2013

RF & MICROWAVE ENGINEERING

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)

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

i) The main advantage of microwave is that it

a) is highly directive

b) moves at the speed of light

c) has greater S/N ratio

d) has higher penetration power.

ii) Klystron operates on the principle of

a) amplitude modulation

b) frequency modulation

c) pulse modulation

d) velocity modulation.

[Turn over

iii) In a waveguide the dominant mode is

a) lowest cut-off frequency

b) lowest cut-off wavelength

c) highest cut-off frequency

d) none of these.

iv) A TRAPATT diode is preferred to an IMPATT diode because of

a) its higher efficiency

b) its lower noise

c) lesser sensitivity of harmonics

d) its larger bandwidth.

v) The Tunnel diode

a) has a tiny hole through its centre to facilitate tunnelling

b) is a point contact diode with very high reverse resistance

c) uses a high level of doping to provide a narrow junction

d) works by quantum tunnelling exhibited by gallium arsenide.

vi) A microstrip is analogous to a

a) co-axial line

b) parallel wire line

c) rectangular waveguide

d) circular waveguide.

vii) If VSWR is infinite, the transmission line is terminated in

a) short circuit b) complex impedance

c) open circuit d) either (a) or (c).

viii) The main advantage of using microwaves for communications is

a) large bandwidth b) small bandwidth

c) low power d) high power.

ix) The range of *X*-band is

a) 12-20 GHz b) 20-27 GHz

c) 1-2 GHz d) 8-12 GHz.

x) An H-plane Tee is

a) two-port network b) one-port network

c) three-port network d) four-port network.

xi) Large microwave power can be measured by

a) Calorimeter wattmeter

b) Bolometer

c) Wattmeter

d) Wavemeter.

xii) In a rectangular waveguide dominant mode is

a) TM_{11} b) TE_{11}

c) TE_{10} d) TE_{01}.

xiii) PIN diode is

a) a microwave isolator

b) a microwave amplifier

c) a microwave filter

d) a microwave switch.

GROUP – B

(Short Answer Type Questions)

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

2. Define microwave. What is the significance of using 'S' parameter in microwave engineering ? 2 + 3

3. What are the differences between TED's and junction devices ? Distinguish between 'Group Velocity' and 'Phase Velocity'. 3 + 2

microwave circulator. Describe the operating principle four-port microwave circulator. 1 + 4

hat do you mean by cut-off frequency of a waveguide ? hat is the power in the auxiliary arm for a 3 dB coupler th input power of 167 mW. The input of the coupler mination results in a VSWR of 2. 1 + 4

tate the advantages and disadvantages of waveguides compared to coaxial lines.

Can a circulator be used as an isolator ? If so, how ?

GROUP – C

(Long Answer Type Questions)

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

a) Does TEM exist in rectangular waveguide ? Why ?

b) Which is the dominant mode in rectangular waveguide ? Why ?

c) A hollow rectangular waveguide operates at f = 1 GHz and it has dimension 5 cm × 2 cm. Check whether TE_{21} mode propagates or not. 5 + 5 + 5

9. a) Explain Read diode. Give the electric field distribution, doping profile, voltage and current characteristics of read diode.

   b) What is IMPATT diode ? How does the negative resistance arrive in this diode ?

   c) Explain PIN diode and give its application. 6 + 5 + 4

10. a) Explain the tunnelling action in a tunnel diode.

    b) With the help of two-valley, explain how negative resistance can be created in Gunn diode. Mention its applications. 5 + 10

11. a) Derive the equation for the scattering matrix of magic Tee.

    b) Differentiate between circulators and isolators. 7 + 8

Describe how the frequency of a given microwave source can be measured.

Explain how low VSWR can be measured using a microwave bench. 7 + 8