Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.Tech (ECE)/SEM-2/MCE-202/2010

2010

MICROWAVE AND MILLIMETREWAVE TECHNIQUES

Time Allotted : 3 Hours | Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

i) The space between two cavities of a klystron is called

a) Drift space b) Free space

c) Running space d) Normal space.

ii) A hollow waveguide behaves as

a) Low-pass filter b) Band-pass filter

c) High-pass filter d) All pass filter.

iii) Which of the following wave does not exist in a waveguide ?

a) TE32 b) TM11

c) TEM d) TE21.

iv) Distance between maxima and minima of a standing wave is

a) $\lambda/2$ b) λ

c) $3\lambda/4$ d) $\lambda/4$.

v) Klystron operates in the principle of

a) Amplitude modulation b) Frequency modulation

c) Pulse modulation d) Velocity modulation.

vi) The X-band waveguide is

a) WR-31 b) WR-62

c) WR-90 d) WR-137.

vii) The basic effects in IMPATT diode is

a) Avalanche effect b) Zener effect

c) Impact ionization d) Both (a) and (c).

viii) To detect a target at a distance 500 km the maximum pulse repetition frequency should be

a) 30 Hz b) 300 Hz

c) 30 KHz d) 300 KHz.

ix) The noise in an IMPATT diode arises mainly from

a) Jhonson noise

b) Flicker noise

c) Generation-Recombination noise

d) Shot noise.

x) The material used in Gunn diode is

a) Si b) Ge

c) AlGaAs d) GaAS.

xi) The first higher sideband or valley of Gunn diode using InP is

a) $k = 0$ (Γ point) b) (111)-axis(L)

b) (100)-aixs (X) d) none of these.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. Describe the high frequency limitations of conventional tubes. 5

3. What is mode jumping in Magnetron ? What are the advantages of millimetrewave over microwave ? 2 + 3

4. Why exactly 94 GHz frequency band is used for RADAR or any other millimetrewave applications ? Why duplexer is used in RADAR ? Why is it not possible to measure the range of a target using a Continuous Wave (CW) in RADAR ?

2 + 1 + 2

5. Explain how the pulse width and pulse repetition frequency determine the minimum detectable range and maximum unambiguous range. 5

6. What is injection locking and phase noise ? Calculate phase noise to carrier power ratio. 2 + 3

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) A 400 kW cylindrical magnetron operating at X-band has the following set of parameters : Anode voltage = 32 kV, Beam voltage = 84A, Radius of cathode cylinder = 6 cm, Radius of anode cylinder = 12 cm, Magnetic flux density = 0·01 wb/ m^2.

Calculate the cyclotron angular frequency, the cut-off magnetic fiux density for a fixed V_{DC}, the cut-off voltage for a fixed B_O, the efficiency. 6

b) Describe velocity modulation with the help of 'Applegate diagram' in two cavity klystorn. 6

c) What are the application of TWT ? 3

8. a) Deduce S-parameters of a Magic Tee. 4

   b) Define 'isolation' and 'Directivity' of a Directional Coupler. 4

   c) Explain different modes of radio wave propagation ? 3

   d) Estimate the maximum distance between transmitter and receiver in LOS communication. 4

9. a) Derive an expression for impedance of IMPATT diode using small signal analysis.

   b) Draw the equivalent circuit of the IMPATT diode.

   c) Plot the real and imaginary parts of impedance *vs* frequency.

   d) Draw the biasing arrangement of the IMPATT diode with current and voltage source. 9 + 2 + 2 + 2

10. a) Derive the radar equation and modify it for minimum output signal to noise power ratio (SNR).

    b) What do you mean by Radar Cross-Section (RCS) of target ?

    c) Draw the block diagram of a CW radar and explain its basic principle. How is the sign of the radial velocity of the target determined using CW radar ?

    d) Explain the duct propagation. 4 + 2 + 6 + 3

11. a) What is parabolic reflector ? Describe 'cassegrain feed'. 3 + 3

    b) What is E-plane H-plane TEE ? 2 + 2

    c) Describe the radiation mechanism of microstrip patch antenna. 5