

2022

ELECTRONICS — HONOURS

Paper : DSE-B-2

(Transmission line, Antenna, Microwave Devices)

Full Marks : 50

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer *question no. 1* and *any four* questions from the rest.

1. Answer *any ten* questions :

1×10

- (a) In a wave-guide, the TE mode means that
- (i) magnetic field is perpendicular to direction of wave propagation
 - (ii) magnetic and electric field are perpendicular to each other
 - (iii) electric field is perpendicular to the direction of wave propagation
 - (iv) none of the above.
- (b) The _____ is a measure of the mismatch between a load and the transmission line.
- (i) Return loss
 - (ii) SWR
 - (iii) Phase-shift constant
 - (iv) Reflection coefficient.
- (c) The cut-off frequency of TEM wave is
- (i) zero
 - (ii) hundred
 - (iii) infinity
 - (iv) none of these.
- (d) The wave-guide is employed in the transmission lines, when operated at the range of
- (i) Hz
 - (ii) kHz
 - (iii) MHz
 - (iv) GHz.
- (e) Directivity of an antenna is determined by
- (i) gain
 - (ii) impedance pattern
 - (iii) radiation pattern
 - (iv) efficiency.

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- (f) Helix antenna provides complete
- (i) linear polarization
 - (ii) circular polarization
 - (iii) elliptical polarization
 - (iv) parallel polarization.
- (g) In mobiles, which of the following antenna is widely used?
- (i) Microstrip antenna
 - (ii) Horn antenna
 - (iii) Yagi-uda antenna
 - (iv) Lens antenna.
- (h) Which of the following is the correct statement for isotropic radiation?
- (i) It is a point source radiator
 - (ii) It radiates uniformly in all direction
 - (iii) Maintains uniform intensity
 - (iv) All of these.
- (i) High frequency long distance propagation mostly depends on
- (i) ionospheric reflection
 - (ii) tropospheric reflection
 - (iii) ground reflection
 - (iv) inverted reflection.
- (j) During ground-wave propagation, earth behaves like
- (i) leaky capacitor
 - (ii) leaky inductor
 - (iii) series combination of capacitor and inductor
 - (iv) parallel combination of capacitor and inductor.
- (k) Tunnel diode can also be used as _____ power microwave oscillators
- (i) high
 - (ii) low
 - (iii) medium
 - (iv) none of these.
- (l) Klystron operates on the principle of
- (i) amplitude modulation
 - (ii) frequency modulation
 - (iii) pulse modulation
 - (iv) velocity modulation.
2. (a) Derive the transmission line equations for a uniform twin wire line in time domain.
- (b) Define standing wave ratio (SWR). What is the SWR for an open circuit?
- (c) A lossy co-axial cable operating at 500 MHz has the following primary constants, $R = 3 \Omega/m$, $L = 1.2 \mu H/m$, $C = 100 \text{ pF/m}$ and $G = 0 \text{ S/m}$. Find the propagation constant and the attenuation constant.

3. (a) Find the possible TM modes through an air-filled rectangular wave guide with dimensions $22.82 \text{ mm} \times 10.16 \text{ mm}$ at 25 GHz.
 (b) What are transverse electric (TE) waves? How are they different from transverse magnetic waves?
 (c) What is bandwidth of a wave-guide? How is it related to the dimension of a rectangular wave-guide? 4+(2+1)+(1+2)
4. (a) Define power gain and antenna efficiency.
 (b) What is beamwidth and bandwidth of an antenna?
 (c) What is an end-fire antenna? (2+2)+(2+2)+2
5. (a) Derive the expression of Radiated power for a half wave dipole antenna.
 (b) A magnetic field strength of $5 \mu\text{A/m}$ is required at a point on $\theta = \pi/2$, which is 2 km from a half wave dipole antenna in air. How much power must the antenna transmit? [Neglect ohmic loss]
 (c) Write the Friis equation. 4+4+2
6. (a) What is a log-periodic antenna?
 (b) What is scattering cross section?
 (c) Draw the power pattern of the Hertzian dipole.
 (d) What is an antenna array? Define array factor. 2+2+2+(2+2)
7. (a) Name the different modes of radio wave propagation.
 (b) Differentiate between ground wave, space wave and sky wave.
 (c) What are the different layers of the ionosphere? Draw the electron density profile of the ionosphere. 3+3+(2+2)
8. (a) Write short notes on (*any two*) of the following :
 (i) Reflex klystron
 (ii) Magnetron
 (iii) Tunnel diode.
 (b) Draw the schematic block diagram of a TWT.
 (c) What is bunching of electrons? (3+3)+2+2
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