# B.Sc. ELECTRONICS
## Fifth Semester
## MICROWAVE THEORY
### (BSE - 22)

**Duration: 3Hrs.**                                      **Full Marks: 70**

Part-A (Objective) =20
Part-B (Descriptive) =50

## (PART-B: Descriptive)

**Duration: 2 hrs. 40 mins.**                              **Marks: 50**

### Answer any *five* of the following questions:

1. (a) Derive the equation   $\dfrac{1}{\lambda_0^2} = \dfrac{1}{\lambda_c^2} + \dfrac{1}{\lambda_g^2}$

   (b) A wave is propagating in a parallel plate guide operating in $TE_{10}$ mode at a
   frequency of $6\,GHz$. The separation between the plates is $5\,cm$. Find:
   (i) the cut off wavelength
   (ii) wavelength within guide
   (iii) group and phase velocity.

   $(5+5=10)$

2. (a) What is magnetron? Explain the working principle of magnetron.
   (b) Explain the process of velocity modulation.

   $(5+5=10)$

3. (a) Find the greatest number of half waves of electric intensity with which it may be
   possible to propagate a signal of $10\,GHz$ in a waveguide whose wall separation is
   0.05m. Calculate the guide wavelength for this mode of propagation.
   Explain the operation of TWT with a suitable schematic diagram.

   $(5+5=10)$

4. (a) Explain the working principle of Gunn diode. State how domain is formed in
   Gunn diode.
   (b) Write short notes on: (any *two*)
   a) Negative resistance       b) Avalanche break down       c) $\pi$ mode oscillation

   $(6+4=10)$

5. (a) What is IMPATT diode? Explain the working principle of IMPATT diode.
   (b) Write short notes on:
      a) Varactor diode            b) TRAPATT

                                                                    (6+4=10)

6. (a) Explain with diagram basic principles of RADAR.
   (b) Derive RADAR range equation.

                                                                    (5+5=10)

7. (a) Derive current and voltage equations of transmission line.
   (b) Define SWR. Write the mathematical expression for it.

                                                                    (6+4=10)

8. (a) Explain with diagram operation of PIN diode.
   (b) Explain the operation of reflex Klystron with the aid of a suitable schematic
      diagram; indicate the polarity of the voltages applied to the various electrodes.

                                                                    (5+5=10)


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**Duration: 20 minutes**

**Marks – 20**

### (PART A- Objective Type)

**I. Choose the correct answer:**

**1×20=20**

1. Wave guide supports:
   a) TE mode
   b) TM mode
   c) TEM mode
   d) both TE and TM mode

2. Velocity of wave in free space is
   a) $\dfrac{1}{\sqrt{\mu\varepsilon}}$
   b) $\sqrt{\mu\varepsilon}$
   c) $\dfrac{1}{\sqrt{\mu_0\varepsilon_0}}$
   d) $\sqrt{\mu_0\varepsilon_0}$

3. Klystron is a microwave:
   a) oscillator
   b) amplifier
   c) switch
   d) none of the above

4. Performance characteristics of Gunn diode is related to:
   a) –ve resistance
   b) voltage
   c) current
   d) none of the above.

5. Velocity modulation is involved in the working principle of:
   a) Klystron
   b) Magnetron
   c) TWT
   d) both a) and b)

6. Which one of the following is a crossed field device?
   a) Magnetron
   b) Klystron
   c) TWT
   d) TRAPATT

7. Range of frequencies in X- band is:
   a) 2-4 GHz
   b) 4-8 GHz
   c) 8-12 GHz
   d) none of the above

8. Klystron can be used as power:
   a) source
   b) receiver
   c) both a) and b)
   d) none of the above.

9. Gradient of any function $f(x, y, z)$ is a:
   a) scalar quantity
   b) vector quantity
   c) unit vector quantity
   d) none of the above

10. Cut off frequency expression for parallel plate wave guide is:

(a) $\dfrac{1}{\lambda_0^{\,2}} = \dfrac{1}{\lambda_c^{\,2}} + \dfrac{1}{\lambda_g^{\,2}}$    (b) $\dfrac{1}{\lambda_c^{\,2}} = \dfrac{1}{\lambda_0^{\,2}} + \dfrac{1}{\lambda_g^{\,2}}$

(c) $\dfrac{1}{\lambda_g^{\,2}} = \dfrac{1}{\lambda_c^{\,2}} + \dfrac{1}{\lambda_0^{\,2}}$    (d) $\dfrac{1}{\lambda_c^{\,2}} = \dfrac{1}{\lambda_g^{\,2}} + \dfrac{1}{\lambda_0^{\,2}}$

11. Π -mode is supported in:
   a) Magnetron            b) Klystron
   c) TWT                  d) both a) and b)

12. RADAR uses:
   a) antenna              b) duplexer
   c) only antenna         d) both a) and b)

13. Electrons in Reflex Klystron are captured at repeller end by:
   a) buncher cavity       b) catcher cavity
   c) resonant cavity      d) none of the above

14. Which one of the following is not a microwave semiconductor device?
   a) Magnetron            b) TRAPATT
   c) IMPATT               d) Schottky diode

15. Intrinsic impedance of free space is:
   a) 376Ω                 b) 377Ω
   c) 375Ω                 d) none of the above

16. Which of the following statements are true for a transmission line parameters $R, L, G$ and $C$?
   a) $R$ and $L$ are series elements.
   b) $G$ and $C$ are shunt elements.
   c) both $R$ and $G$ depend on conductivity of the conductors forming the line.
   d) only $R$ depends explicitly on frequency.

17. Signals coming back from RADAR target is known as:
   a) echos                b) reflected signal
   c) pulse                d) none of the above

18. VSWR is used for calculating:
   a) voltage ratio        b) current ratio
   c) pulse ratio          d) none of the above

19. Calculation of λ value is carried out using:
   a) slotted line         b) attenuator
   c) matched load         d) none of the above

20. Which one of the following is correct?
   a) Wave velocity is greater than group velocity.
   b) Group velocity is greater than wave velocity.
   c) Wave velocity is equal to group velocity.
   d) None of the above.

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