

Microwave Engineering & Radar System (315342)

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

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) State any four advantages of waveguide over two-wire transmission line at microwave frequencies.
- b) Draw neat sketches of E-plane bend and H-plane bend of a rectangular waveguide.
- c) Draw the microwave frequency spectrum and show the IEEE band designations L, S, C, X and Ku in it.
- d) List any four limitations of conventional vacuum tubes at microwave frequencies.
- e) A pulse RADAR transmits pulses of width $2\ \mu\text{s}$ at a PRF of 1000 Hz. Calculate its duty cycle and maximum unambiguous range.
- f) State the RADAR range equation and give the meaning of each term used in it.
- g) List any four applications of SONAR.

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

- a) Sketch the electric and magnetic field patterns of TE_{10} mode in a rectangular waveguide (end view and top view).
- b) With a neat diagram explain the construction and working of a three-port (Y-junction) ferrite circulator. State two applications.
- c) Explain the types of microwave radiation hazards (HERP, HERO, HERF). State the preventive measures.
- d) Draw the block diagram of a basic pulse RADAR and explain the function of the duplexer.

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

- a) Explain the working principle of reflex klystron. Show the bunching of electrons using an Applegate diagram.

- b) Explain the construction and working of Gunn diode with the help of its velocity–electric field characteristic.
- c) Draw the A-scope display of a RADAR and explain how the range of a target is read from it.
- d) Explain the working of a two-hole directional coupler with a neat sketch. Define coupling factor and directivity.

Q.4 Attempt any THREE of the following:

12

- a) Compare IMPATT, TRAPATT and BARITT diodes with respect to: i) Structure ii) Operating principle iii) Efficiency iv) Noise.
- b) Explain helical scanning and spiral scanning of a RADAR antenna with neat sketches.
- c) Explain the working principle of SONAR with a neat block diagram.
- d) Explain conical scan tracking with a neat sketch. State one advantage and one disadvantage of it.
- e) Draw a neat sketch of magic tee and state its properties.

Q.5 Attempt any TWO of the following:

12

- a) An air-filled rectangular waveguide has inner dimensions $a = 2.29$ cm and $b = 1.02$ cm and operates at 10 GHz. Calculate: i) cut-off frequency of TE_{10} and TE_{11} modes (state whether they propagate) ii) guide wavelength iii) phase velocity and group velocity iv) wave impedance of TE_{10} mode.
- b) Draw the block diagram of MTI RADAR and explain how moving targets are separated from fixed targets. State two advantages of MTI RADAR.
- c) Explain the following microwave applications with neat diagrams: i) RADAR radiometer ii) Remote sensing RADAR iii) Biomedical application.

Q.6 Attempt any TWO of the following:

12

- a) A RADAR operating at 5 GHz has a peak transmitted power of 250 kW and an antenna of effective aperture 4 m^2 . The minimum detectable signal is 10^{-13} W and the RADAR cross-section of the target is 12 m^2 . i) Calculate the maximum range of the RADAR. ii) If the target approaches the RADAR at 720 km/h, calculate the Doppler frequency shift.
- b) With a neat cross-sectional diagram explain the working of a cylindrical cavity magnetron. Explain the effect of electric and magnetic fields on the electron path. State two applications.
- c) Compare pulsed RADAR and CW Doppler RADAR (any six points). Draw the block diagram of CW Doppler RADAR.

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