

Microwave Engineering & Radar System (315342)

MSBTE Diploma · K-Scheme · Electronics & Telecommunication (EJ), Semester 5 · Important Questions

How this list was made: Based on MSBTE papers **W-2025** and **S-2026** available on msbte.ac.in (the only two K-scheme papers of this course available so far). Every question of both papers was grouped by topic. **High** = asked in both papers, **Medium** = asked in one paper, **Low** = in the K-scheme syllabus but not asked yet. Practice guidance only — not a prediction of the exam.

Most repeated topics

#	Topic	Unit	Times asked
1	Tee junctions – E-plane tee, magic (hybrid) tee, rat-race	2	3 (W-25, S-26)
2	Basic pulse RADAR – block diagram, advantages	5	3 (W-25, S-26)
3	Waveguide vs transmission line – advantages / comparison	1	2 (W-25, S-26)
4	Field patterns of TE ₁₀ / TE ₁₁ / TE ₂₀ modes; TE and TM modes	1	2 (W-25, S-26)
5	Rectangular waveguide numerical (cut-off frequency, λ_g , impedance, propagating modes)	1	2 (W-25, S-26)
6	Microwave spectrum, band designations, IEEE and OSHA standards	1	2 (W-25, S-26)
7	Bends, corners, twists and tapers – sketches	2	2 (W-25, S-26)
8	Ferrite devices – isolator, circulator, gyrator	2	2 (W-25, S-26)
9	Klystron with Applegate diagram (reflex / two-cavity)	3	2 (W-25, S-26)
10	IMPATT, TRAPATT, BARITT diodes – comparison	3	2 (W-25, S-26)

Unit I – Fundamentals of Transmission Lines and Microwaves (12 M)

Question / topic	Marks	Asked in	Probability
Waveguide vs transmission line – advantages / comparison <ul style="list-style-type: none"> State the advantages of waveguide over transmission line. (W-25 Q.1g) Compare waveguide with transmission line on the basis of construction, supporting theory, operating mode, application. (S-26 Q.2a) 	2 M, 4 M	W-25, S-26	High
Field patterns of TE₁₀ / TE₁₁ / TE₂₀ modes; TE and TM modes <ul style="list-style-type: none"> Sketch the field pattern of TE₁₀, TE₁₁, TE₂₀ modes of rectangular waveguide. (W-25 Q.2c) Define TE mode and TM mode; sketch field pattern of TE₁₀ mode. (S-26 Q.3a) 	4 M	W-25, S-26	High
Rectangular waveguide numerical (cut-off frequency, λ_g, impedance, propagating modes)	6 M	W-25, S-26	High

<ul style="list-style-type: none"> • $a = 3 \text{ cm}$, $b = 1.5 \text{ cm}$, $\epsilon_r = 5$: cut-off of TE₁₀ and TE₁₁, guide wavelength, impedance at 4 GHz, attenuation ... (W-25 Q.5a) • $a = 2.5 \text{ cm}$, $b = 1 \text{ cm}$: find all the modes which will propagate at 8.66 GHz. (S-26 Q.5a) 			
Microwave spectrum, band designations, IEEE and OSHA standards <ul style="list-style-type: none"> • Describe IEEE and OSHA standards role and band designations w.r.t. microwave communication. (W-25 Q.3d) • Draw microwave frequency spectrum and designate appropriate band in it. (S-26 Q.1d) 	2 M, 4 M	W-25, S-26	High
Group velocity and phase velocity <ul style="list-style-type: none"> • Define group velocity and phase velocity. (W-25 Q.1b) 	2 M	W-25	Medium
VSWR and reflection coefficient (standing waves) <ul style="list-style-type: none"> • Define VSWR and reflection coefficient w.r.t. transmission lines. (S-26 Q.1a) 	2 M	S-26	Medium
Circular waveguide – structure, TE₁₁ pattern, applications; dominant mode In syllabus, not asked yet — prepare for a surprise question.	—	Not yet	Low

Unit II – Microwave Components (12 M)

Question / topic	Marks	Asked in	Probability
Tee junctions – E-plane tee, magic (hybrid) tee, rat-race <ul style="list-style-type: none"> • Draw neat sketch of rat race junction (hybrid ring) and label it. (W-25 Q.1e) • E-plane tee: power division when coplanar arm lengths are same / differ by $\lambda/2$ / λ / arbitrary. (W-25 Q.3c) • Sketch hybrid tee junction, state its properties, explain hybrid tee as a duplexer. (S-26 Q.5b) 	2 M, 4 M, 6 M	W-25, S-26	High
Bends, corners, twists and tapers – sketches <ul style="list-style-type: none"> • Draw the neat sketches of corners and twists. (W-25 Q.1a) • Draw neat sketches of tapers and twists. (S-26 Q.1b) 	2 M	W-25, S-26	High
Ferrite devices – isolator, circulator, gyrator <ul style="list-style-type: none"> • Compare with neat sketch gyrator, isolator and circulator (six points). (W-25 Q.5b) • With neat constructional diagram explain the working of isolator. (S-26 Q.2d) 	4 M, 6 M	W-25, S-26	High
Wilkinson power divider <ul style="list-style-type: none"> • Explain construction, working principle, application of Wilkinson power divider. (W-25 Q.2b) 	4 M	W-25	Medium
Microwave cavity resonator <ul style="list-style-type: none"> • List any two applications of microwave cavity resonator. (S-26 Q.1c) 	2 M	S-26	Medium

Microwave phase shifter • Draw constructional diagram and explain working principle of microwave phase shifter. (S-26 Q.4b)	4 M	S-26	Medium
Directional coupler / rotating coupler In syllabus, not asked yet — prepare for a surprise question.	—	Not yet	Low

Unit III – Microwave Tubes and Microwave Semiconductor Devices (16 M)

Question / topic	Marks	Asked in	Probability
Klystron with Applegate diagram (reflex / two-cavity) • Working principle of reflex klystron; set-up of oscillations using Applegate diagram. (W-25 Q.4b) • Bunching process of two-cavity klystron with Applegate diagram; two applications. (S-26 Q.6b)	4 M, 6 M	W-25, S-26	High
IMPATT, TRAPATT, BARITT diodes – comparison • Compare with neat sketches BARITT, IMPATT, TRAPATT diode (six points). (W-25 Q.6a) • Compare IMPATT, TRAPATT, BARITT w.r.t. principle, frequency, power, application. (S-26 Q.4c)	4 M, 6 M	W-25, S-26	High
Limitations of vacuum tubes at microwave frequencies • List limitations of vacuum tubes at microwave frequencies. (W-25 Q.1f)	2 M	W-25	Medium
Microwave radiation hazards (HERO, HERP, HERF) and preventive measures • Explain preventive measures from microwave radiation hazards. (W-25 Q.2a)	4 M	W-25	Medium
Backward wave oscillator (BWO) • Draw and explain backward wave oscillator in detail. (W-25 Q.3a)	4 M	W-25	Medium
HEMT • With neat diagram explain construction, working principle and applications of HEMTs. (W-25 Q.4e)	4 M	W-25	Medium
HBT • Describe working principle of HBT with its structural diagram. (S-26 Q.2b)	4 M	S-26	Medium
Tunnel diode • Draw symbol of tunnel diode. Describe working of tunnel diode. (S-26 Q.3d)	4 M	S-26	Medium
Varactor diode – applications • State applications of varactor diode (any two). (S-26 Q.1e)	2 M	S-26	Medium
Magnetron – effect of E and H fields • With cross-sectional diagram describe effect of electric and magnetic field in magnetron. (S-26 Q.4a)	4 M	S-26	Medium

Gunn diode, PIN diode In syllabus, not asked yet — prepare for a surprise question.	—	Not yet	Low
TWT and gyrotron In syllabus, not asked yet — prepare for a surprise question.	—	Not yet	Low

Unit IV – RADAR Fundamentals (14 M)

Question / topic	Marks	Asked in	Probability
RADAR range equation – state / derive, factors affecting range • State RADAR range equation; state each term. (W-25 Q.1c) • Derive maximum radar range equation and state factors affecting range. (S-26 Q.3b)	2 M, 4 M	W-25, S-26	High
RADAR range numerical • 10 GHz, 500 kW, $S_{min} = 0.1 \text{ pW}$, $A_e = 5 \text{ m}^2$, $\sigma = 20 \text{ m}^2$: find maximum range. (W-25 Q.6c(ii)) • $P_t = 200 \text{ kW}$, $A_e = 3 \text{ m}^2$, $\sigma = 15 \text{ m}^2$, $S_{min} = 10^{-10} \text{ W}$, $G = 2000$: find maximum range. (S-26 Q.6a)	2 M, 6 M	W-25, S-26	High
Doppler effect, pulse width, PRF, duty cycle • Define Doppler effect, pulse width, PRF, duty cycle w.r.t. RADAR. (W-25 Q.2d) • Define pulse width and pulse repetition frequency w.r.t. radar. (S-26 Q.1f)	2 M, 4 M	W-25, S-26	High
Antenna scanning methods • Explain different RADAR antenna scanning methods with neat diagram. (W-25 Q.4a) • Explain antenna scanning methods with neat diagram used for RADAR. (S-26 Q.4d)	4 M	W-25, S-26	High
Display methods – A-scope, PPI, RHI • Compare with neat sketches A-scope, PPI, RHI display methods. (W-25 Q.6c(iii)) • Draw sketch of A-scope display and state its working principle. (S-26 Q.2c)	2 M, 4 M	W-25, S-26	High
Antenna tracking – sequential lobing, conical scan, monopulse • List antenna tracking types and describe any two in detail. (W-25 Q.4d)	4 M	W-25	Medium
RADAR clutter – surface, sea, land • Compare surface clutter, sea clutter and land clutter. (W-25 Q.6c(i))	2 M	W-25	Medium
RADAR beacons In syllabus, not asked yet — prepare for a surprise question.	—	Not yet	Low

Unit V – Microwave and RADAR System Applications (16 M)

Question / topic	Marks	Asked in	Probability
Basic pulse RADAR – block diagram, advantages <ul style="list-style-type: none"> List two advantages of pulse RADAR system. (W-25 Q.1d) Compare pulsed RADAR, CW RADAR, MTI RADAR (six points). (W-25 Q.5c) Draw block diagram of basic pulse radar system. (S-26 Q.1g) 	2 M, 6 M	W-25, S-26	High
MTI RADAR – block diagram, moving target detection <ul style="list-style-type: none"> Compare pulsed, CW and MTI RADAR. (W-25 Q.5c) Draw block diagram of MTI RADAR and explain detection of moving target. (S-26 Q.3c) 	4 M, 6 M	W-25, S-26	High
CW Doppler RADAR <ul style="list-style-type: none"> Compare pulsed, CW and MTI RADAR. (W-25 Q.5c) Draw block diagram of CW Doppler RADAR and explain Doppler effect. (S-26 Q.4e) 	4 M, 6 M	W-25, S-26	High
SONAR – principle, types, applications <ul style="list-style-type: none"> Describe basic working principle of SONAR with neat sketch. (W-25 Q.3b) Working principle of SONAR with diagram; types and two applications. (S-26 Q.6c) 	4 M, 6 M	W-25, S-26	High
Microwave applications in real life <ul style="list-style-type: none"> Explain different microwave applications in real life with neat diagram. (W-25 Q.4c) List four applications of microwave systems; explain LORAN with neat sketch. (S-26 Q.5c) 	4 M, 6 M	W-25, S-26	High
RADAR applications (speed detection, self-driving cars, parking, ATC, weather) <ul style="list-style-type: none"> Compare different RADAR applications in real life with neat diagram. (W-25 Q.6b) 	6 M	W-25	Medium
RADAR navigation – LORAN, VOR, TACAN, ILS <ul style="list-style-type: none"> Explain Long Range Navigation System (LORAN) with neat sketch. (S-26 Q.5c) 	6 M	S-26	Medium
Remote sensing RADAR, MST RADAR, RADAR radiometer, biomedical applications In syllabus, not asked yet — prepare for a surprise question.	—	Not yet	Low

Exam tips from the two papers

- Both papers had **two 6-mark numericals**: a rectangular-waveguide problem (cut-off frequency / propagating modes / λ_g) and a RADAR maximum-range problem. Practise the formulas $f_c = (c/2)\sqrt{((m/a)^2 + (n/b)^2)}$ and $R_{\max} = [P_t G A_e \sigma / ((4\pi)^2 S_{\min})]^{1/4}$ with units.

- Every main question had at least one **sketch-type** question: bends/twists/tapers, TE_{10} field pattern, tees, isolator, Applegate diagram, A-scope / PPI, scanning patterns, SONAR.
- Unit V block diagrams (pulse RADAR, CW Doppler, MTI) and SONAR appeared in both papers — learn the blocks in order.
- With only two papers, 'High' simply means 'asked in both papers'. Many 'Medium' topics (HBT, HEMT, BWO, magnetron, Wilkinson divider) were asked once as 4-mark questions — do not skip them.

Note: This is a **important-question list 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

