

R18

Code No: 152AE

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech I Year II Semester Examinations, May - 2019

APPLIED PHYSICS
(Common to EEE, CSE, IT)

Time: 3 hours

Max. Marks: 75

Note: This question paper contains two parts A and B.

Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART-A

(25 Marks)

- 1.a) What is Photo-electric effect. Give the Einstein's equation. [2]
- b) What are donors and acceptors? Give two examples of each. [2]
- c) What are direct and Indirect band gap semiconductors [2]
- d) Explain Population Inversion and how is it achieved? [2]
- e) State the Faraday's Law. [2]
- f) Give the Born's interpretation of wave function. [3]
- g) Explain the concept of Hall effect. [3]
- h) Give three differences between semiconductor laser and LED. [3]
- i) Explain the construction of optical fiber. [3]
- j) Derive the relation between \bar{B} , \bar{H} and \bar{M} [3]

PART-B

(50 Marks)

- 2.a) Derive an expression for the wavelength λ of the matter waves.
- b) Describe a experiment to verify the existence of matter waves.
- c) For an electron in a one-dimensional infinite potential well of width 1Å , calculate the energy separation between the two lowest energy levels and also calculate the frequency and wavelength of the photon corresponding to a transition between these two levels. [10]

OR

- 3.a) Explain Heisenberg's Uncertainty principle.
 - b) Using the Heisenberg's Uncertainty principle explain why electron cannot exist in the nucleus of radius 10^{-14}m .
 - c) Show that the particle trapped in a potential box possesses discrete energy levels. [10]
- 4.a) What are intrinsic and extrinsic semiconductors?
 - b) Distinguish between N-type and P-type semiconductors with an example.
 - c) A rectangular plate of a semiconductor has dimensions 2.0 cm along y direction, 1.0 mm along z-direction. Hall probes are attached on its two surfaces parallel to x z plane and a magnetic field of 1.0 tesla is applied along z-direction. A current of 3.0 mA is set up along the x direction. Calculate the hall voltage measured by the probes, if the hall coefficient of the material is $3.66 \times 10^{-4}\text{ m}^3/\text{C}$. Also, calculate the charge carrier concentration. [10]

OR

- 5.a) The conductivity of N-type Germanium semiconductor is $39 \Omega^{-1} \text{m}^{-1}$. If the mobility of electrons in Germanium is $0.39 \text{ m}^2 \text{V}^{-1} \text{s}^{-1}$, then find the concentration of the donor atoms.
- b) Define Fermi level. Where does a Fermi level exist in a Intrinsic semiconductor, P-type semiconductor and N- type semiconductor at moderate temperature?
- c) Explain the working for a Common Base PNP transistor with a suitable circuit diagram. [10]

- 6.a) What is a photodetector? Explain the principle of photodetection in semiconductors.
- b) When 3×10^{11} photons each with wavelength of $0.85 \mu\text{m}$ are incident on a photodiode, on average 1.2×10^{11} electrons are generated. Determine the quantum efficiency and responsivity.
- c) What is a solar cell? Explain with a neat diagram. Define the efficiency and fill factor. [10]

OR

- 7.a) Explain the construction and working of a LED.
- b) What are the major differences between PIN and Avalanche photodiode?
- c) A silicon photodiode has quantum efficiency of 65% with photon energy $1.5 \times 10^{-19} \text{ J}$. Its band gap energy is 0.67 eV . Calculate:
- i) Responsivity (R)
- ii) Incident power required to obtain a photo current $2.5 \mu\text{A}$ (P_0)?. [10]

- 8.a) Explain the construction, principle and working of Ruby laser.
- b) A He-Ne gas laser of wavelength 6328 \AA has an output power of 2.3 mW . How many photons are emitted each minute when it is operated?
- c) Explain about the different modes that are propagated through step-index and graded-index fiber? [10]

OR

- 9.a) Elaborate the various applications of laser in the field of medicine and military.
- b) Discuss the concept of Acceptance angle and Acceptance cone of a fiber. Derive a relation between acceptance angle and the refractive indices of core and cladding materials.
- c) The numerical aperture of an optical fiber is 0.5 and core refractive index 1.54 . i) Find refractive index of cladding; ii) Calculate the change in core cladding refractive index per unit refractive index of the core. [10]
- 10.a) What is dielectric polarization? Describe briefly types of polarizations.
- b) Derive Clausius-Mosotti relation for a cubic dielectric structure.
- c) Write notes on ferroelectricity and piezoelectricity. [10]

OR

- 11.a) Derive a relation between electric polarization and electric susceptibility of the dielectric medium.
- b) Describe dielectric displacement, dielectric loss, dielectric strength.
- c) Describe the Hysteresis loop of ferromagnets. How can it be used to distinguish between hard and soft magnetic materials? [10]

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