

Shiv Nadar University Chennai

End Semester Examinations, 2023-2024 Odd

Question Paper

Question Paper		
Name of the Program: Common to B.Tech. AI & DS, B.Tech. CSE (CS)		Semester: I
Course Code & Name: PH1001T ENGINEERING PHYSICS		
Regulation 2021		
Time: 3 Hours	Answer All Questions	Maximum: 100 Marks

Q.No	PART A (10 × 2 =20 marks)		Marks	CO#	KL#
1	a	Why is the role of Helium and Nitrogen gases in a carbon dioxide laser.	2	CO4	KL2
2	a	The velocity of ultrasonic waves in liquids depends on the compressibility (K) and density (ρ). Given the dimensions of K as LT^2M^{-1} and ρ has the dimension of ML^{-3} . Obtain the relation for the velocity in terms of these two parameters	2	CO1	KL1
3	a	Evaluate the uncertainty in measuring the velocity of a particle of mass of approximately 3×10^{-27} kg when its position is determined with an accuracy of 5 Å. Use h as 6.6×10^{-34} Js	2	CO2	KL2
4	a	Draw the appropriate relationship between temperature and conductivity of an extrinsic semiconductor such that the bandgap of the semiconductor and ionization energy of the dopant can be estimated from the resulting graph.	2	CO3	KL2
5	a	Find the temperature at which a level 0.08625 eV above the fermi level has a probability of occupation by an electron of 5%. (Boltzmann's constant $k=8.625 \times 10^{-5}$ eV/K.)	2	CO2	KL2
6	a	Differentiate between direct and indirect band gap semiconductors with the help of energy band diagram.	2	CO3	KL2
7	a	An extrinsic semiconductor has a majority carrier concentration of $10^{16}/cm^3$. What would be the minority carrier concentration, given that the carrier concentration in the intrinsic case is $10^{10}/cm^3$?	2	CO3	KL2
8	a	How many sources of equal power can be arranged in a circle such that the total intensity level at the center of the circle when all of them are simultaneously ON is 100 dB.	2	CO1	KL2
9	a	What is the ratio of the energy density of black body radiation emitted at 150 THz to that at 30 THz at 650 K?	2	CO4	KL2
10	a	Explain the terms temporal and spatial coherence.	2	CO4	KL2
		PART B (5 × 6 =30 marks)			
11	a	Intrinsic silicon with bandgap $E_g = 1.12$ eV is doped with phosphorous density of $10^{21}/m^3$. If ionization energy of dopant is 0.04 eV in silicon, find the shift in Fermi level due to doping at 0 K. Draw the curve for density of electrons in the conduction band for the doped and undoped silicon.	6	CO3	KL3
12	a	For a laser to oscillate, the pumping scheme should provide a threshold power. Explain this threshold condition for lasing with respect to the laser cavity. Evaluate the threshold losses per meter that would have to be counteracted, given that the length of the cavity is 0.2 mm and the reflectivity of the end-mirrors are 0.99 assuming that other losses are negligible.	6	CO4	KL4
13	a	Calculate the intrinsic carrier concentration of GaAs semiconductor at room temperature (300K) using the following data. Also calculate the ratio of conductivity at 320 K to that at 300 K. GaAs - $E_g = 1.5$ eV, $m_e^* = 0.067 m_0$, $m_h^* = 0.47 m_0$, $\mu_e = 0.85 m^2/Vs$, $\mu_h = 0.04 m^2/Vs$, $k=8.625 \times 10^{-5}$ eV/K	6	CO3	KL2

14	a	An electron with an effective mass of 9×10^{-31} kg is confined to move freely, in one dimension, between two infinite potential walls separated by a distance of 1 Å. Calculate the lowest three allowed energy levels (in eV), it can have and its de Broglie wavelength in each of these levels.	6	CO2	KL2
15	a	Dispersion in the fiber deteriorates the frequency rate at which the signal is sent through the fiber. If the material used in the core has a bandwidth of 5 GHz/km, for a source spectral width of 20 nm, what is the material dispersion?	6	CO5	KL3
PART C ($5 \times 10 = 50$ marks)					
16	a	Explain 2 methods to detect ultrasonic waves with relevant figures.	10	CO1	KL2
		OR			
	b	Describe the frequency dependence of perception of human ears and its variation with intensity levels with the help of equal loudness curves.	10	CO1	KL2
17	a	Derive the expression for density of states in a material supported by relevant diagrams.	10	CO2	KL2
		OR			
	b	Arrive at the expression for the conductivity of a metal at 0 K based on the quantum free electron theory assuming the expression for density of states. Show that at 0 K, the energy of electrons in the fermi energy level is 1.67 times that of the average energy of electrons in the metal at 0 K.	10	CO2	KL2
18	a	Derive the expression for electron density in the conduction band for an intrinsic semiconductor.	10	CO3	KL2
		OR			
	b	Obtain the expression for the carrier concentration for a P-type semiconductor in terms of the effective mass of holes m_h^* and difference between the acceptor energy level E_A and top of valence band E_v .	10	CO3	KL2
19	a	Derive the main conditions for enhancing stimulated emission over all other interactions of light with matter as per Einstein's theory. What is the additional condition that needs to be ensured in the resonator for making a laser?	6 + 4	CO4	KL2
		OR			
	b	Explain the construction and working of a heterojunction laser. What are its advantages over a homojunction laser?	10	CO4	KL2
20	a	List and explain various losses that happen in an optical fiber that attenuates the light propagation. If the output power at the end of a 10 km long fiber is 1 nW and if the attenuation coefficient of the fiber is 3 dB/km, what should be the minimum input power that has to be fed to the fiber?	7 + 3	CO5	KL2
		OR			
	b	What are active and passive fiberoptic sensors. Describe the working of a passive fiberoptic sensor for measuring displacements. What is the approximate range of displacements for which this sensor will have maximum sensitivity?	10	CO5	KL2

KL – Bloom's Taxonomy Levels

(KL1: Remembering, KL2: Understanding, KL3: Applying, KL4: Analyzing, KL5: Evaluating, KL6: Creating)

CO – Course Outcomes