# Microwave Engineering & Radar System (315342)

MSBTE Diploma · K-Scheme · Model Question Paper — Set B

**Time: 3 Hours** **Max. Marks: 70**

**Instructions:**

1. All questions are compulsory.
2. Answer each next main question on a new page.
3. Illustrate your answers with neat sketches wherever necessary.
4. Figures to the right indicate full marks.
5. Assume suitable data, if necessary.
6. Use of non-programmable electronic pocket calculator is permissible.
7. Mobile phone, pager and any other electronic communication devices are not permissible in the examination hall.

**Q.1 Attempt any FIVE of the following:** **10**

a) Define phase velocity and group velocity. Write the relation between them for a waveguide.

b) Draw neat sketches of a waveguide twist and a waveguide taper.

c) Define VSWR and reflection coefficient. Write the relation between them.

d) List any four applications of microwave cavity resonators.

e) Define Doppler effect. Write the expression for Doppler frequency shift in RADAR.

f) State any four applications of RADAR in automobiles and daily life.

g) State the frequency ranges of L, S, C and X bands as per IEEE band designation.

**Q.2 Attempt any THREE of the following:** **12**

a) Distinguish between rectangular waveguide and coaxial transmission line on the basis of: i) Construction ii) Mode of propagation iii) Cut-off frequency iv) Power handling capacity.

b) Explain the construction, working and applications of Wilkinson power divider with a neat diagram.

c) Draw the PPI display and explain its working principle. State where it is used.

d) With a neat constructional diagram explain the working of Faraday-rotation isolator.

**Q.3 Attempt any THREE of the following:** **12**

a) Define TE and TM modes. Sketch the field pattern of the dominant $TE_{11}$ mode in a circular waveguide and state two applications of circular waveguide.

b) Derive the RADAR range equation in terms of transmitted power, antenna gain, effective aperture, RADAR cross-section and minimum detectable signal.

c) Draw the symbol and V–I characteristic of tunnel diode. Explain its working and state two applications.

d) Draw a neat sketch of E-plane tee. Explain why it is called a series tee and what happens when power is fed at the E-arm.

**Q.4 Attempt any THREE of the following:** **12**

a) Explain the construction and working of helix travelling wave tube (TWT) with a neat diagram.

b) Explain sequential lobing and monopulse tracking methods of RADAR with neat sketches.

c) With a neat diagram explain the construction and working of HEMT. State its applications.

d) Explain horizontal (raster) scanning and vertical (nodding) scanning of RADAR antenna with neat sketches.

e) Explain the Long Range Navigation (LORAN) system with a neat sketch.

**Q.5 Attempt any TWO of the following:** **12**

a) An air-filled rectangular waveguide has dimensions a = 4 cm and b = 2.5 cm. Find all the TE and TM modes which will propagate through it at 10 GHz.

b) Compare IMPATT, TRAPATT and BARITT diodes with neat structural sketches (any six points).

c) Explain the working principle of SONAR with a neat sketch. State its types and any four applications.

**Q.6 Attempt any TWO of the following:** **12**

a) A RADAR has peak power 400 kW, transmitting antenna gain 1800, receiving antenna effective aperture 2.5 $m^2$, minimum detectable signal $5 \times 10^{-13}$ W and target cross-section 8 $m^2$. i) Find its maximum range. ii) If the PRF is 800 Hz and pulse width is 1.5 µs, find the maximum unambiguous range, duty cycle and average power.

b) Explain the construction and bunching process of a two-cavity klystron amplifier with the help of Applegate diagram. State two applications.

c) Differentiate between pulse RADAR, CW Doppler RADAR and MTI RADAR on the basis of: principle, transmitted signal, range measurement, velocity measurement, rejection of fixed targets and applications.

**Note:** This is a **model question paper prepared by Ananda Technologies** only for practice and exam preparation, based on the pattern of previous MSBTE question papers and the K-scheme syllabus. It is **not an official MSBTE paper**, and it does **not** mean that these questions will come in the exam. Answers follow standard textbook points; marks shown are indicative. Free for students — anandatechnologies.in