

M.TECH/ECE/1ST SEM /ECEN 5103/2015
2015

Advanced Microwave Communication Engineering
(ECEN 5103) 12

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

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

Group - A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following: 10 x 1=10
- (i) Which of the following diodes does not oscillate due to negative-resistance characteristics?
(a) Tunnel (b) SCR (c) Gunn (d) IMPATT.
- (ii) HEMT used in microwave circuit is a
(a) Source (b) High power amplifier (c) Detector (d) Low noise Amplifier.
- (iii) Slot antenna is made of
(a) rectangular waveguide (b) circular waveguide
(c) dielectric lens (d) a solid metallic body.
- (iv) A parabolic dish antenna is used to have beamwidth
(a) very small (b) very large (c) 45 degree (d) 350 degree.
- (v) In circular waveguide the dominant mode is
(a) TM_{45} (b) TM_{11} (c) TE_{11} (d) TE_{23} .
- (vi) In the broadside array the principle maximum occurs _____ the length of the array
(a) along (b) perpendicular to (c) 45 degrees to (d) none.
- (vii) The fringing fields make the patch
(a) electrically wider (b) electrically narrower
(c) no change (d) none.
- (viii) In a radio communication system the received signal strength is proportional to
(a) $G_T G_R$ (b) $G_T + G_R$
(c) $G_T - G_R$ (d) G_T / G_R .
(where G_T and G_R are the gain of transmitting and receiving antenna respectively).

M.TECH/ECE/1ST SEM /ECEN 5103/2015

- (ix) Millimeter wave propagation occurs at a frequency range
(a) 30-300 MHz (b) 30-300 GHz
(c) 3-30 MHz (d) 300-3000 MHz.
- (x) When the transmitter and receiver are separated by a skip distance the sky wave link must be working at
(a) MUF (b) Less than MUF (c) LHF (d) None

Group - B

- 2.(a) Gunn Oscillator operation is based on negative resistance characteristic of Gunn diode. Explain the origin of negative resistance. How does it lead to microwave oscillation in a cavity? Explain the oscillation mechanism. What is LSA mode of oscillation?
- (b) Determine the conductivity of n type GaAs Gunn Diode with following specifications
Electron Density $n=10^{18} \text{ cm}^{-3}$ $n_i=10^{10} \text{ cm}^{-3}$ $n_u=10^8 \text{ cm}^{-3}$ $T=300^{\circ} \text{ K}$.
6+6 = 12
- 3.(a) Using a neat diagram, show the construction of a MESFET and its biasing circuit at microwave frequencies.
- (b) Describe the physical structure, negative resistance effect of IMPATT diode. Explain the microwave oscillation theory based on the working of an IMPATT diode.
5 + 7 = 12

Group - C

- 4.(a) Derive the S-matrix for a directional coupler and explain its relevant parameters.
- (b) Explain the significance of return loss measurement for microwave devices. Show how return loss is measured by using Vector Network Analyzer for a two port device.
5 + 7 = 12
- 5.(a) What are different types of impedance matching network used in microwave circuits? Explain any one with example.
- (b) Explain the operating principle of Isolator and Circulator.
- (c) Design a microstrip low pass filter with 2 GHz cut-off frequency, 30 dB attenuation at 3.5 GHz frequency for Chebyshev attenuation response with 0.2 dB ripple. Use alumina substrate of thickness 0.63 mm.
3 + 3 + 6 = 12

Group - D

- 6.(a) What are the different auxiliary functions used for the calculation of electric field and magnetic field of Hertzian dipole antenna?

M.TECH/ECE/1ST SEM /ECEN 5103/2015

- (b) Explain the phenomenon of beam broadening in beam steered linear array.
- (c) A four element linear array of isotropic radiators has uniform amplitude and uniform spacing of 0.5λ . Find i) the array factor ii) directivity.

3 + 4 + 5 = 12

7. (a) What is Babinet's Principle?

- (b) Describe with reasons why Normal mode of operations is seldom used in helical antenna.
- (c) Design a rectangular microstrip antenna using a substrate (RT/duroid 5880) with dielectric constant of 2.2, $h=0.1588$ cm (0.0625 inches) so as to resonate at 10 GHz.

3 + 5 + 4 = 12

Group - E

- 8.(a) Give a list of different frequency bands used in radio communication. What are different subbands and their frequency range in microwave communication? Mention the application area of MF, HF, VHF and UHF.
- (b) Derive Friis transmission formula. Explain its significance in the design of a satellite communication system.

6 + 6 = 12

9. (a) What is fading? What is its effect on propagation?

- (b) Explain the phenomenon of 'ducting'. What are the conditions required for the manifestation of this phenomenon?
- (c) An antenna with effective height of 160 meters is transmitting at 4 MHz carrying a current of 8 Amperes. If the receiving antenna is situated at a distance of 40 km away with a height of 2 meters, find the voltage induced over it.

3 + 4 + 5 = 12