B.Sc. in EEE, 8th Semester

May 04, 2023
Time: 10:00am-01:00pm

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

Final-Semester Examination
Course No.: EEE 4841
Course Title: Microwave Engineering

Summer Semester, A. Y. 2021-2022
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) Formulate equations for the voltage and current of an ideal transmission line carrying microwave signals. Assume the transmission line to be a coaxial cable. **20 (CO1, PO1)**

   b) Compare the wave equation of voltage (of the transmission line specified in **question 1.a**) and the wave equation of a TEM wave. **05 (CO2, PO2)**

2. a) For the section of the transmission line in **Figure 2(a)**, calculate the reflection coefficient and transmission coefficient at the point of load. [$\beta=\frac{\pi}{3}$ rad/cm, ab= $\frac{1}{2}$cm]. **15 (CO2, PO2)**

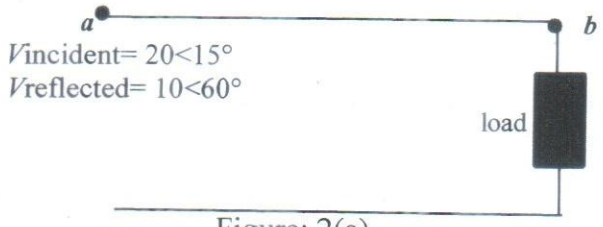

Figure: 2(a)

State the performance of the line in terms of power loss.

   b) Identify the main reason behind power loss in a microwave-carrying transmission line and describe its detrimental effects. Name some parameters that are used to analyze the status of power flow in such lines. **10 (CO1, PO1)**

3. a) Formulate an expression for the voltage reflection coefficient in terms of impedances only. **10 (CO1, PO1)**

   b) For the section of the transmission line in **Figure 3(b)**, find out the reflection coefficient at the point of load, using Smith chart. [$\beta=\frac{\pi}{3}$ rad/cm, ab= $\frac{1}{2}$cm, load impedance=(100+j40) ohm, characteristic impedance= 50 ohm]. **15 (CO2, PO2)**

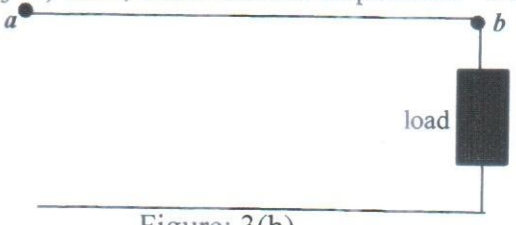

Figure: 3(b)

4. a) Determine the centre and the radius of contours on Smith Chart for the following resistances and reactances, respectively - **12 (CO2, PO2)**

- Resistance= 0, 1/3, 1, ∞
- Reactance= 0, 1/3, 1, ∞

b) Formulate an expression for the impedance and admittance of an ideal transmission line (carrying microwave) ending with a very large load. You can assume open-circuit termination for this case. Comment on your result. **13 (CO1, PO1)**

5. a) A transmission line with characteristic impedance of 75 ohm is connected to a load. The line is filled with a material that has a dielectric constant of 1.4. The VSWR on the line is 2.4. The distance to the first maximum voltage amplitude point from the load is 0.867cm. The operating frequency is 10 GHz. Determine- **20 (CO2, PO2)**

- the reflection coefficient at the point of the load
- the minimum impedance on the line
- the distance (in cm) between the load and the **second** maximum voltage

b) Explain the reason behind tuning a microwave/ high frequency circuit. Explain the drawback of tuning at a particular frequency. **05 (CO1, PO1)**

6. a) Discuss the characteristics of open-circuit and short-circuit stubs that make them suitable for tuning purposes.
Tune a transmission line, using stubs of your choice, with characteristic impedance of 50 ohm and with a load of (60-j80) ohm. Determine the design specifications. **20 (CO3, PO3)**

b) Find the design of a quarter wave transformer to match 100 ohm load on a 40 ohm transmission line at 5 GHz. **05 (CO3, PO3)**