(c) Show that Newton's lens equation 5

$$x_1 x_2 = f_1 f_2$$

9. (a) Find the general solution of damped harmonic oscillator with a damping constant μ. And discuss its solution in 8

(i) Overdamped condition ($\mu > \omega_0$)

(ii) Underdamped condition ($\mu < \omega_0$)

(b) What is logarithmic dewment of damped oscillation? 2

Or

10. (a) Show that the amplitude of damped forced oscillator is given by 6

$$A = \frac{F_0/m}{\sqrt{(\omega_0{}^2 - \omega^2)^2 + 4\mu^2\omega^2}}$$

(b) What is amplitude resonance? Show that Q-factor is $Q = \frac{\omega_0}{2\mu_0}$ at resonance. 4

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UG (CBCS) EVEN SEMESTER EXAMINATION, 2023

EDUCATION (B.Sc. B.Ed.)

PHYSICS (HONOURS)

2nd Semester

Course No. : BSPH - 202

(Mathematical Physics, Geometrical Optics, Waves & Oscillation)

Full Marks : 50

Pass Marks : 20

Time : 2 hours

The figures in the margin indicate full marks for the questions

1. (a) Find the value of n for which the vector $r^n \vec{r}$ is solenoidal, where $\vec{r} = x\,\hat{i} + y\,\hat{j} + z\,\hat{k}$ 4

(b) What is directional derivative of a scalar function ϕ ? 1

(c) Find the directional derivative $\phi(r) = \frac{1}{r}$ at (1, -1, -1) in the direction $\vec{r}$. 5

Or

2. (a) Write the volume elements : 2

(i) spherical polar coordinate system

(ii) cylindrical coordinate system.

(b) Obtain the unit vectors $\hat{r}, \hat{\theta}$ and $\hat{\phi}$ in spherical polar coordinate system. 3

(c) State Gauss' divergence theorem. Demonstrate the divergence theorem physically. 5

3. (a) Defin Fourier series of the function $f(x)$ in the interval $[-\Pi, \Pi]$ 1

(b) Find the Fourier series of the function f(x) defined by $f(x) = x$, $0<x<2\Pi$. Also sketch its graph from $x = -4\Pi$ to $x = 4\Pi$ 6

(c) State Gamma function. Show that 3

$\Gamma(n+1) = n\Gamma(n)$

$\Gamma(n+1) = n!$

Or

4. (a) Define orthogonal matrix. 1

(b) Show that $A = \frac{1}{3}\begin{pmatrix} 1 & 2 & 2 \\ 2 & 1 & -2 \\ -2 & 2 & -1 \end{pmatrix}$

is an orthogonal matrix. 1

(c) Find the eigen values and eigen vectors of the matrix A. 5

$$A = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$$

5. (a) State Fermat's principle of light. 1

(b) Using Fermat's principle show that 5+4=9

(i) Laws of reflection

(ii) Snell's law

Or

6. (a) Show that the axial chromatic aberration is equal to the product of dispersive power (ω) and mean focal length (f). 5

(b) Find the condition for achromatism of two lenses in contact. 3

(c) Calculate the focal length of a lens of $\omega_2 = 0.031$ which should be placed in contact with a convex lens of $f_1 = 0.88$ m and $\omega_1 = 0.022$ to make the combination achromatism. 2

7. (a) Explain monochromatic spherical aberration. 4

(b) Derive the minimum condition of spherical aberration of a combination of two plan-convex lenses. 6

Or

8. (a) Find the condition for simultaneous minimum of chromatic and spherical aberration of a system of two lenses separated bya distanced. 3

(b) Show that the equivalent power of Hyugen's eye-piece is $P = \frac{2}{3}p_1$ 2