11) A grating has 20,000 lines per cm. Can it be used to measure the wavelength of X- rays? Give a reason to your answer.

12) Describe the intensity distribution in Fraunhoffer diffraction due to a single slit?

13) Two waves of amplitudes 3 mm and 4 mm respectively travel in the same medium and in the same direction. If the phase difference between these waves at a point in their path is $\pi/2$, what will be the resultant amplitude at that point due to this waves?

14) Explain the statement 'Newton's rings are the fringes of equal thickness.'

FOUR marks Questions

1) What is meant by interference of light? State the fundamental conditions for the production of interference fringes.

2) Obtain an expression for the intensity at a point in the interference pattern?

3) Obtain the conditions for maximum and minimum intensity distribution in the interference pattern?

4) Explain analytically the interference of light in the form of wave theory?

5) Discuss the phase change on reflection of light on the basis of stokes treatment?

6) Write short note on phase change on reflection?

7) Write a short note on ' Stoke's treatment'?

8) Prove the relation $\lambda = [D_m^2 - D_n^2] / 4(m - n)R$, where the symbol have their usual meaning.

9) What are Newton's rings? Describe the experimental arrangement for producing Newton's rings.

10) Explain the formation of Newton's Rings.

11) Explain clearly the theory of the experimental arrangement of Newton's ring experiment.

12) How will you determine the wavelength of sodium light by Newton's ring?

13) How will you determine the refractive index of liquid using Newton's ring?

14) Discuss the formation of Newton's ring by transmitted light.

15) Discuss the formation of Newton's ring by reflected light.

16) In a Newton's ring experiment the diameter of the 10th ring changes from 1.40 cm to 1.27 cm when a liquid is introduced between the lens and the plate? Calculate the refractive index of the liquid.

17) Distinguish between Fresnel's diffraction and the Fraunhoffer diffraction.

18) Explain Fresnel's assumption.

19) Show that the area of each half period zone is equal to $\pi b\lambda$.

20) Explain in brief the concept of Fresnel's half period zones.

21) Derive an expression for the angular dispersion of a plane diffraction grating?

22) Explain the phenomenon of diffraction.

23) In a Newton's ring experiment, the Diameter of the 15th ring was found to be 0.590 cm and that of the 5th ring was 0.336 cm and radius of the plano-conex lens is 100 cm, calculate the wavelength of light used?

24) In a Newton's ring experiment, find the radius of curvature of the lens surface in contact with the glass plate when with a light of wavelength 5890 x 10^{-8} cm, the diameter of the third dark ring is 3.2 mm. The light is falling at such an angle that it passes through the air film at an angle of zero degree to the normal.

25) Write short notes on the following-   (INCOMPLETE)

SIX marks Questions

1) Obtain the condition $2\mu t\cos(\beta + \gamma) = n\lambda$ for destructive interference in a thin

wedge shaped film?

2) What is Newton's ring and how are they formed? How can the refractive index of a liquid be determined using these fringes?

3) Explain necessary theory of the Newton's ring method for the measurement of wavelength of light.

4) Describe Newton's ring experiment and explain how it is used to determine the wavelength of Sodium light.

5) Discuss the formation of Newton's ring by i) reflected light   ii) transmitted light.

6) Describe the method for determination of- 1) Wavelength of light 2)   Refractive index of liquid, using Newton's ring.

7) Give the theory of Fraunhoffer diffraction due to single slit and discuss the intensity distribution on the screen.

8) Give the theory of plane transmission grating.

9) What is Fresnel diffraction? Explain rectilinear propagation of light using Fresnel diffraction.

10) Give the theory of Fraunhoffer diffraction due to double slit.

CHAPTER 3 : Optical Instruments

TWO marks Questions

1) In photographic camera, on what factors the opening time of shutter depends?

2) What is f-ratio or f-number?

3) What is angular magnification in telescopes?

4) How will you compare human eye with a fine camera?

5) Describe in short accommodation as a part of process of vision.

6) What do you know about presbyopia?

7) What is an important feature of a good camera?

8) What is a fovea in human eye? What is its use?

9) State and explain the fundamental principle of camera.

10) On what factors, the light entering a camera depends?

11) What is the direct measure of speed of a camera lens?

12) A converging lens has a focal length of 27cm.What is its power in diopter?

13) State the type & nature of two lenses used in simple astronomical telescope.

14) In a photographic camera, what is the size and nature of image on photographic film?

15) In a photographic camera for f-ratios 5.6,8,11,16,22 what are the respective correct exposures in seconds?

16) In the case of human eye, what are the functions of lens system and iris?

17) What is the role of crystalline lens and lens capsule in human eye?

18) Why a telephoto lens is used in camera?

THREE marks Questions

1) What is depth of focus? Describe its importance in camera.

2) State the construction, working & use of telephoto lens in a camera.

3) Describe three main uses of telescopes.

4) In photography, define the terms brightness (or luminance B) and illuminance E. On what factors illuminance E depends?

5) In the case of human eye, explain the concept of visual angle, & angular magnification.

6) Explain the utility of depth of focus and telephoto lens in a photographic camera.

7) In the case of astronomical telescope, draw a neat labeled diagram showing formation of image at infinity and magnification as a ratio of image field angle and a object field angle.

FOUR marks Questions

1) Write a short note on 'photographic camera'?

2) What are entrance and exit pupils of an astronomical telescope? Hence show that the magnification is equal to the ratio of the diameter of the objective to the diameter of exit pupil.

3) A telescope with an objective of focal length 50cm is used to bring into view an object 150cm distant. When the eyepiece is adjusted to form an image at infinity, the magnifying power is 5. (a) Calculate the focal length of eyepiece and (b) Calculate the magnifying power of telescope, if the eyepiece is adjusted to view objects at infinity.

4) What are hypermetropia and myopia? Show diagrammatically, these defects can be corrected by spectacle lenses?

5) What is retina? What is its function? How do cones & rods work?

6) Define power of lens. State its unit. State the values of power of the cornea of the human eye and the entire system of the eye.

7) Define 'visual angle'. Give its short account. What is angular magnification with reference to human eye?

8) Derive an expression for depth of focus in a camera.

9) A person has his near point at 15.0cm and a range of distinct vision of 85cm. What is his range of distinct vision when he wears close fitting spectacles having a power of -0.8diopter?

10) Write a short note on telephoto lens.

11) Describe with suitable diagram, the working principle of photographic camera.

12) Derive an expression for magnifying power of an astronomical telescope when the final image is formed at near point. Draw the necessary ray diagram.

<u>SIX</u> marks Questions

1) Describe a simple photographic camera with suitable diagram.

2) What do you know about refracting astronomical telescope? Explain its normal adjustment and hence prove that magnification is the ratio of focal lengths of objective & the eyepiece.

3) Draw the necessary ray diagram and show that angular magnification is greater than when the final image is formed at the near point.

4) Describe an internal structure of human eye, by drawing a cross sectional diagram showing principle optical components & the retina.

CHAPTER 4 : Michelson Interferometer

TWO marks Questions

1) State the principle of operation of Michelson Interferometer.

2) Which are the conditions to obtain circular fringes in Michelson-Interferometer?

3) Which are the conditions to obtain localized fringes in Michelson-Interferometer?

4) Under which conditions fringes are obtained by using white-light source in Michelson-Interferometer?

5) What are the fringes of equal inclination?

6) What is meant by fringes of equal thickness?

7) What are the fringes of equal chromatic order?

8) In Michelson-Interferometer the planes of the mirrors M1 and M2 are exactly perpendicular to each other. State the nature of air-film and nature of fringes.

9) In Michelson-Interferometer the planes of the mirrors M1 and M2 are not exactly perpendicular to each other. State nature of air film and nature of fringes.

10) In a Michelson interferometer experiment zoo fringes cross the field of view when the movable mirror is displaced through 0.0589 mm. Calculate the wavelength of monochromatic light used.

11) A shift of 'n' circular fringes is observed when the movable mirror of Michelson-Interferometer is shifted by 0.0295 mm Calculate the value of n, if the wavelength of light used is 5900A^o.

12) Write an expression fro visibility of fringes in case of Michelson-Interferometer. What is its value for monochromatic light?

13) Write an expression for minimum visibility (Vmin). What will be the value of Vmin, if the two interfering beams have equal intensities?

THREE marks Questions

1) Explain the function of semi-silvered glass plate in Michelson-Interferometer.

2) Explain why compensating glass plate is used in Michelson Interferometer.

3) State at least three applications of Michelson interferometer.

4) What is meant by 'fringes of equal thicknesses? State an example (experiment) where these fringes are formed.

5) What is meant by fringes of equal inclination? State an example (experiment) where these fringes are observed.

6) Write an expression relating intensity and path difference in case of Michelson interferometer. Interpret the relation.

7) "The displacement of mirror in Michelson interferometer causes shifting of fringes". Comment.

FOUR marks Questions

1) Describe the construction of Michelson interferometer.

2) Explain the formation of circular and localized fringes in Michelson interferometer.

3) Explain the formation of localized and white light fringes in Michelson interferometer.

4) Explain the formation of white light fringes and circular fringes in Michelson interferometer.

5) Explain how wavelength of monochromatic light is determined by Michelson interferometer.

6) Describe the working of Michelson interferometer.

7) Describe the difference between the two glass-plates used in Michelson interferometer.

8) Write a short note on Michelson interferometer

SIX marks Questions

1) Explain the term visibility of fringes in case of Michelson interferometer. Also explain the dependence of visibility on path difference with the help of necessary equations.

2) Write the constructional details of Michelson interferometer. Explain, how circular fringes are obtained.

3) Explain the working of Michelson interferometer and describe how wavelength of monochromatic light is determined.

4) State the applications of Michelson interferometer. Describe the procedure to determine the wavelength monochromatic light.

CHAPTER 5 : MODERN OPTICS

TWO marks Questions

1) What is spontaneous emission?

2) What is stimulated emission?

3) What is indused absorption?

4) What do you maen by metostable state?

5) What do you mean by pumping?

6) What do you mean by active system?

7) What do you mean by population inversion?

8) What do you mean by optical pumping?

9) Sketch the energy level diagram of ruby laser.

10) Sketch the well labelled diagram of exprimental set up of ruby laser.

11) Sketch the well labelled diagram of exprimental set up of He-Ne laser.

12) Sketch the energy level digram of He-Ne Laser.

13) Enlist the applications of LASER.

14) What is LASER ? Name the differents types

15) Sketch the energy level digram for papulation inversion ?

16) What is holography ?

17) What is hologram ?

18) Sketch experimental arrangement to optian hologram

19) What are the charactristics of LASER?

THREE marks Questions

1) What do you mean by laser ? explain the meaning of spontaneous and stimulated emission

2) With engery level diagram explain the term population inversion

3) With neat diagram explain the operation of laser

4) Explain the population inversion in ruby laser

5) Explain the population inversion in He-Ne laser

6) Explain the operation of He-Ne laser

7) Explain the operation of ruby laser

8)   What are the requirements of laser ?

FOUR marks Questions

1)   With neat diagram explain the construction of ryby laser.

2)   With neat diagram explain the construction of He-Ne laser

3)   With engery level diagram explain the operation of ruby laser .

4)   With enegry level diagram explain the operation of He-Ne laser.

5)   In brief explain any four uses of laser .

6)   Explain what are the requirements of laser ?

7)   With neat diagram explain the principle of operation of laser

8)   Give the comparision between spontaneous and stimuleted emission .

9)   With enegry level diagram explain population inversion in laser

10)   With enegry level diagram explain what is the need of metastable state.

11)   A laser beam has a wavelength of 8000 A^0 and aperature 0.005 m . the laser beam is sent to moon . the distance of the moon from the earth is 400000 km . i) caluate the angular spread of the beam . ii) the areal spread whent it reaches the moon .

12)   A laser beam of wavelegnth 6000 A^0 on earth is focused by a tens of diameter 200 cm . on to a creater on the moon . The distance of the moon from the earth is 400000 km . How big is spot on the moon ? neglect the effect of earth atmosphere.

13)   A laser beam has a power of 50mw (milliwatt) . It has an apearture of $5*10^{-3}$ m and it emits light of wavelegnth 7200 A^0 . The beam is focused with a tens of fowl length 10 cm. Calculate the area and the intensity of the image.

14)   The coherence length for sodium light is $2.945*10^{-2}$ m. The wavwelength of sodium light is 5890 A^0. Calculate the number of oscillations corresponding to the coherence length and the coherence time.

SIX marks Questions

1)   What do mean by the following terms. a) Population inversion   b) Pumping c) Metastable state.

2)   Explain in detail the process of stimulated emission? Draw a neat diagram of ruby laser. Explain its operation.

3)   Explain in detail the process of stimulated emission. Draw a neat diagram of ruby

laser. Explain its operation

4) Explain the operation of He-Ne gas laser. Draw its schematic diagram. Describe how stimulated emission takes place with the exchange of energy between the Helium and Neon atoms.

5) Write notes on Ruby LASER?

6) Compare spontaneous emission and stimulated emission.

BEST OF LUCK