

**M.Sc. ELECTRONICS  
THIRD SEMESTER  
ELECTROMAGNETIC THEORY & MICROWAVE  
TECHNOLOGY-I  
MSE-305 A**

Duration: 3 Hrs.

Marks: 70

PART : A (OBJECTIVE) = 20  
PART : B (DESCRIPTIVE) = 50

[ PART-B : Descriptive ]

Duration: 2 Hrs. 40 Mins.

Marks: 50

[ Answer question no. One (1) & any four (4) from the rest ]

1. Write Poynting Theorem. Derive the mathematical expression using Maxwell's equation. (5+5=10)  
The electric field amplitude of a uniform plane wave propagating in  $\hat{a}_z$  direction of 250V/m. If  $E = E_x \hat{a}_x$  and  $\omega = 1 \text{ Mrad / s}$ , find  
a) frequency, b) wavelength, c) period and d) amplitude of H.
2. Derive wave equation for conducting medium. (5+5=10)  
Find the value of attenuation constant ( $\alpha$ ) and phase constant ( $\beta$ ) for conducting medium.
3. Find transmission line equations for voltage and current showing its equivalent circuit. (6+4=10)  
Find characteristic impedance ( $Z_0$ ) for lossless and distortionless line.
4. Calculate the series and shunt admittance of a transmission line (4+6=10)  
at  $\omega = 5.5 \times 10^3 \text{ rad / sec}$ . The primary parameter of the line are  $R = 10.4 \text{ ohm}$ ,  $L = 3.64 \text{ mH}$ ,  $C = 0.00825 \text{ } \mu\text{F}$  and  $G = 0.08 \text{ } \mu\text{mho}$ .  
Find the cut off frequency, phase velocity and group velocity between parallel planes for TE mode.
5. Define different types of microwave tubes. Explain the working principles of each with example. (5+5=10)  
Explain the process of velocity modulation for Klystron.
6. What is Magnetron? Explain with diagram operation of Magnetron. (5+5=10)  
Write the working principle of Travelling Wave Tube.
7. Write short notes on: (any two) (5+5=10)  
i) Schottky diode ii) Varactor diode iii) IMPATT diode

8. Write integral form of Maxwell's equation. Define TE and TM mode of propagation. (3+3+4=10)

Derive Maxwell's 4<sup>th</sup> equation from Ampere's circuital law.

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**[ PART-A : Objective ]**

**Choose the correct answer from the following:**

**1×20=20**

1. The characteristic impedance  $Z_0$  of transmission line is:

- a.  $\sqrt{\frac{R + j\omega L}{G + j\omega C}}$       b.  $\sqrt{\frac{G + j\omega C}{R + j\omega L}}$   
c.  $\sqrt{\frac{G - j\omega C}{R + j\omega L}}$       d.  $\sqrt{\frac{G - \omega C}{R + \omega L}}$

2. If a plane wave satisfies the equation  $\frac{\partial^2 E_x}{\partial z^2} = \frac{1}{c^2} \frac{\partial E_x}{\partial t^2}$ , the wave propagates in:

- a. x direction      b. z direction  
c. y direction      d. both a) and b)

3. Point form of Maxwell's first equation for time varying field is:

- a.  $\vec{\nabla} \cdot D = \rho$       b.  $\vec{\nabla} \times D = \rho$   
c.  $\vec{\nabla} \cdot D = J + \frac{\partial D}{\partial t}$       d.  $\vec{\nabla} \cdot D = 0$

4. Velocity of wave in free space is:

- a.  $\frac{1}{\sqrt{\mu\epsilon}}$       b.  $\sqrt{\mu\epsilon}$   
c.  $\frac{1}{\sqrt{\mu_0\epsilon_0}}$       d.  $\sqrt{\mu_0\epsilon_0}$

5. For lossless transmission line, which statement is correct?

- a.  $R = 0, G = 0$       b.  $R \neq 0, G = 0$   
c.  $R = 0, G \neq 0$       d.  $R \neq 0, G \neq 0$

6. For TE wave

- a.  $E_z = 0$       b.  $E_z \neq 0$   
c.  $H_z = 0$       d.  $H_z \neq 0$

7. The ratio of magnitude of electric field intensity to the magnitude of magnetic field intensity is called:

- a. attenuation constant      b. phase constant  
c. extrinsic impedance      d. intrinsic impedance

8. The characteristic of a good dielectric is:

- a.  $\frac{\sigma}{\omega\epsilon} \geq 1$   
b.  $\frac{\sigma}{\omega\epsilon} \leq 1$   
c.  $\frac{\omega\epsilon}{\sigma} \leq 1$   
d.  $\frac{\omega\epsilon}{\sigma} \geq 1$

9. Which of the following statements are true for a transmission line parameters  $R, L, G$  and  $C$ ?

- a.  $R$  and  $L$  are series elements.  
b.  $G$  and  $C$  are shunt elements.  
c. both  $R$  and  $G$  depend on conductivity of the conductors forming the line.  
d. only  $R$  depends explicitly on frequency.

10. The Poynting vector  $P$  is equal to:

- a.  $E \bullet H$   
b.  $E \times H$   
c.  $\frac{E}{H}$   
d.  $\frac{H}{E}$

11. Attenuation constant  $\alpha$  is:

- a.  $\omega \sqrt{\left(\frac{\mu\omega}{2}\right) \left[ \sqrt{1 + \left(\frac{\sigma}{\omega\epsilon}\right)^2} - 1 \right]}$   
b.  $\omega \sqrt{\left(\frac{\mu\omega}{2}\right) \left[ \sqrt{1 + \left(\frac{\sigma}{\omega\epsilon}\right)^2} + 1 \right]}$   
c.  $\sqrt{\left(\frac{\mu\omega}{2}\right) \left[ \sqrt{1 + \left(\frac{\sigma}{\omega\epsilon}\right)^2} - 1 \right]}$   
d.  $\sqrt{\left(\frac{\mu\omega}{2}\right) \left[ \sqrt{1 + \left(\frac{\sigma}{\omega\epsilon}\right)^2} + 1 \right]}$

12.  $\nabla^2 B = \mu_0 \epsilon_0 \frac{\partial^2 B}{\partial t^2}$  is the wave equation for:

- a. free space E      b. free space B  
c. free space H      d. free space D



13. Which one of the following is not a microwave semiconductor device?  
 a. Magnetron            b. TRAPATT  
 c. IMPATT                d. Schottky diode
14. Π-mode is supported in:  
 a. Magnetron            b. Klystron  
 c. TWT                    d. both a) and b)
15. Wave propagation is divided into:  
 a. unbounded media propagation.  
 b. bounded media or guided wave propagation.  
 c. both a) and b).  
 d. none of the above.
16. Continuous interaction between r.f. field and electron beam occurs in:  
 a. TWT                    b. Klystron  
 c. CFO                    d. IMPATT diode
17. Klystron is a microwave:  
 a. oscillator            b. amplifier  
 c. switch                 d. none of the above
18. Performance characteristics of Gunn diode is related to:  
 a. -ve resistance  
 b. voltage  
 c. current  
 d. none of the above
19. Velocity modulation is involved in the working principle of:  
 a. Klystron  
 b. Magnetron  
 c. TWT  
 d. both a) and b)
20.  $\nabla^2 E - \mu\epsilon \frac{\partial^2 E}{\partial t^2} - \mu\sigma \frac{\partial E}{\partial t} = 0$  is wave equation for:  
 a. conducting media  
 b. dielectric media  
 c. free space  
 d. None of above

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Course : .....

Semester : ..... Roll No : .....

Enrollment No : ..... Course code : .....

Course Title : .....

Session : ..... 2017-18 ..... Date : .....

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**Instructions / Guidelines**

- The paper contains twenty (20) / ten (10) questions.
- Students shall tick (✓) the correct answer.
- No marks shall be given for overwrite / erasing.
- Students have to submit the Objective Part (Part-A) to the invigilator just after completion of the allotted time from the starting of examination.

Full Marks	Marks Obtained
20	

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 Scrutinizer's Signature

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 Examiner's Signature

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 Invigilator's Signature