

BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI  
(END SEMESTER EXAMINATION)

CLASS: M.Tech/PRE-PHD  
BRANCH: ECE

SEMESTER : I  
SESSION : MO/2022

SUBJECT: EC505 MICROWAVE THEORY AND ANTENNAS

TIME: 3:00 Hours

FULL MARKS: 50

INSTRUCTIONS:

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
  2. Attempt all questions.
  3. The missing data, if any, may be assumed suitably.
  4. Before attempting the question paper, be sure that you have got the correct question paper.
  5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
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- Q.1(a) Compare the characteristics of low frequency and high frequency circuits. [2]  
Q.1(b) Construct the ABCD matrix for a two-port network consisting of a series Z element followed by a shunt Y element. [3]  
Q.1(c) A two-port network is driven at both ports such that the port voltages and currents have the following values ( $Z_0 = 50 \text{ ohm}$ ),  $V_1 = 10\angle 90^\circ$ ,  $I_1 = 0.2\angle 90^\circ$ ,  $V_2 = 8\angle 0^\circ$ ,  $I_2 = 0.16\angle -90^\circ$ . Determine the input impedance seen at each port and find the incident and reflected voltages at each port. With the help of the signal flow graph of this network, also find the response of the circuit. [5]
- Q.2(a) List some of the specific applications of power dividers and directional coupler. [2]  
Q.2(b) A 20 dBm power source is connected to the input of a directional coupler having a coupling factor of 20 dB, a directivity of 35 dB, and an insertion loss of 0.5 dB. If all ports are matched, find the output powers (in dBm) at the through, coupled, and isolated ports. [3]  
Q.2(c) Derive the [S] for a reciprocal and matched four-port symmetrical network. [5]
- Q.3(a) List few important applications of the Periodic structures. [2]  
Q.3(b) Explain the characteristics of the periodic structures with the help of  $K_0$ - $\beta$  diagram. [3]  
Q.3(c) Considering a Capacitively loaded coaxial line by means of thin circular diaphragms, derive the expression for the characteristic impedance  $Z_B$  for the matched condition of this periodic structure. [5]
- Q.4(a) Discuss the important parameters of the antenna desired for its application in GEO satellites. [2]  
Q.4(b) With the help of a suitable 2-D diagram show the various important parameters that can be extracted from the diagram. [3]  
Q.4(c) Explain how Friss transmission formula can be used for measuring the gain of an antenna. [5]
- Q.5(a) Discuss the requirement of antenna for LEO satellite link? [2]  
Q.5(b) Justify that requirement of 5G and beyond dictates the need of the MIMO antenna. [3]  
Q.5(c) Discuss atleast one specific antenna used in mobile handsets. [5]

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