Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

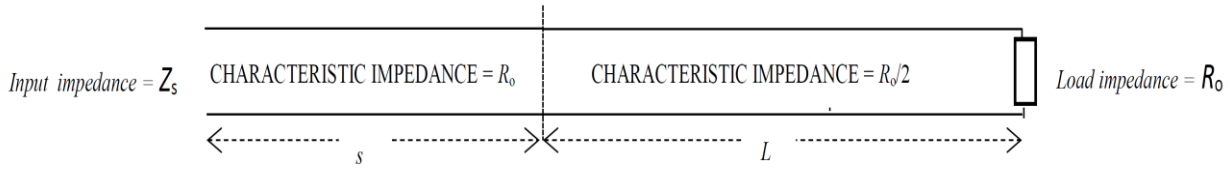
SEVENTH SEMESTER BTECH. (E & C) DEGREE END SEMESTER EXAMINATION
JANUARY/FEBRAURY 2021
SUBJECT: RF & MICROWAVE ENGINEERING (ECE - 4102)

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to candidates

- Answer **ALL** questions.
- Missing data may be suitably assumed.
- Use of Smith Chart is permitted and used Chart has to be uploaded

1A. A lossless transmission line of length L and of characteristic impedance $R_o/2$ is terminated in a purely resistive load of R_o. If a second lossless transmission line of length s and characteristic impedance R_o is now appended to the above system as shown in figure below,



i. What will be Z_s if s is equal to L?

ii. If operating frequency is 300 MHz and the length L is 2.8 m, is there a value of s for which Z_s will be purely resistive? If yes, what is the smallest possible such value of s and what will be that purely resistive Z_s?

1B. A lossless transmission line of length s has $Z_{sc} = -j30\ \Omega$ and $Z_{oc} = j25\ \Omega$. Determine the transmission line's characteristic impedance. What will be a possible value of s if operating frequency is 300MHz?

(7+3)

2A. A rectangular wave guide of cross section 4.0 cmx2.0 cm is used to propagate TM_{11} mode wave at 10GHz. Determine the cut-off wave length and wave impedance.

2B. A rectangular wave guide has dimensions 2.5x5.0 cm^2. Determine the guide wavelength λ_g, phase constant β, and phase velocity v_p at signal wavelength 4.5 cm for the dominant mode.

(5+5)

3A. With suitable examples, explain the applications of Magic Tee, isolators and directional coupler.

3B. A directional coupler has the scattering matrix given below. Find the return loss, coupling factor, directivity and insertion loss. Assume that the ports are terminated with matched loads.

$$[S] = \begin{bmatrix} 0.1\angle 40^0 & 0.944\angle 90^0 & 0.0056\angle 90^0 & 0.178\angle 180^0 \\ 0.944\angle 90^0 & 0.1\angle 40^0 & 0.178\angle 180^0 & 0.0056\angle 90^0 \\ 0.0056\angle 90^0 & 0.178\angle 180^0 & 0.1\angle 40^0 & 0.944\angle 90^0 \\ 0.178\angle 180^0 & 0.0056\angle 90^0 & 0.944\angle 90^0 & 0.1\angle 40^0 \end{bmatrix}$$

(5+5)

4A. Derive the velocity modulation equation for reflex klystron and explain its working.

4B. Compare klystron amplifiers with TWT amplifier.

4C. A 50 ohm lossless line connects a signal of 100kHz to a load of 100 ohm. The load power is 100mW. Calculate the

i. Voltage reflection coefficient of the load
ii. VSWR of the load
iii. Position of the first V_{min} and V_{max}
iv. Impedance at V_{min} and V_{max} and values of V_{max} and V_{min}

(4+3+3)

5A. With the help of a neat and labelled diagram for an equivalent circuit of the tunnel diode, derive the equations for resistive cut off frequency and self-resonance frequency. Also, neatly sketch the graph for resistive cut off frequency vs magnitude of negative resistance (R_n) of the tunnel diode, R_n varies from 10 Ω to 60 Ω, C = 0.5 pF, R_s = 10 Ω and L_s = 5 nH. Comment on the relationship between resistive cut off frequency and negative resistance obtained from the graph.

5B. With the help of neat and labelled diagrams, describe the physical structure and explain the mechanism of oscillations in a cylindrical magnetron.

(5+5)