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B.Sc. in EEE, 5th Semester

December 09, 2023, Saturday
09:00 AM – 12:00 PM

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination
Course No.: EEE 4579
Course Title: Engineering Materials

Winter Semester, A. Y. 2022-2023
Time: 3 Hours
Full Marks: 150

There are **6 (six)** questions. Answer all **6 (six)** questions. The symbols have their usual meanings. Programmable calculators are not allowed. Marks of each question and corresponding COs and POs are written in the brackets.

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1. a) Explain how dielectric loss of a dielectric medium is directly connected to the imaginary part of relative permittivity with proper mathematical notation. **15** (CO2, PO2, PO3)

   b) A parallel plate capacitor has an area of 500 mm^2 and the separation between plates is 0.15 mm. The space between the plates is filled with a material, having real dielectric constant, $\epsilon_r' = 2.75$ when subjected to the frequency of 0.55 MHz. The loss tangent at this frequency is 2.7×10^{-4}. Find the parameters of the equivalent circuit- (i) parallel R-C circuit and (ii) series R-C circuit. **10** (CO2, PO2, PO3)

2. a) Explain how Schrödinger came up with a wave equation for the quantum particle. **12** (CO1, PO1)

   b) Solve the Schrödinger's wave equation with proper explanation. **13** (CO1, PO1)

3. a) Explain with proper illustration how metal behaves as a transparent material in higher frequencies. (Using Drude Model) **12** (CO1, PO1, PO3)

   b) Suppose you are experimenting with a dielectric material with a negative refractive index. Illustrate how light will behave in that material. State at least two cases where this phenomenon can be applied. **13** (CO2, PO3)

4. a) Define how metamaterial is different than naturally available materials. Discuss the advantages metamaterial can provide over naturally available materials. **10** (CO1, CO2, PO1, PO3)

   b) State a few areas where insulators are used in electrical equipments. **15** (CO1, CO2, PO1, PO3)

5. a) Describe the characteristic of different types of magnetic materials and compare between them. Explain which one is suitable for engineering application with proper examples. **15** (CO1, CO2, PO1, PO3)

   b) Evaluate the differences between hard and soft magnetic materials. Explain with proper graphs. **10** (CO1, PO1)

6. a) Illustrate the working principle of quartz watch. Justify whether this type of watches are superior than the mechanical ones. **10** (CO2, PO1, PO3)

   b) Explain how pyroelectric sensors work. **7** (CO2, PO1,PO3)

   c) Suppose a piezoelectric spark generator is given in the form of a cylinder. The piezoelectric coefficient is given $d = 225 \times 10^{-12} mV^{-1}$ and $\epsilon_r = 450$. The piezoelectric cylinder has height of 14 mm and a diameter of 4.5 mm. The spark gap is 1.5 mm and the breakdown of air within this gap is about 6 .5 $kVmm^{-1}$. Calculate the force that is required to spark the gap. State if this is a realistic Force. **8** (CO2, PO2, PO3)