AU–386

M.Sc. (Semester-III) (C.B.C.S.) Examination

PHYSICS

Paper—3PHY4 (iv) Photonics-I (Fundamentals of Photonics)

Time : Three Hours]   [Maximum Marks : 80

Note :— ALL questions are compulsory and carry equal marks.

1. (a) Show that $f(x - vt)$ and $f(x + vt)$ represent waves travelling along the positive and negative directions of the x axis respectively.   6

    (b) Light of wavelength λ is incident on a slit of width d. What are the conditions under which the ray approximation is valid ?   4

    (c) An electric field of electromagnetic wave is 4×10^9 V/m in vacuum. Calculate intensity and peak of B-field envelope.   6

OR

    (p) Define plane waves. Write out the expression for a hypothetical plane wave, travelling in the z direction that has maximum amplitude of unity and a wavelength in the visible portion of the spectrum at 514.5 nm.   6

    (q) What is chromatic aberration ? Explain it with the help of optical ray diagram.   6

    (r) Differentiate between phase and group velocity.   4

2. (a) Derive the Kramers-Kronig relations for Reflected Amplitude and Phase.   8

    (b) Write a brief note on angular momentum of a Photon.   5

    (c) Differentiate between Fresnel and Fraunhofer diffraction.   3

OR

    (p) Derive Kramers-Kronig relations for refractive index and absorption spectrum.   8

    (q) Show that both linear and circularly polarized light are special cases of elliptically polarized light.   4

    (r) Define the following terms : (i) Nonlinear medium, (ii) Inhomogeneous medium, (iii) Dispersive medium, (iv) Anisotropic medium.   4

3. (a) Derive the Fourier transform of point spread function. 6

    (b) Using Fourier analysis, prove the collimating property of a convex lens. 8

    (c) How microwave oven door shields us from microwaves but not from visible light ? 2

OR

    (p) What is a spatial filter ? Explain the working of simplest spatial filter. 6

    (q) What is Holography ? How holographic camera differs from conventional camera ? 6

    (r) Find the Fourier transform of delta function. 4

4. (a) What are the limitations of conventional optical microscopy ? 4

    (b) Define the following terms (i) Evanescent waves and (ii) Penetration depth. 4

    (c) Draw and explain the picture showing field distribution of light emanating from a nanoscopic fiber tip. 8

OR

    (p) Draw and explain the different modes of near-field microscopy. 10

    (q) Which two factors limit the resolution in near-field scanning microscopy (NSOM) and photon scanning tunneling microscopy (PSTM) ? What steps are undertaken to improve them ? 6

5. (a) Describe the method to measure the optical tweezers strength. 6

    (b) Draw schematics of the experimental set up of optical tweezers. What precautions does one need to take in designing optical tweezers ? 6

    (c) What are the limitations of Doppler cooling ? 4

OR

    (p) Explain the working of magneto optical trap for atoms. 8

    (q) Write the principle of evaporative cooling technique. 6

    (r) Write any two potential applications of Bose-Einstein Condensate. 2