**Code: AE72**    **Subject: MICROWAVE THEORY AND TECHN...**

## AMIETE – ET (NEW SCHEME)

Time: 3 Hours    $\boxed{\textbf{DECEMBER 2011}}$    Max. Marks: 100

**NOTE: There are 9 Questions in all.**
- **Please write your Roll No. at the space provided on each page immediately after receiving the Question Paper.**
- **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.**

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

a. The free space wave length for a 9 GHz signal is

   **(A)** 10 cms                          **(B)** 20 cms
   **(C)** 3.33 cms                        **(D)** 5 cms

b. A directional coupler is _____ port junction.

   **(A)** 5 port junction                 **(B)** 3 port junction
   **(C)** 2 port junction                 **(D)** 4 port junction

c. The cutoff wave length for $\text{TE}_{m,o}$ mode is given by _____

   **(A)** $\lambda_o = \dfrac{2}{\sqrt{\left(m/a\right)^2 + \left(n/b\right)^2}}$          **(B)** $\lambda_o = \dfrac{4a}{m^2 + n^2}$

   **(C)** $\lambda_o = \dfrac{2a}{m}$                          **(D)** $\lambda_o = \dfrac{2a}{\sqrt{m^2 + n^2}}$

d. Wave guides have advantages over coaxial line because _____

   **(A)** mechanical simplicity and much higher operating frequency
   **(B)** power losses in wave guide is more
   **(C)** wall reflections
   **(D)** it does not require matching

e. In a microstrip line the propagating mode is _____

   **(A)** a pure TM mode                   **(B)** a quasi TEM mode
   **(C)** the same as waveguide mode       **(D)** a TE mode only

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f. A uniline or isolator is a _____ device

   **(A)** a ferrite loaded 2 port device     **(B)** A 3 port device
   **(C)** 4 port device                       **(D)** None of them

g. When a transmission line is terminated by an impedance, called characteristic
   impedance represents _____

   **(A)** short circuit                       **(B)** open circuit
   **(C)** infinite line                       **(D)** finite line

h. An X band reflex klystron operates in the frequency range _____

   **(A)** 8 to 12 GHz                         **(B)** 20 to 50 GHz
   **(C)** 4 to 6 GHz                          **(D)** 100 MHz – 200 MHz

i. A klystron oscillator

   **(A)** act as a signal source in microwave generators
   **(B)** used in optical fiber communication
   **(C)** not suitable for microwave applications
   **(D)** not suitable for frequency modulation

j. A device which exhibits negative resistance it is possible to used as

   **(A)** an oscillator                       **(B)** an amplifier
   **(C)** mixer                               **(D)** All of them

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

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**Q.2**  a. What are the different types of transmission lines used?  Explain them with neat
         figures.                                                                  **(4)**

         b. Derive transmission line equations for voltage and current.            **(6)**

         c. Explain Smith Chart and explain how a normalized impedance can be obtained
            from it.                                                               **(6)**

**Q.3**  a. Arrive at the solution of wave equations in a rectangular co-ordinates.  Discuss the
            three distinct cases of propagation constant in the waveguide.         **(10)**

         b. An air filled rectangular waveguide operates in dominant $TE_{10}$ mode as shown
            in Fig.1.  Its inside dimensions are 8×4 cms. Calculate
            (i)  Cut off frequency
            (ii) Find the phase velocity of the wave at 4 GHz
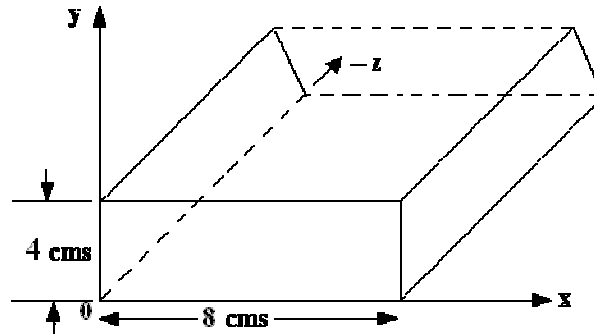            (iii) Determine the guide wave length at the same frequency.           **(6)**

Fig.1

**Q.4**  a. Derive S parameters for two port microwave junction.          **(8)**

b. Draw a neat diagram of directional coupler and derive S matrix for it.    **(8)**

**Q.5**  a. What are microwave solid state devices?  Write a note on their applications and advantages.          **(8)**

b. Explain what is differential negative resistance.  Explain the two valley model theory of Gunn diode.          **(8)**

**Q.6**  a. What do you understand by Apple gate diagram?  With a neat diagram explain the operation of Reflex klystron.          **(10)**

b. Write short notes on Helix travelling wave tube.          **(6)**

**Q.7**  a. Explain linear magnetron, derive the expressions for Hull cut off voltage and Hull cut off magnetic flux density.          **(10)**

b. A linear magnetron has the following operating parameters
Anode voltage $V_O = 10$ kV
Cathode current $I_O = 1$A
Magnetic flux density $B_o = 0.01$ wb/m$^2$
Distance between Cathode and Anode d = 5 cms
Compute the Hull cut off voltage for a fixed $B_O$.          **(6)**

**Q.8**  a. Explain microstrip line with neat diagram.  What are the feeding mechanisms? Explain with neat diagrams.          **(6)**

b. A lossless parallel stripline has a conducting strip width w.  The substrate dielectric separating the two conducting strips has a relative dielectric constant $\in_{rd}$ of 6 and thickness d = 4 mm.  Calculate the required width w of the conducting strip in order to have a characteristic impedance of $50\Omega$.          **(6)**

c. Write explanatory note on coplanar strip lines.          **(4)**

**Q.9**  a. What are the fabrication techniques involved in MMIC?          **(6)**

b. What are planar capacitor film? Explain with neat figures. **(6)**

c. An integrated capacitor fabricated on a GaAs substrate has the following parameters

No of fingers                  $N = 8$
Relative dielectric            $\epsilon_r = 13.10$
Const of GaAs
Substrate height               $h = 0.254$ cm
Finger length                  $\ell = 0.00254$ cms
Finger base width              $w = 0.051$ cms
$A_1 = 0.089 \, pF/cm$         $A_2 = 0.10 \, pF/cm$
Is the contribution of         is the contribution of 2 external
Interior finger for            fingers for $h > w$
$h > w$

Compute the capacitance of the interior finger.                    **(4)**