AMIETE – ET (OLD SCHEME)

Code: AE20 **Subject: MICROWAVE THEORY & TECHNIQUES**
Time: 3 Hours **Max. Marks: 100**

JUNE 2010

NOTE: There are 9 Questions in all.

- **Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1 Choose the correct or the best alternative in the following: (2×10)

a. A hollow rectangular waveguide has dimensions 6 cm×4 cm. The frequency of impressed signal is 3 GHz compute cut-off wavelength for TE_{10} mode.

(A) 0.12 m **(B)** 2.12 m
(C) 3.25 m **(D)** 7.25m

b. In a travelling wave tube, the phase velocity of the axial component of the RF field on the slow-wave structure is kept

(A) equal to the velocity of the electrons.
(B) slightly less than the velocity of electrons.
(C) slightly more than the velocity of electrons.
(D) equal to the velocity of light in free space.

c. A waveguide section in a microwave circuit will act as a

(A) Low-pass filter **(B)** band-pass filter
(C) High-pass filter **(D)** band-reject filter.

d. A disadvantage of microstrips with respect to stripline is that the former

(A) do not lend themselves to printed- circuit techniques.
(B) are more likely to radiate.
(C) are bulkier.
(D) are more expensive and complex to manufacture.

e. Which one of the can be used for amplification of microwave energy?

(A) Travelling wave tube **(B)** Magnetron
(C) Reflex klystron **(D)** Gunn diode.

f. A lossless line having characteristic impedance Z_0 is terminated in a pure reactance of value $-jZ_0$. The VSWR of the line will be

(A) 10 **(B)** 2

(C) 1 **(D)** Infinite.

g. For a matched transmission line. The VSWR (voltage standing wave ratio) is

(A) Unity **(B)** Infinity
(C) Zero **(D)** 0.25

h. A directional coupler with three or more holes is sometime preferred over two-hole coupler

(A) because it is more efficient
(B) to increase coupling of the signal
(C) to reduce spurious mode generation
(D) to increase the bandwidth of the system.

i. A transmission line consists of the following distributed constants

(A) resistance and inductance
(B) inductance and shunt capacitance only
(C) resistance and series capacitance only
(D) resistance, inductance ands hunt capacitance.

j. A semiconductor diode which can be used in switching circuits at microwave frequencies

(A) Pin diode **(B)** Varactor diode
(C) Tunnel diode **(D)** Gunn diode

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

Q.2 a. What are the steps involved in connecting a stub to a transmission line for the purpose of impedance matching? **(6)**

b. Show that a TEM wave cannot propagate in a waveguide. **(5)**

c. Calculate the cut-off frequency of the TE_{01}, TM_{11} and TE_{22} modes in a square waveguide of dimensions $4\text{ cm} \times 4\text{ cm}$. **(5)**

Q.3 a. Derive the wave equations for a TE wave propagating in a circular wave guide and obtain all field components. **(8)**

b. A lossless transmission line of $Z_0 = 50\Omega$ is terminated by a load $Z_l = 100 + 100j$ using smith chart, design a single stub matching arrangement to match the load to the generator and the line. Calculate the position of the short circuited stub and the length of the stub for matching. **(8)**

(8)

Q.4 a. List the drawbacks of single stub matching. **(4)**

b. Write a short note on microwave integrated circuits. **(4)**

c. Define fading? Explain the various types of fading. **(8)**

Q.5 a. How are microwave measurements differ from low frequency measurements? **(4)**

b. Explain working of TWT with neat sketch. **(6)**

c. A plane wave propagation through glass having relative permittivity 5 has the magnitude of electric field vector as 100 V/ m and frequency 1MHz. Calculate:
(i) Velocity and phase shift constant of wave
(ii) Magnitude of magnetic field intensity. **(6)**

Q.6 a. Explain how Magic tee can be used as a balanced microwave mixer. **(4)**

b. Explain the working of a 4 port directional coupler with a neat diagram and derive the relevant parameters. **(8)**

c. Explain two properties of scattering matrix. **(4)**

Q.7 a. Explain working principle of magnetron with neat sketch. **(8)**

b. Explain with diagram the microwave setup to measure the frequency of a wave in a rectangular waveguide. **(8)**

Q.8 a. Write a short notes on TRAPATT. **(6)**

b. What do you understand by over the horizon microwave system? Explain in brief. **(5)**

c. Explain action of isolator using ferrite. **(5)**

Q.9 Write short notes on any **TWO** of the following:

(i) MASERS.
(ii) E & H plane tee junctions.
(iii) microwave applications
(iv) Irises, posts & tuning screws. **(8×2)**