

JK Lakshmipat University, Jaipur
INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination, December 2022

B. Tech. (ECE), Semester V, 2022-23

Roll No.....

EE1104: Electromagnetics and Microwaves

Time: 3 hours

Max. Marks: 30

Instructions to students: Answer ALL questions

1. Do not write anything other than your roll number on question paper
2. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever required are an integral part of the answer
3. Use of programmable calculator, class lecture notes/handouts, etc., are not allowed
4. Assume suitable data wherever required and mention it clearly

-
- Q. 1 If the volume charge density of a spherical body of radius 'a' is
 $\rho_v(r, \theta, \phi) = \rho_0/r$ C/m³, calculate the total charge in the sphere 4
[CO 1, 2]
-
- Q. 2 (i) Calculate the conduction and displacement current densities in a material 6
having $\sigma = 10^{-3}$ S/m and $\epsilon_r = 2.5$ if the electric field in the material is
 $E = (5 \times 10^{-6})\sin(9 \times 10^9)t$ V/m [CO 2, 3, 4]
- (ii) Given $E = 10\sin(\omega t - \beta z)\mathbf{a}_y$ V/m in free space, calculate **D**, **B** and **H**.
($\epsilon_0 = 8.85 \times 10^{-12}$ F/m)
-
- Q. 3 (i) Analyze TE_{mn} and TM_{mn} modes of propagation through a rectangular 8
waveguide using $E_z = C.\sin(m\pi x/a).\sin(n\pi y/b)$ and
 $H_z = C.\cos(m\pi x/a).\cos(n\pi y/b)$ and prove their existence. [CO 5, 6]
- (ii) For TE_{11} mode, calculate the minimum launch frequency into a rectangular waveguide with $a = 4$ cm and $b = 3$ cm internal dimensions. Give specifications of one IEEE standard to ensure EMC in such waveguides used for radar applications.
-
- Q. 4 (i) Calculate the waveguide impedances Z_{TM} and Z_{TE} and obtain the conditions 8
when $Z_{TM} \leq \eta$ and $Z_{TE} \geq \eta$ [CO 6, 7]
- (ii) Obtain the scattering matrix [**S**] of a magic tee junction.
-
- Q. 5 Illustrate using basic block diagram, the principle of velocity modulation in a 4
klystron and show what is transit time effect. [CO 8]