Sardar Patel Institute of Technology

Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058-India
(An Autonomous Institute Affiliated to University of Mumbai)

End Semester Examination

August 2021

Max. Marks: 60 **Semester: I**
Course Code: AS101
Class: FY B.Tech. **Branch: COMP/ I.T.**

Name of the Course: Engineering Physics

Instructions:

(1) All Questions are Compulsory
(2) Explain with the help of neat diagrams, wherever applicable
(3) Assume suitable data if necessary

Question No.		Max. Marks	CO
Q1 (a)	Draw the energy band diagrams of an insulator and a n-type semiconductor at room temperature. Why does Fermi level lie at the center of forbidden energy gap of an intrinsic semiconductor? Explain it qualitatively. OR Explain the origin of Hall voltage using suitable diagram. Mention the important applications of Hall effect.	(3+2)	CO1
Q1 (b)	Justify the second ad-hoc postulate of Bohr's atomic model by de Broglie's hypothesis using the right mathematical expressions and diagram. Define the new meaning of quantum number.	(4+1)	CO1
Q1 (c)	Explain the role of Meta stable state and Population Inversion to generate laser light. OR Explain the terms: Induced Absorption and Stimulated Emission with the help of suitable diagrams.	(2+3)	CO1

Q1 (d)	Explain the working of a solar cell with a neat diagram and write two important advantages and two applications of it. OR Explain the working of a LED with a neat diagram and write two important advantages and two applications of it.	(3+2)	CO1
Q2 (a)	The He-Ne system is capable of lasing at several different wavelengths, the prominent one being at 3.3913 μm. Determine the energy difference in eV between the upper and lower lasing levels and the frequency of this laser radiation?	(4+1)	CO2
Q2 (b)	A rod of p-type Ge is 6 mm long, 1 mm wide and 0.5 mm thick has an electrical resistance of 120 ohm. Determine its conductivity and impurity concentration. Name the majority charge carriers. Given: μ_h =0.19 m^2/V-s.	(3+1+1)	CO2
Q2 (c)	The resistivity of two sides of a p-n junction are 4 Ω cm on p-side and 2 Ω cm on n-side at 300 K. Calculate the barrier potential, given that the intrinsic carrier density is $2.25x10^{19}/m^3$, mobility of electrons is 0.38 m^2/V-s and mobility of holes is 0.18 m^2/V-s.	(5)	CO2
Q2 (d)	A proton beam of 5.0 eV is incident on a barrier of height 6.0 eV and thickness 0.35 nm and at a rate equivalent to a current of 1.0 kA. Calculate the average time taken for one proton to be transmitted?	(5)	CO2
Q2 (e)	A pulsed Ruby LASER has its active medium a synthetic Ruby Crystal in the form of a cylinder 6 cm long and 1 cm in diameter. Ruby consists of Al_2O_3 in which in this case – one Al^{+3} in every 3500 has	(5)	CO2

	been replaced by Cr^{+3}. These Cr^{+3} ions accounts for the lasing transitions at a wavelength of 694.3 nm. Suppose that all the Cr^{+3} ions are in metastable state. How much energy is available for release in single pulse of laser light if all these ions revert to the ground state in a single stimulated emission chain reaction? Given the density of Al_2O_3 is 3700 kg/m3 and its molar mass is 102gm/mol.		
Q3 (a)	What is an optical resonator? What role does it play in the generation of laser? Explain it with the help of relevant diagrams.	(5)	CO4
Q3 (b)	Derive the energy levels of an electron confined in a 1D box of infinite height and show that these levels are discrete. Derive Eigen functions and show that the probability of finding the particle varies as a function of the distance 'x' with the help of the diagram.	(5+5)	CO3

----END---