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

CLASS: BE **SEMESTER : V**
BRANCH: ECE **SESSION : MO/19**

SUBJECT: EC5203 MICROWAVE ENGINEERING

TIME: 3 HOURS **FULL MARKS: 60**

INSTRUCTIONS:
1. The question paper contains 7 questions each of 12 marks and total 84 marks.
2. Candidates may attempt any 5 questions maximum of 60 marks.
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.

Q.1(a) Write the frequency bands for the following: [2]
(i) U band (ii) E band (iii) UWB Radio (iv) DBS

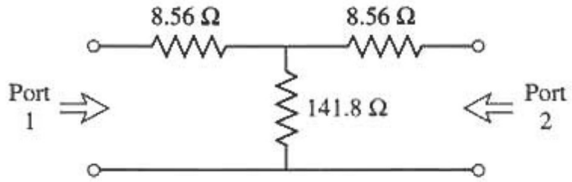
Q.1(b) Describe the advantages of microwave frequencies compared to low frequency waves. [4]

Q.1(c) Explain Monolithic Microwave Integrated Circuit with its advantages and limitations. [6]

Q.2(a) What are the advantages of circuit analysis to a microwave problem compared to solving Maxwell's equations for the same problem? [2]

Q.2(b) Prove that the impedance matrix of a lossless N-port network has purely imaginary elements. [4]

Q.2(c) Calculate the S parameters of the circuit shown in Figure and show that the circuit acts as a 3 dB attenuator. [6]



Q.3(a) Is it possible to construct a three-port network which is lossless, reciprocal, and matched at all ports? Justify your answer. [2]

Q.3(b) Design a Wilkinson power divider with a power division ratio of $\frac{P_3}{P_2} = \frac{1}{3}$, and a source impedance of 50 Ω. [4]

Q.3(c) A directional coupler has the scattering matrix given below. Calculate the directivity, coupling, isolation, and return loss at the input port when the other ports are terminated in matched loads. [6]

$$[S] = \begin{bmatrix} 0.05\angle 30 & 0.96\angle 0 & 0.1\angle 90 & 0.05\angle 90 \\ 0.96\angle 0 & 0.05\angle 30 & 0.05\angle 90 & 0.1\angle 90 \\ 0.1\angle 90 & 0.05\angle 90 & 0.04\angle 30 & 0.96\angle 0 \\ 0.05\angle 90 & 0.1\angle 90 & 0.96\angle 0 & 0.05\angle 30 \end{bmatrix}.$$

Q.4(a) List the properties of a semiconductor compound that can be used in design of transfer electron devices. [2]

Q.4(b) A single-pole switch is to be constructed using a PIN diode with the following parameters C_j=0.5pF, R_r= 2 Ω, Rf =1.5 Ω, L_i =0.5 nH. If the operating frequency is 1.8 GHz, and Z_0= 50 Ω, Which switch circuit (series or shunt) should be used to obtain the greatest ratio of off-to-on attenuation. [4]

Q.4(c) Explain the working of a Reflex klystron. [6]

Q.5(a) A certain lossless circulator has a return loss of 20 dB. Calculate the circulator isolation and transmission. [2]

Q.5(b) In a resonance isolator a ferrite slab is placed inside the waveguide at a location that sees a circularly polarized field. Explain the reason. [4]

Q.5(c) An infinite lossless ferrite medium with a saturation magnetization of $4\pi M_s$ =1200 G and a dielectric constant of 10 is biased to a field strength of 500 oersted. At 8 GHz, calculate the differential phase shift per meter between an RHCP and an LHCP plane wave propagating in the direction of bias. Given that $\mu_0\gamma = 2.8\ \mathrm{MHz/o_e}$ [6]

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Q.6(a)	Draw the electric and magnetic fields for a microstrip line.	[2]
Q.6(b)	Describe effective dielectric constant. Explain its effect on the design of microstrip line.	[4]
Q.6(c)	Calculate the dielectric attenuation dB/λ of a 50 Ω copper strip line conductor at 10 GHz. The Substrate provided has a thickness of 0.32cm, ε_r= 2.20 and loss tangent is .001.	[6]

Q.7(a)	Explain the difference between spectrum analyzer and vector network analyzer?	[2]
Q.7(b)	Explain any one method to measure impedance of a device under test.	[4]
Q.7(c)	Calculate the maximum power received at a distance of 0.5 km over a free space 1GHz circuit consisting of a transmitting antenna with a 25dB gain and a receiving antenna with 20dB gain. The transmitting antenna input is 150W.	[6]

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