Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE –SEMESTER 1&2(NEW SYLLABUS)EXAMINATION- WINTER 2018

Subject Code: 3110018 Date: 04-01-2019

Subject Name: Physics

Time: 10:30 am to 01:00 pm Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	Give assumptions of classical free electron theory.	**03**
	(b)	Explain mechanism of superconductivity.	**04**
	(c)	What is photovoltaic effect. Explain construction and working of solar cell.	**07**
Q.2	**(a)**	Give difference between N type and P type semiconductors.	**03**
	(b)	Derive an expression for joint density of states.	**04**
	(c)	Explain Kronig Penney model in detail.	**07**
		OR	
	(c)	Explain properties of superconductors.	**07**
Q.3	**(a)**	What are hot probe method.	**03**
	(b)	Explain fermi levels.	**04**
	(c)	Explain classification of materials as conductors, insulators and semiconductors.	**07**
		OR	
Q.3	**(a)**	Give difference between intrinsic and extrinsic semiconductors.	**03**
	(b)	Explain drift and diffusion current.	**04**
	(c)	Explain direct and indirect band gap with E-k diagrams.	**07**
Q.4	**(a)**	Define superconductivity and critical temperature.	**03**
	(b)	Discuss fermi golden rule.	**04**
	(c)	Explain diffusion mechanism in detail.	**07**
		OR	
Q.4	**(a)**	Define radiative and non-radiative transitions.	**03**
	(b)	Explain emission and absorption.	**04**
	(c)	Explain experimental procedure for DLTS.	**07**
Q.5	**(a)**	The critical temperature of Nb is 9.15 K. At zero kelvin, the critical field is 0.196 T. Calculate the critical field at 6 K.	**03**
	(b)	Explain Drude model.	**04**
	(c)	Why two probe method for resistivity measurement failed and hence explain four probe method.	**07**
		OR	
Q.5	**(a)**	Give success and drawback of classical free electron theory.	**03**
	(b)	Derive expression of electron concentration in conduction band.	**04**
	(c)	Discuss UV – VIS method for band gap measurement of semiconductors.	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– I & II (NEW) EXAMINATION – WINTER 2019

Subject Code: 3110018 **Date: 02/01/2020**

Subject Name: Physics

Time: 10:30 AM TO 01:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

			Marks
Q.1	**(a)**	Enlist the assumptions of free electron theory.	**03**
	(b)	Give the difference between Direct and Indirect band gap.	**04**
	(c)	Explain forward and reverse bias conditions in PN junction diode.	**07**
Q.2	**(a)**	Define Intrinsic and extrinsic semiconductor .	**03**
	(b)	The thermal and electrical conductivity of Cu at 20˚C are $390 Wm^{-1}K^{-1}$ and $5.87x10^{7} (\Omega m)^{-1}$ respectively. Calculate the Lorentz number.	**04**
	(c)	Explain Schottky diode in detail.	**07**
		OR	
	(c)	Explain the dependence of Fermi level on temperature	**07**
Q.3	**(a)**	Explain Drude model	**03**
	(b)	Fermi energy of a given substance is 7.9 eV. What is the average energy and speed of electron in this substance at 0 K?	**04**
	(c)	Explain photovoltaic effect. With required diagrams discuss construction and working of solar cell.	**07**
		OR	
Q.3	**(a)**	Write a short note on exciton.	**03**
	(b)	Consider two-dimensional square lattice of side 3.0 Å. At what electron momentum values do the sides of first Brillouin zone appear? What is the energy of free electron with this momentum?	**04**
	(c)	Derive an equation of joint density of states.	**07**
Q.4	**(a)**	Define Hall effect. Give its physical significance.	**03**
	(b)	2.0Cm wide and 1.0 mm thick copper strip is placed in a magnetic field $1.5 Wb/m^2$ perpendicular to the strip. Suppose a current of 200A is set up in the strip what will be the Hall potential appeared across the strip? ($n=8.4x10^{28}$ electrons $/m^3$).	**04**
	(c)	Discuss UV-VIS method for band gap measurement of semiconductor.	**07**
		OR	
Q.4	**(a)**	Discuss Fermi golden rule.	**03**
	(b)	The transmitted intensity is 0.4 times intensity of incident light. If this light is incident on a semiconductor having a thickness of 0.5cm then find absorption coefficient.	**04**
	(c)	Explain four probe method. Derive an equation to calculate resistivity of a thin sample.	**07**

Q.5	**(a)**	Write short note cryotron.	**03**
	(b)	Explain London's penetration depth.	**04**
	(c)	Give the difference between type 1 and type 2 superconductor.	**07**

OR

Q.5	**(a)**	Write short note on SQUID.	**03**
	(b)	Calculate the critical current for a superconducting wire of lead having a diameter of 2 mm at 2 K. Critical temperature for lead is 4 K and Hc (0) = 6.5×10^4 A/m.	**04**
	(c)	Explain the properties of superconductors in detail.	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–I & II (NEW) EXAMINATION – WINTER 2020

Subject Code:3110018 Date:17/03/2021

Subject Name:Physics

Time:10:30 AM TO 12:30 PM Total Marks:56

Instructions:

1. **Attempt any FOUR questions out of EIGHT questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

			Marks
Q.1	**(a)**	Explain how the materials are classified into conductors, semiconductors and insulators on the basis of energy band diagram.	**03**
	(b)	Define Fermi level for intrinsic semiconductor. How it will change in p-type and n-type semiconductors. Explain with suitable diagrams.	**04**
	(c)	Explain formation and working of p-n junction diode in forward and reverse biasing by proper diagrams and its I-V characteristics.	**07**
Q.2	**(a)**	Explain absorption, spontaneous emission and stimulated emission in semiconductors with proper diagrams.	**03**
	(b)	Write down an expression for the probability of occupancy of a particular energy state of an electron in an intrinsic semiconductor. Explain it from the graph at 0^0 K and at room temperature	**04**
	(c)	Describe formation of Energy bands by using Kronig-Penney Model.	**07**
Q.3	**(a)**	Explain n-type and p-type semiconductors with suitable diagrams	**03**
	(b)	Explain direct band gap and indirect band gap semiconductors with proper E-k diagrams.	**04**
	(c)	Derive an expression for density of energy states in metals.	**07**
Q.4	**(a)**	Write down any three differences between intrinsic and extrinsic semiconductors.	**03**
	(b)	Explain construction and working of Schottky junction	**04**
	(c)	Give the names of semiconductor optoelectronic devices, their characteristics and applications.	**07**
Q.5	**(a)**	Explain law of mass action.	**03**
	(b)	Explain Photovoltaic Effect and derive an expression for photo voltage.	**04**
	(c)	Write down various properties of superconductors.	**07**
Q.6	**(a)**	Explain (i) Non-radiative transitions and (ii) Exciton .	**03**
	(b)	Explain construction and working of a solar cell by proper diagrams and I-V characteristics.	**04**
	(c)	Explain UV-VIS spectroscopy and how to find energy band gap of a material from this technique.	**07**
Q.7	**(a)**	At 0 magnetic field, a superconducting Tin has a critical temperature of 3.7 K. At 0 K, critical magnetic field is 0.306 T. Calculate the critical magnetic field at 2 K	**03**
	(b)	Write down the applications of superconductors.	**04**
	(c)	Derive a formula for carrier concentration in n-type semiconductor	**07**

Q.8 **(a)** Describe Hall Effect with a suitable diagram. **03**

(b) A semiconductor has Hall coefficient 3.75×10^{-4} m^3/C. The resistivity of the sample is 7.21×10^{-3} ohm m. Calculate the mobility and density of charge carriers. Given that the magnitude of charge on electron = 1.6×10^{-19} C. **04**

(c) Explain **07**

(a) Type I and Type II superconductors 02

(b) Low T_c and High T_c superconductors 02

(c) SQUIDS and its applications 03

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–1/2 EXAMINATION – WINTER 2021

Subject Code:3110018 Date:22/03/2022

Subject Name:Physics

Time:10:30 AM TO 01:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			Marks
Q.1	**(a)**	Define absorption, spontaneous emission and stimulated emission for bulk semiconductors.	**03**
	(b)	Write a short note on P-N junction diode.	**04**
	(c)	Give assumptions of classical free electron theory and discuss its limitations.	**07**
Q.2	**(a)**	Find the temperature at which there is 1% probability that a state with energy 2eV is occupied. Given that Fermi energy is 1.5 eV.	**03**
	(b)	What is drift and diffusion current in p-n junction diode?	**04**
	(c)	Explain the Kronig-Penny model of solids and show that how it explains the origin of band gap in solids.	**07**
		OR	
	(c)	Explain intrinsic and extrinsic (N & P type) semiconductors with the help of energy band diagram.	**07**
Q.3	**(a)**	In an N-type semiconductor, the Fermi level lies 0.3 eV below the conduction band at room temperature. If the temperature is increased to 330°K, Find the position of Fermi level.	**03**
	(b)	Write an expression for Fermi Dirac distribution function *f(E)*. Show that at all temperatures (T > 0K) probability of occupancy of Fermi level is 50%.	**04**
	(c)	Discuss the effect of temperature on the Fermi level in extrinsic (N & P type) semiconductors.	**07**
		OR	
Q.3	**(a)**	Find the concentration of holes and electrons in N-type silicon if the conductivity is 0.1 Ω-cm^{-1}, mobility of electrons is 1300 cm^2/V-s and total carrier concentration is 1.5x10^{10} carriers / cm^3.	**03**
	(b)	Establish the relation between Einstein's coefficients.	**04**
	(c)	Explain Meissener's effect in detail and show that for superconductor, $\chi_m = -1$.	**07**
Q.4	**(a)**	Write a short note on effective mass of electron.	**03**
	(b)	What is mass action law? Explain Schottky junction.	**04**
	(c)	Explain Drude model and discuss how it is used for Hall measurements and magnetoresistance.	**07**
		OR	
Q.4	**(a)**	What is an exciton? What is DLTS? Define Hall mobility.	**03**

	(b)	What is Fermi level and Fermi energy? What is Photovoltaic Cell?	**04**
	(c)	Explain four point probe method with diagram for the measurement of resistivity of bulk sample.	**07**
Q.5	**(a)**	Explain Fermi Golden rule for transition probability.	**03**
	(b)	What is Josephson junction? Write a short note on SQUID.	**04**
	(c)	Explain how to measure band gap of the semiconductor using UV-Vis spectroscopy.	**07**

OR

Q.5	**(a)**	Calculate the critical current for a superconducting wire of lead having a diameter of 1mm at 4.2 K. Critical temperature for lead is 7.18 K and $H_c(0) = 6.5 \times 10^4$ A/m.	**03**
	(b)	Write a short note on Hot-point probe measurement technique.	**04**
	(c)	What is superconductivity? Explain any six properties of superconductor.	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–I &II (NEW) EXAMINATION – SUMMER-2019

Subject Code: 3110018 Date: 03/06/2019

Subject Name: Physics

Time: 10:30 AM TO 01:00 PM Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

			Marks
Q.1	**(a)**	Give formation and applications of SQUID.	**03**
	(b)	Explain intrinsic and extrinsic semiconductors with necessary diagram.	**04**
	(c)	What is PN junction diode? What is external bias? Describe its forward and reverse bias conditions with appropriate diagram.	**07**
Q.2	**(a)**	What is photo conductivity, photoluminescence, phototransistor?	**03**
	(b)	Calculate the energy gap of Si, given that radiation of wavelength 11,000 Å is incident on it. Also find allowed wavelength for Ge with energy gap 0.90 eV.	**04**
	(c)	Write a note on energy band diagram and formation of energy bands.	**07**
		OR	
	(c)	Define Hall effect and Hall coefficient. Derive equation to find Hall voltage. What does it signify?	**07**
Q.3	**(a)**	Differentiate between soft and hard superconductors	**03**
	(b)	What is London penetration depth? Derive its equations.	**04**
	(c)	Derive equations for n-type semiconductor to determine dependence of fermi level on temperature and doping concentration.	**07**
		OR	
Q.3	**(a)**	The critical current density equal to 1.71×10^8 A/m^2 is required to change a superconducting wire of radius 0.5 mm at 4.2 K. If the critical temperature of the material is 7.18 K, calculate the maximum value of the critical magnetic field.	**03**
	(b)	Explain BCS theory for superconductivity.	**04**
	(c)	Write a note on metal semiconductor junctions.	**07**
Q.4	**(a)**	Write a note on exciton.	**03**
	(b)	Give details of applications of solar cell (at least 4)	**04**
	(c)	What is radiative and non-radiative transition. Explain in brief the optical joint density of states.	**07**
		OR	
Q.4	**(a)**	What are direct and indirect band gap?	**03**
	(b)	What is deep level transient spectroscopy (DLTS)? Give its experimental procedure.	**04**
	(c)	Discuss the technique to obtain band gap by UV-Vis spectroscopy using absorption or transmission.	**07**
Q.5	**(a)**	What are capacitance voltage measurements?	**03**
	(b)	Consider n-type silicon semiconductor with a length of 100 μm, cross sectional area 10^{-7} cm^2, minority charge carrier life time 10^{-6} s, μ_e is 0.13 m^2 / Vs and μ_h is 0.05 m^2 / Vs. Find (a) Electron transit time	**04**

(b) Photo conductor gain when voltage applied to the photoconductor is 12 V

(c) Discuss Van Der Pauw method. **07**

OR

Q.5 **(a)** What is the cause and remedy for optical loss in photovoltaic cell? **03**

(b) State principle and discuss working of semiconductor laser. **04**

(c) What is photovoltaic effect? Explain construction and working of a solar cell with suitable diagram **07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–I & II(NEW)EXAMINATION – SUMMER 2022

Subject Code:3110018 Date:04-08-2022

Subject Name:Physics

Time:10:30 AM TO 01:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			Marks
Q.1	**(a)**	What is physical significance of the negative effective mass?	**03**
	(b)	Find the probability of an electron occupying an energy level 0.02 eV above the Fermi level at 200 K and 400 K in a material.	**04**
	(c)	Derive an expression for electrical and thermal conductivity in a material and hence verify Wiedemann-Franz law.	**07**
Q.2	**(a)**	Show that for an intrinsic semiconductor the Fermi level lies at the middle of the energy gap.	**03**
	(b)	The intrinsic carrier density of given semiconductor is 1.5×10^{16} m^{-3}. If the mobility of the electrons and holes are 0.13 and 0.05 $m^2 V^{-1} s^{-1}$ respectively, calculate the conductivity.	**04**
	(c)	Obtain an expression for concentration of holes in valance band in intrinsic semiconductor.	**07**
		OR	
	(c)	Derive the formula for concentration of electrons in conduction band in n-type semiconductor.	**07**
Q.3	**(a)**	Write the difference between spontaneous emission and stimulated emission.	**03**
	(b)	Explain Ohmic junction with necessary diagram.	**04**
	(c)	What do you mean by joint density of state? Derive mathematical expression for optical joint density of states.	**07**
		OR	
Q.3	**(a)**	Write short note on exciton.	**03**
	(b)	If the light having wavelength of 4000 A° falls on semiconductor having bandgap of 2.1 eV. Assuming mass of electron in conduction band and valance band is same as rest mass of electron, calculate the optical joint density of states for given semiconductor.	**04**
	(c)	For bulk semiconductor show that the ratio of Einstein's co-efficient is directly proportional to cube of frequency.	**07**
Q.4	**(a)**	Write the drawbacks of two probe method.	**03**
	(b)	An n-type Ge sample has donor density of 10^{21} m^{-3}. It is arranged in a Hall effect experiment having B_z = 0.5 Wb/m^2 and J_x = 500 A/m^2. Find Hall voltage if the width of sample is 3 mm.	**04**
	(c)	What is Hall effect? Obtain expressions for Hall Voltage and Hall mobility.	**07**

OR

Q.4	**(a)**	Explain Hot point probe measurement.	**03**
	(b)	A 20.0 mm wide and 1.0 mm thick silver strip is placed in 1.5 Wb/m^2 magnetic field in such a way that magnetic field remains perpendicular to strip. A current of 200 A is set-up in the strip. Calculate the Hall voltage of the strip. (given: $n = 8.4 \times 10^{28}\ m^{-3}$)	**04**
	(c)	Explain Current-Voltage characteristic of Solar cell.	**07**
Q.5	**(a)**	Define: (1) Critical Temperature (2) Critical Magnetic field (3) Critical Current density.	**03**
	(b)	For specimen of V_3Ga, the critical fields are 1.4×10^5 A/m and 4.2×10^5 A/m at 14 K and 13 K respectively. Calculate the value of transition temperature.	**04**
	(c)	Write and explain characteristics of superconductors.	**07**

OR

Q.5	**(a)**	The critical temperature for Hg with isotopic mass 199.5 is 4.185 K. Calculate its critical temperature when its isotopic mass changes to 203.4.	**03**
	(b)	Write the difference between Type-I and Type-II superconductor.	**04**
	(c)	Explain BCS theory.	**07**

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