Registration no: | | | | | | | | | | |

Total Number of Pages: 03 **B.Tech**
PCEC4402

8th Semester Regular / Back Examination 2016-17
MICROWAVE ENGINEERING
BRANCH(S): AEIE, ECE, EIE, ETC, IEE
Time: 3 Hours
Max Marks: 70
Q.CODE: Z110

Answer Question No.1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.

Q1 **Answer the following questions:** **(2 x 10)**

a) What do you mean by periodic structures in microwave?
b) Define cavity resonator? Which factors of the cavity determines its equivalent inductance, capacitance and resistance.
c) Differentiate between transmission line and wave guide?
d) Write conditions of quasi-TEM mode with applications?
e) When $\omega = 0.5\ c_o$, what are the phase and group velocities in a medium having the dispersion relation $k = \omega^2/c_o$?
f) Electronic admittance of reflex klystron is non-linear, Justify? On what factors it depends?
g) What are RWH theory that justifies for the band structure of a semiconductor to exhibit negative conductance.
h) What is the phase difference between two adjacent anode plates for the sustaining oscillation in a magnetron? Why zero mode is not used in magnetron operation?
i) How persons working in microwave field affected with non-thermal interaction?
j) Define the return loss? Write its range values?

Q2 **a)** What do you mean by double stub matching? How it is beneficial over Single stub matching? **(2)**

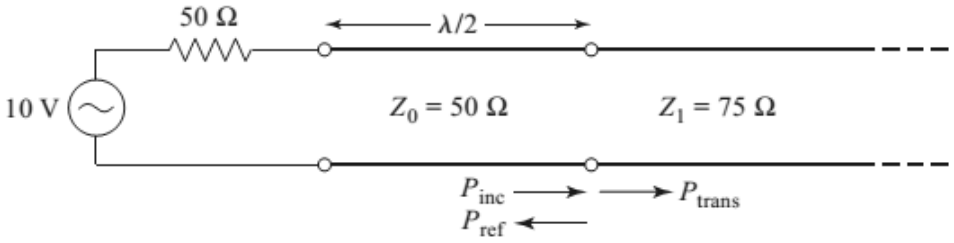
b) What do you mean by Smith chart? Derive and justify that a Smith chart contains constant resistance and reactance circle? Write down the characteristics of Smith chart? **(8)**

Q3 **a)** An open-wire transmission line has R = 5 Ω/m, L = 5.2 x 10^{-8}H/m, G = 6.2 x 10^{-3} mho/m, and C = 2.13 X 10^{-10} F/m. The signal frequency is 4 GHz. Calculate: **(5)**

(i) The characteristic impedance of the line in both rectangular form and polar form
(ii) The propagation constant of the wave along the line
(iii) The normalized impedance of a load 100 + j 100
(iv) The reflection coefficient at the load

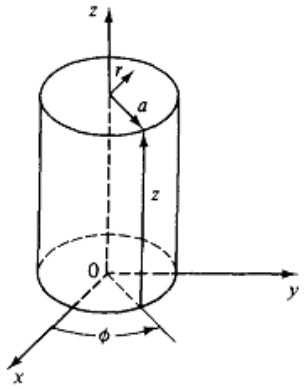
(v) The sending-end impedance if the line is assumed a quarter-wavelength long.

b) Consider the transmission line circuit shown in the accompanying figure. Compute the incident power, the reflected power, and the power transmitted into the infinite 75Ω line. Show that power conservation is satisfied. **(5)**



Q4 a) For the cylindrical waveguide the scalar Helmholtz equation in cylindrical coordinates is given by **(5)**

$$\frac{1}{r}\frac{\partial}{\partial r}\left(r\frac{\partial \psi}{\partial r}\right)+\frac{1}{r^2}\frac{\partial^2 \psi}{\partial \varphi^2}+\frac{\partial^2 \psi}{\partial z^2}+k^2\psi=0$$



Using the method of separation of variables i.e.considering $\psi = R(r)\Phi(\varphi)Z(z)$, where $R(r)$ = a function of the r coordinate only, $\Phi(\varphi)$= a function of the φ coordinate only, $Z(z)$ = a function of the z coordinate only,(The symbols having their usual meaning)

Prove that $\psi = \psi_0 J_n(k_r r)\cos(n\varphi)\, e^{-j\beta_g z}$

b) An air-filled rectangular cavity resonator has its first 3 resonant modes at the frequencies 5.2 GHz, 6.5 GHz, and 7.2 GHz. Find the dimensions of the cavity. **(5)**

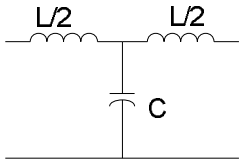
Q5 a) Derive and explain the velocity modulation and transit time of Reflex Klystron? **(5)**

b) A 250kW pulsed cylindrical magnetron is operated with the following parameters- Anode voltage = 25KV, Peak anode current = 25A, Magnetic field B = 0.35 Wb/m^2, Radius of cathode cylinder = 4 cm, Radius of cylinder = 8 cm, **(5)**

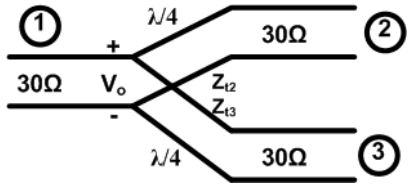
Calculate

(i) The efficiency of the magnetron
(ii) The cyclotron frequency
(iii) The cutoff magnetic Field
(iv) The cut-off voltage

Q6 **a)** Design a low-pass composite filter with cutoff frequency of 2GHz and impedance of 75W. Place the infinite attenuation pole at 2.05GHz, and plot the frequency response from 0 to 4GHz. **(5)**



b) Design a lossless T-junction divider with a 30Ω source impedance to give a 3:1 power split. Design quarter-wave matching transformers to convert the impedances of the output lines to 30Ω. Determine the magnitude of the scattering parameters for this circuit, using 30Ω characteristic impedance. **(5)**



Q7 TWTA is a example of 'O' type microwave tube, justify? Why TWTA requires slow wave structures? What are the types of slow wave structures? Explain construction, working principle and characteristics of Helix TWT? **(10)**

Q8 **Write short answer on any TWO:** **(5 x 2)**

a) Gunn oscillation mode

b) Hazards of Electromagnetic radiation to Personnel

c) Fixed and Precision Variable Attenuator

d) Filter design by Insertion loss method