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BAST-104

Roll No. | | | | | | | | | | |

Odd Semester Examination, 2019-20
B. Tech.
Semester: 1st
Engineering Physics

Time: 3:00 hrs. **Max. Marks: 100**

Total no. of printed pages: 2

Note : All questions are compulsory.
Each question carries equal marks.

Q1. Attempt any four of the following. $4 \times 5 = 20$

a. State and prove differential form of Gauss law.

b. State the Heisenberg's uncertainty principle. Apply it to prove the non-existence of the electron in the nucleus.

c. Explain Meissner's effect. How does the magnetization vary with applied magnetic field in *Type I* and *Type II* superconductors?

d. Discuss the important postulates of Drude-Lorentz free electron theory of metals.

e. Explain the conditions for light amplification and mention any three engineering applications of laser.

f. Explain Hall Effect and its significance. Give its applications.

Q2. Attempt any four of the following. $4 \times 5 = 20$

a. In a Hall coefficient experiment, a current of 0.25 A is sent through a metal strip having thickness 0.2 mm and width 5 mm. The Hall coltage is found to be 0.115 mV when a magnetic field of 2000 $gauss$ is used. (i) What is the carrier concentration? (ii) What is the drift velocity of the carriers?

b. Newton's rings are observed normally in reflected light of wavelength 6000Å. The diameter of the $10th$ dark ring is 0.50 cm. Find the curvature of the lens and the thickness of the film.

c. Find the energy of neutron in unit of electron volt whose de-Broglie wavelength is 1 Å.

d. A step-index fiber is made with a core of refractive index 1.52, a diameter of 29 μm and a fractional difference index of 0.0007 it is operated at a wavelength of 1.3 μm. Find the *V-number* and the number of modes that the fiber will support.

e. If the earth receives $2 cal min^{-1} cm^{-2}$ solar energy, what are the amplitudes of electric and magnetic fields of radiation?

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f. If $\vec{r} = x\hat{\imath} + y\hat{\jmath} + z\hat{k}$, then evaluate $grad\, r^n$ and $div\, r^n\vec{r}$.

Q3. Attempt any two of the following. **$2 \times 10 = 20$**

a. Explain clearly the Phase velocity and Group velocity and show that the phase velocity of the electron is greater than the speed of light c while the group velocity of the electron is equal to the electron's velocity.

b. Differentiate between 'spontaneous emission' and 'stimulated emission' of radiation. Obtain a relation between transition probabilities of the two.

c. Discuss the phenomenon of Fraunhoffer diffraction at a single slit and show that the relative intensities of the successive maxima are nearly

$$1 : \frac{4}{9\pi^2} : \frac{4}{25\pi^2} : \frac{4}{49\pi^2} \cdots$$

Q4. Attempt any two of the following. **$2 \times 10 = 20$**

a. Drive time dependent and time-independent Schröedinger wave equation and also show that de Broglie wavelength of a particle of rest mass m_o having kinetic energy K is given by

$$\lambda = \frac{hc}{\sqrt{K(K + 2m_o c^2)}}$$

b. Using the expressions of 'electron' and 'hole' concentration show that the Fermi level in an intrinsic semiconductor lies in the middle of the energy gap and define the effect of temperature on Fermi level of intrinsic and extrinsic semiconductors.

c. What do you understand by the resolving power of an optical instrument and limit of resolution? Apply it to deduce an expression for the resolving power of a plane transmission grating.

Q5. Attempt any two of the following. **$2 \times 10 = 20$**

a. Derive expression for electric field due to a uniformly charged sphere at a point (i) outside the charged sphere (ii) on the surface of sphere and (iii) inside the sphere.

b. What are Poynting vectors? Deduce Poynting theorem for the flow of energy in an electromagnetic field.

c. In Newton's rings experiment show that in reflected light (a) the diameters of the dark rings are proportional to the square root of natural numbers and (b) the diameters of the bright rings are proportional to the square root of odd natural number.