B.Sc. in EEE, 8th Semester

May 17, 2024, Friday
10:00 AM – 01:00 PM

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

Semester Final Examination
Course No.: EEE 4803
Course Title: Engineering Materials

Summer 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 can be quantified into a circuit. Formulate the equivalent series configuration. **15** (CO2, PO2)

b) A parallel plate capacitor has an area of 800 mm^2 and the separation between plates is 0.18 mm. The space between the plates is filled with a dielectric having $\epsilon_r' = 3.50$ when subjected to the frequency of 0.5 MHz. The loss tangent at this frequency is 1.9×10^{-4}. Find the parameters of the equivalent circuit- (i) parallel R-C circuit and (ii) series R-C circuit. **10** (CO2, PO2)

2. a) Explain with proper illustration how metal behaves in higher frequencies. (Using Drude Model) **12** (CO1, PO1)

b) Explain with proper mathematical expression how a material can exhibit negative refractive index . State at least two cases where this phenomenon can be applied. **13** (CO2, PO2)

3. a) State the assumptions Schrodinger used to define wave equation for quantum particles. Following those assumptions, construct the wave equation for quantum particles. **10** (CO1,PO1)

b) Justify the wave equation $\frac{\partial^2 y}{\partial x^2} = \frac{1}{v^2}\frac{\partial^2 y}{\partial t^2}$ is applicable for classical waves. **8** (CO1,PO1)

c) A nano particle of a certain mass at rest explodes into two particles having masses in the ratio of 4:3 . Calculate the corresponding ratio of the de Broglie wavelengths? **7** (CO2, PO2)

4. a) State the Schrodinger's wave equation and develop a solution of that equation with an approach of solving it as a differential equation. **15** (CO1, PO1)

b) Suppose a piezoelectric spark generator is given in the form of a cylinder. The piezoelectric coefficient is given $d = 250 \times 10^{-12} mV^{-1}$ and $\epsilon_r = 500$. The piezoelectric cylinder has height of 15 mm and a diameter of 3 mm. The spark gap is 2.5 mm and the breakdown of air within this gap is about 8.5 $KVmm^{-1}$. Calculate the force required to spark the gap? Comment whether this force is a realistic force or not? **10** (CO2,PO2)

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, PO1)

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. **9** (CO2, PO2)

b) Explain how pyroelectric sensors work. **8** (CO1,PO1)

c) State a few areas where insulators are used in electrical equipment. **8** (CO2, PO2)