

Code: AE20

Subject: MICROWAVE THEORY & TECHNIQUES

AMIETE – ET (OLD SCHEME)

Time: 3 Hours

OCTOBER 2012

Max. Marks: 100

PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.

NOTE: There are 9 Questions in all.

- Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.
- The answer sheet for the Q.1 will be collected by the invigilator after 45 Minutes of the commencement of the examination.
- Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.
- Any required data not explicitly given, may be suitably assumed and stated.

Q.1 Choose the correct or the best alternative in the following: (2×10)

- a. In a circular waveguide with radius 'r', the dominant mode is
- (A) TE_{01} (B) TM_{01}
(C) TE_{11} (D) TM_{11}
- b. Which one of the following can be used for amplification of microwave energy?
- (A) Travelling wave tube (B) Magnetron
(C) Reflex klystron (D) Gunn diode.
- c. A waveguide section in a microwave circuit will act as a
- (A) Low-pass filter (B) band-pass filter
(C) High-pass filter (D) band-reject filter
- d. A disadvantage of microstrips with respect to stripline is that the former
- (A) do not lend themselves to printed- circuit techniques
(B) are more likely to radiate
(C) are bulkier
(D) are more expensive and complex to manufacture
- e. Transmission of signals in a terrestrial microwave system is achieved through
- (A) reflection from the ionosphere (B) line of sight mode
(C) reflection from the ground (D) diffraction from the stratosphere
- f. A semiconductor diode which can be used in switching circuits at microwave frequencies
- (A) Pin diode (B) Varactor diode
(C) Tunnel diode (D) Gunn diode

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- g. In microwave power measurement using bolometers the principle of working is the variation of
- (A) Inductance with absorption of power
 - (B) Resistance with absorption of power
 - (C) Capacitance with absorption of power
 - (D) Cavity dimensions with heat generated by the power
- h. Which one of the following is a transferred electron device?
- (A) BARITT diode
 - (B) IMPATT diode
 - (C) Gunn diode
 - (D) Step recovery diode
- i. In order to couple two generators to a waveguide system without coupling them to each other, one could not use a
- (A) Rat race
 - (B) E-plane T
 - (C) Hybrid ring
 - (D) Magic T
- j. _____ is directly measured in sweep reflectometer
- (A) SWR
 - (B) Impedance
 - (C) Return loss
 - (D) reflection coefficient

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

- Q.2** a. Derive the transmission line equations. (8)
- b. The terminating impedance $Z_L = (100 + j100) \Omega$ and the characteristic impedance Z_0 of the line and stub is 50Ω . The first stub is placed at 0.4λ away from the load. The spacing between the 2 stubs is $3/8\lambda$. Determine the length of the short-circuited stubs where the match is achieved. What terminations are forbidden for matching the line by the double stub device? Use Smith chart. Why is double stub matching preferred over single stub matching? (8)
- Q.3** a. Derive the wave equation for a TM wave and obtain all the field components in a rectangular waveguide. (8)
- b. A rectangular waveguide has $a = 4$ cms; $b = 3$ cms as its sectional dimensions. Find all the modes which will propagate at 5000 MHz. (8)
- Q.4** a. List the drawbacks of single stub matching. (4)
- b. Write a short note on microwave integrated circuits. (4)
- c. Define fading? Explain the various types of fading. (8)

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- Q.5** a. Explain the construction and working of directional coupler. Derive expression for coupling factor and directivity. Compare single hole and double hole directional coupler. (6)
- b. What is Magic Tee? Why is it called so? Explain the characteristics of the Tee considering various input/output conditions. (6)
- c. What is circulator? Describe construction and working of a four port Faraday rotation circulator. (4)
- Q.6** a. Describe how an ordinary voltmeter can be made to read VSWR. What are the drawbacks of this method? (5)
- b. A 25 dB isolator is added in series at the output of a signal generator to reduce the possibility of frequency pulling due to an affected system VSWR mismatch of 1.75. If signal generator power output is 234 mW, what is the value of reflected signal received at the generator. (5)
- c. Briefly explain the following:
- (i) VSWR Measurement (3)
- (ii) Wave Meter (3)
- Q.7** a. Explain the various modes of operation of Gunn diode. (6)
- b. Discuss the working of two cavity klystron amplifier and derive expression for the efficiency of above amplifier starting from basic principles. (10)
- Q.8** a. Explain working of TWT (Travelling-Wave Tube) with neat sketch. (8)
- b. Explain the structure of field lines in strip lines and microstrip lines. (8)
- Q.9** Write short notes on the following:
- (i) Analog microwave communications
- (ii) Microwave antennas (2×8)