Microwave Engineering & Radar System (315342)

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

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 dominant mode. Name the dominant mode of rectangular and circular waveguides.

b) Draw a neat labelled sketch of rat-race junction (hybrid ring).

c) Draw neat sketches of an E-plane corner and an H-plane corner of rectangular waveguide.

d) Draw the symbol of varactor diode and state any two of its applications.

e) Define pulse repetition frequency (PRF). A RADAR has a PRF of 2 kHz; calculate its maximum unambiguous range.

f) Draw the block diagram of a basic pulse RADAR system.

g) Define RADAR clutter and list its types.

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

a) Explain the role of IEEE and OSHA standards in microwave engineering. State the IEEE band designations of microwave frequencies.

b) Describe the working principle of Heterojunction Bipolar Transistor (HBT) with its structural diagram. State its applications.

c) Explain the construction and working of a dielectric-vane microwave phase shifter with a neat diagram.

d) Compare A-scope, PPI and RHI display methods of RADAR (any four points) with neat sketches.

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

a) Sketch the field patterns of TE_{10}, TE_{20} and TE_{11} modes in a rectangular waveguide.

b) State the RADAR range equation. Explain the factors which affect the maximum range of a RADAR.

c) With a neat structural diagram explain the working of IMPATT diode. State its applications.

d) Explain the gyrator with a neat sketch and its symbol. State its applications.

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

a) Explain the construction and working of backward wave oscillator (BWO) with a neat diagram.

b) Explain the construction and working of gyrotron with a neat diagram. State its applications.

c) Draw the block diagram of CW Doppler RADAR and explain how the speed of a target is measured.

d) List the RADAR antenna scanning methods. Explain helical and vertical (nodding) scanning with neat sketches.

e) Draw the schematic of reflex klystron and explain its working. Why should the transit time in the repeller space be (n + ¾) cycles?

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

a) A rectangular waveguide of inner dimensions 2.5 cm × 1.25 cm is completely filled with a dielectric of $\varepsilon_r = 2.25$. The operating frequency is 5 GHz. Calculate: i) cut-off frequencies of TE_{10} and TE_{11} modes ii) guide wavelength iii) phase and group velocities iv) wave impedance of TE_{10} mode.

b) Draw neat sketches of H-plane tee and magic tee. State the properties of magic tee and explain its use as a duplexer.

c) Explain the following RADAR applications with neat sketches: i) Vehicle speed detection ii) Vehicle parking assistance iii) Air traffic control iv) Weather surveillance RADAR.

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

a) A RADAR operating at 3 GHz uses the same antenna of gain 2000 for transmission and reception. Its peak power is 1 MW, minimum detectable signal is 10^{-12} W and the target cross-section is 5 m². i) Find the maximum range. ii) Find the Doppler frequency shift when an aircraft approaches the RADAR at 900 km/h.

b) Draw the block diagram of MTI RADAR and explain the delay-line canceller. Define blind speed and calculate the first two blind speeds of an MTI RADAR operating at 6 GHz with a PRF of 1200 Hz.

c) Explain the working principle of SONAR with a neat diagram. Compare SONAR and RADAR (any four points).

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