Reg. No.



FIFTH SEMESTER BTECH. (E & C) DEGREE END SEMESTER EXAMINATION MARCH 2021 SUBJECT: MICROWAVE ENGINEERING (ECE - 3154)

TIME: 3 HOURS	MAX. MARKS: 50
Instructions to candidates	
• Answer ALL questions.	

- Missing data may be suitably assumed.
- 1A. A directional coupler has the scattering matrix given below. If port (1) is input port, port (2) received power port, port (3) is forward coupled port and port (4) is isolation (back power) port. Determine the directivity, coupling and isolation.

[S] =	0.0530	0.960	0.1 <u>90</u>	0.05 <u>90</u>
	0.96 <u>0</u>	0.05 30	0.05 90	0.1 <u>90</u>
	0.1 <u>90</u>	0.05 <u>90</u>	0.04 30	0.96 <u>0</u>
	0.05 <u>90</u>	0.1 <u>90</u>	0.96 <u>0</u>	0.05 <u> 30</u>

- 1B. A two-cavity klystron amplifier has the following parameters: $V_0=1200V$, $I_0=25mA$, $R_0=48K\Omega$, f=10GHz, d=1mm, L=4cm, and $R_{Sh}=30K\Omega$. Take J_1 (X) = $J_1(1.84)=0.582$. Calculate:
 - i. The input voltage for maximum output voltage.
 - ii. The voltage gain in decibels.

(5+5)

- 2A. The collinear ports (1) and (2) of magic tee are terminated by impedances of reflection coefficients $\rho_1=0.5$ and $\rho_2=0.6$. The difference port (4) is terminated by an impedance with reflection coefficient of 0.8. If 1 watt power is fed at sum port (3), calculate the power reflected at port (3) and power divisions at the other ports.
- 2B. A symmetric directional coupler given in **Figure 2B** has an infinite directivity and a forward attenuation of 20dB. The coupler is used to monitor the power delivered to a load Z₁ as shown in below figure. Bolometer 1 introduces a VSWR of 2.0 on arm 1, bolometer 2 is matched to arm 2. If bolometer 1 reads 9mW and bolometer 2 read 3mW, then determine,
 - i. Power dissipated in the load Z_l
 - ii. VSWR on arm 3

(5+5)

- 3A. A microstrip antenna with overall dimension of L=0.357 inches and W=0.467 inches, substrate with height h=0.1588 cm and dielectric constant $\varepsilon_r = 2.2$ is operating at 10GHz. Find:
 - i. The input impedance.
 - ii. The position of the inset feed-point where the input impedance is 50 ohms.

3B. With equations explain Directivity, Polarization loss factor & Antenna temperature.

(5+5)

- 4A. Obtain the value of Directivity (Using exact and two approximate formulae) when the power pattern is $\cos^2\theta$ in the upper hemisphere & zero in the lower hemisphere for all angles.
- 4B. i. For an Electric current source obtain the solution of Vector wave equation.
 - ii. Write the dual expressions of the vector wave equation and its solution discussed in (i)

(5+5)

(5+5)

- 5A. For an infinitesimal Dipole antenna, starting from fundamentals, derive the expressions for far fields, using the concept of far field radiation. What is the criteria for deciding a dipole antenna as an infinitesimal dipole antenna?
- 5B. What are broadside and end fire arrays? Show that for an ordinary end fire array of "N" isotropic point sources with uniform amplitude and spacing $D_0=4L/\lambda$, for $L/d \gg 1$. "L" is the length of the array, and "d" is the spacing between elements.



Figure. 2B