5/12/2024 FE ALL BRANCHES SEM-II C SCHEME EP-II QP CODE: 10065903

Time:2 Hrs **Marks:60**

N.B:

1) Question No. 1 is compulsory
2) Attempt any three questions from Q. 2 to Q. 6
3) Use suitable data wherever required.
4) The figures to the right indicate full marks

Q. 1 Attempt any five of the following. (15)

(a) How do you increase the resolving power of a diffraction grating?
(b) Differentiate between single-mode and multimode fibre.
(c) Calculate the curl of the vector function $\overrightarrow{A(x,y,z)} = y\cos x\ \hat{x} + (y + e^{x})\ \hat{z}$
(d) Draw the schematic diagram to explain the construction of photo diode optical sensor.
(e) How fast must an electron move in order to have its mass equal to the rest mass of the proton($1.67 \times 10^{-27}\ kg$)?
(f) Obtain the expression for Gauss's law of electrostatics in point form.
(g) What are nanomaterials and what are their different types?

Q. 2

(a) Discuss the phenomenon of Fraunhofer diffraction at a single slit and obtain the conditions for maxima and minima.
A plane grating just resolves two lines in the second order. Calculate the grating element if
$d\lambda$ = 6Å, λ= 6 x 10^{-5} cm, and the width of the ruled surface is 2 cm.
(4+4)
(b) With a neat energy level diagram explain the construction and working of a Nd-YAG Laser. State its application.
In a multimode step index fibre with μ_1 = 1.53, μ_2 = 1.50 and λ = 1µm. If the core radius is 50 µm, calculate the normalized frequency of the fibre and the number of guided modes. (4+3)

Q. 3

(a) Derive the expression of numerical aperture for a step-index fibre. (5)
(b) How fast would a rocket have to go relative to an observer for its length to be contracted to 99 per cent of its original length? (5)
(c) Explain in detail top-down and bottom-up approaches to prepare nanomaterials. (5)

Q. 4

i. Define and explain what is gradient?
ii. If $\alpha(x,y,z) = 3x^2y + y^3z^2$, then Calculate the gradient of $\alpha(x,y,z)$ at (1, 2, -3) (5)

(a) What is absent spectra? Derive the condition for absent spectra in grating. (5)
(b) Distinguish between SEM and AFM. (5)

Q. 5

(a) What is the longest wavelength that can be observed in the fourth order for a transmission grating having 5000 lines per cm? (5)
(a) Obtain the expression for Ampere's circuital law in point form. (5)
(b) Find the maximum resolving power of a grating 2 cm wide with 6000 lines/cm illuminated by a light of wavelength 5890 Å (5)

Q. 6

(a) With the schematic diagram explain the principle construction and working of Transmission Electron Miroscope. (7)
(b) What are the different techniques to synthesize nanomaterials? Explain any two of them in detail. (8)