UG (CBCS) EVEN SEMESTER EXAMINATION, 2024

EDUCATION
(B.Sc. B.Ed.)

2nd Semester

Course No. : BSPH – 202
(Mathematical Physics, Geometrical Optics, Waves & Oscillations)

Full Marks : 50
Pass Marks : 20

Time : 2 hours

The figures in the margin indicate full marks for the questions

(*Answer any five*)

$\vec{A} = xyz\,\hat{\imath} + 3x^2y\,\hat{\jmath} + (xz^2 - y^2z)\,\hat{k}$

1. (a) Evaluate $\vec{\nabla}\varphi$ if (i) $\varphi = \ln r$ and (ii) $\varphi = \frac{1}{r}$

   where $r = (x^2 + y^2 + z^2)^2$ 4

   (b) Find the value of n for wich the vector $\vec{A} = r^n\,\vec{r}$ is solenoidal. 6

Or

2. (a) Evaluate at a point (2, -1, 1)

   if 5

   (b) Show that the spherical coordinate system is orthogonal. 5

3. (a) Define Fourier series of a periodic function. 2

(b) A sinusoidal voltage E_0 sin is passed through a half-wave rectifer that clips the negative portion of the wave. Find the Fourier series of the resulting function

8

Or

4. (a) Define gamma function. Show that 5

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

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

5. Derive the laws of reflection and refraction using Fermat's principle of light. 5+5=10

Or

6. (a) What is the difference between the axial and lateral chromatic aberration? 2

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

(c) Show that the condtion for achromatism of two lenses of same material separated by a distance d is where f_1 and f_2 are focal lengths of two lenses, respectively. 3

7. (a) What is Huygen's eye piece? Draw neat labelled diagram of Huygen's eye piece. 1+2=3

(b) Find the condition for simultaneous minimum of spherical and chromatic aberrations of a system of two lenses separated by a distance d. 4

(c) If m and m_L are lateral and longitudinal magnifications then show that $m_L = -m^2$. 3

Or

8. (a) Discuss briefly the monochromatic spherical aberration. 4

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

9. Show that the displacement of a damped harmonic oscillator is 8

$$x = \frac{1}{2}\, a_0 e^{-\left(\frac{t}{2\tau}\right)} \left[\left(1 + \frac{1}{2\beta\tau}\right) e^{\beta t} + \left(1 - \frac{1}{2\beta\tau}\right) e^{-\beta t}\right]$$

The symbols indicate the usual meanings.

(b) Obtain the displacement of the oscillator in underdamped condition. 2

Or

10. (a) Derive the energy density $E = 2\pi^2 n^2 a^2 \rho$ of a plane progressive wave. 7

(b) Show that the total energy of the plane progressive wave is equal to the $2T_{av}$ where T_{av} is the average K.E. over the complete wavelength. 3

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