B.E. VII (EXTC) (Rev) - Nov. 2006

Microwave Devices and Circuits

Con. 5192-06. YM-5932

(REVISED COURSE)

(3 Hours) [Total Marks : 100

N.B. (1) Question No. **1** is **compulsory.**
(2) Attempt any **four** questions out of remaining **six** questions.
(3) Assume any **suitable data** wherever **required** but **justify** the **same.**
(4) Illustrate answer with **sketches.**
(5) Answers to questions should be **grouped** and written **together.**

1. Attempt in brief (any **four**) :— 20
   (a) Cross field microwave tubes
   (b) High field domain theory
   (c) Isolate and circulators
   (d) Microstrip and stripline transmission line
   (e) Excitation of resonant cavities.

2. (a) Distinguish between the characteristic impedance and the input impedance of a transmission line. Under what conditions will they be the same ? In a lossless line how can the input impedance be made purely inductive, capacitive, infinite and zero ? 10
   (b) A load impedance of 130 + j 90 Ω terminates a 50 Ω transmission line that is 0·3 λ long. Find : 10
      (i) the reflection coefficient at the load,
      (ii) the reflection coefficient at the input to the line.
      (iii) the input impedance
      (iv) the SWR on the line
      (v) the return loss
      (use Smith chart)

3. (a) Derive the expression for the field in TE modes of circular waveguide. 10
   (b) Match a load impedance of Z_L = 100 + j 80 Ω to a 50 Ω line using a single series open-circuited stub. Give two solutions. (Use Smith chart). 10

4. (a) Why S-parameters are used at microwave frequencies ? List and explain properties of S-parameter matrix. 10
   (b) Explain two-hole directional coupler and derive its S matrix. 10
   Define terms—Coupling Coefficient and Directivity.

5. (a) Explain the constructional features and operation of IMPATT diode. 10
   (b) Describe a method of measuring impedance of a terminating load in a microwave system. 10

6. (a) Explain with neat diagram the basic principle of a Reflex Klystron oscillator, indicating how the kinetic energy of electrons in the beam is converted to radio frequency energy ? Explain how particular mode of the operation could be selected by the choice voltage on the repeller with the help of mode curves. 10
   (b) An X band pulsed conventional magnetron has the following operating parameters : 10

Anode voltage :	V_0 = 22 kV
Beam current :	I_0 = 28 A
Operating frequency :	f = 10 GHz
Resonator conductance :	Gr = 3×10^{-4} mho
Loaded conductance :	G_l = 3×10^{-5} mho
Vane capacitance :	C = 3 pF
Duty cycle :	0·001
Power loss :	P_{loss} : 200 kW.

Compute :
   (i) The angular resonant frequency
   (ii) The unloaded quality factor Q_{un}
   (iii) The loaded quality factor Q_l
   (iv) The external quality factor Q_{ex}
   (v) The circuit efficiency
   (vi) The electric efficiency.

7. (a) What is the advantage of a parametric amplifier over biopolar transistor amplifier as a pre amplifier at microwave frequencies ? Explain. 6

(b) An up-converter parametric amplifier has the following parameters : 6

Ratio of ouput frequency over signal frequency $= \frac{f_0}{f_s} = 25$

Figure of merit : $\gamma Q = 10$
Factor of merit figure : $\gamma = 0{\cdot}4$
Diode of merit figure $T_d = 350\ ^\circ K$

Calculate : (a) Power gain in decibels
(b) the noise figure in decibles
(c) the bandwidth.

(c) Explain the working of a magic tee clearly showing the field distribution at various arms. Contstruct a four part circular rising magic tees. 8