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B.Sc. in TE (2-yr)
Semester: 3rd

Date: October 09, 2023
Time: 2.30 pm - 4.00 pm

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: EEE 4793
Course Title: Advanced Electronics I

Winter Semester, A.Y. 2022-2023
Time: 90 Minutes
Full Marks: 75

There are **3 (three)** questions. Answer **3 (three)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Do not write on this question paper. Symbols carry their usual meanings.

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1. a) Briefly explain variation of energy bands with alloy composition. Describe with neat diagrams and example. 10

   b) In a long semiconductor bar (E_G = 2 eV), conduction band electrons come in from the left in the positive x-direction with a kinetic energy of 3 eV shown in Fig. 1. They move from location A to B to C to D. Between A and B, the electric field is zero; between locations B and C, there is a linearly varying voltage increase of 4 V; between C and D, the field is again zero. Assuming no scattering, sketch a simplified band diagram describing the motion of these electrons. Assuming that these electrons can be described as plane waves, with a free-electron mass, write down the wave function of the electrons at D. Draw a band diagram and give the wave function at D in terms of the normalization constant. 15

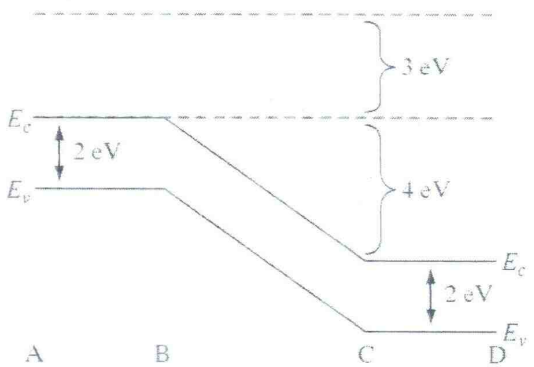

Fig. 1

2. a) Describe electrons and holes in quantum wells. Explain with neat diagrams. 10

   b) A Si sample is doped with 10^{14} As atoms cm^3. What is the equilibrium hole concentration p_0 at 308 K? Where is E_F relative to E_i? 15

3. a) Briefly discuss high field effects. What is hall effect? Find out the hole concentrations and hole mobility. 10

   b) Consider a semiconductor bar with w = 0.1 mm, t = 10 om, and L = 5 mm. For b = 10 kG (1 kG = 10^{-5} Wb/cm^2) and a current of 1 mA, we have V_{AB} = -2 mV and V_{CD} = 100 mV. Find the type, concentration, and mobility of the majority carrier. 15