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 $1A^0$, 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 $3.66 \times 10^{-4} m^3/C$. Also, calculate the charge carrier concentration. [10]

OR

5.a) The conductivity of N-type Germanium semiconductor is 39 $\Omega^{-1}m^{-1}$. If the mobility of electrons in Germanium is 0.39 $m^2V^{-1}s^{-1}$, 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 0.85μm 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 1.5×10^{-19} J. Its band gap energy is 0.67eV. Calculate:

i) Responsivity (R)

ii) Incident power required to obtain a photo current 2.5 μA (P_o)?. [10]

8.a) Explain the construction, principle and working of Ruby laser.

b) A He-Ne gas laser of wavelength 6328 Å 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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