Duration: 3 Hours
Marks: 80

1] Question no. 1 is Compulsory
2] Attempt any three questions out of remaining questions
3] Assume suitable data if require

Q. 1

Attempt any four

a) Explain Wave equation for free space.
b) Calculate Divergence and Curl of $\bar{F} = r \cos \phi \bar{a}_r + rz^2 \bar{a}_\phi$. Units
c) Derive Faraday’s Law with suitable applications.
d) Derive Laplacian’s Equation for charge free dielectric region.
e) Explain Reflection Coefficient of Transmission lines.
f) Explain Gauss’s Law in detail with applications.
g) Derive relationship between Electric field and Voltage.

Q. 2

a) Derive magnetic field provided by infinite thin filament caring current I suspended on ‘z’ axis. Also, provide significance over short filament.
b) Calculate input impedance of the lossless transmission line terminated by load impedance of $Z_L = 100 + 100j \Omega$ in $Z_0 = 50 \Omega$ system with length of $l = 0.35\lambda$ with $f = 3GHz$, air as dielectric for transmission (Either by theoretical method or by Smith chart).

Q. 3

a) Find out total Electric field at Origin because of following charge distributions:
   - Point charge of $20nC$ placed at $(-1, -2, -3)$
   - Point charge of $50nC$ placed at $(-2, -3, -4)$
   - Uniform infinite line charge of $2nC/m$ placed at $x = -5, z = -6$
   - Uniform infinite surface charge of $0.5nC/m^2$ placed at $z = -5$
b) Explain Point and Integral format of Time Varying field Maxwell’s Equation with appropriate examples.

Q. 4

a) If plane interface between two perfect dielectric mediums is located at $z = 0$. A 4GHz uniform planar wave travelling along $z$ axis is incident from region 1, $z \leq 0$ onto region 2, $z \geq 0$. The wavelength in dielectrics are $\lambda_1 = 6cm$ and $\lambda_2 = 4cm$. Both the materials are non-magnetic. What are the percentage of energy on boundary is:
   - Reflected
   - Transmitted
   - Standing wave ratio in region 1
b) Aircraft antenna radiates Electric field in air ($\sigma = 0, \mu = \mu_0, \epsilon = \epsilon_0$) which is $\vec{E} = 25 \cos(10^5t + 0.33x)\bar{a}_y$ $KV/m$ find out following terms related with this EM System:
   - Propagation constant ($k$)
   - Phase Velocity
   - Intrinsic Impedance ($\eta$)
   - Average Poyting Power
   - Magnetic Field ($\vec{H}$)
Q. 5

a) Two plates of cylindrical capacitor describe by their radius $\rho_1 = 1\ mm$ & $\rho_2 = 1\ mm$ holding voltage of $V_1 = 1\ V$ and $V_2 = 100\ V$ find out $E$ in capacitor, also prove that dielectric of capacitor dose not carries any charge. 10

b) Derive Poynting Vector and explain effects of medium parameters on EM power with suitable diagram 10

Q. 6

Write short note on 20

a) Super Conductivity

b) Helmholtz’s Equation

c) Wave equation for transmission line

d) Electrical Discharge