Code No: R2031042 **R20** SET - 1

III B. Tech I Semester Regular/Supplementary Examinations, December -2023
ELECTROMAGNETIC WAVES AND TRANSMISSION LINES
(Electronics and Communication Engineering)

Time: 3 hours Max. Marks: 70

Answer any **FIVE** Questions **ONE** Question from **Each unit**
All Questions Carry Equal Marks
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UNIT-I

1. a) Draw a T-equivalent transmission line circuit and explain each part. [7M]
   b) A lossless transmission line used in a TV receiver has a capacitance of 50 pF/m and an inductance of 200 nH/m. Find the characteristic impedance for section of a line 10 metre long. [7M]

(OR)

2. a) Draw an equivalent circuit of a transmission line and why circuit parameters are called distributed parameters? Explain. [7M]
   b) A lossless transmission line of length 100 m has an inductance of 30mH and a capacitance of 20 nF. Find i) propagation velocity and
   (ii) phase constant at an operating frequency of 100 kHz [7M]

UNIT-II

3. a) For a transmission line which is terminated in a normalized impedance zn , VSWR = 3. Find the normalised impedance magnitude. [7M]
   b) Based on basic equations, prove that $Z_o^2 = Z_{oc} Z_{sc}$ [7M]

(OR)

4. a) Derive a Z_{in} of a transmission line of length 'L' meters. [7M]
   b) Discuss the designing of Smith chart and listout the applications. [7M]

UNIT-III

5. a) Find E at (2, 0, 2) if a line charge of 8 PC/m lies along the *y*-axis. [7M]
   b) Write poisson's and Laplace's equations and explain the importance of these equations. [7M]

(OR)

6. a) Prove that the electric field strength due to a uniform infinite line charge [7M]
$$E = \frac{\rho_L}{2\pi\varepsilon_o\rho} a_\rho \, V/m$$
   b) Draw the structure of a parallel plate capacitor and derive the capacitance equation. [7M]

UNIT-IV

7. a) State boundary conditions on H and B in Magnetostatic fields between two different mediums. Prove any one of the stated boundary condition. [7M]
   b) List out the Maxwell's equations in time-varying fields and explain. [7M]

(OR)

8. a) In a magnetic flux density of **B** □□□**a***x* □□□**a***y* Wb/m^2, a current element, 10$\mathbf{a_z}$ mA-m is placed. Find the force on the current element. [7M]
   b) Prove that H-field due to infinitely long current element $H = \frac{I}{2\pi\rho} \, a_\varphi \, A/m$ [7M]

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UNIT-V

9. a) Prove that the intrinsic impedance of an uniform plane wave in free space is 377Ω. [7M]

   b) Find the depth of penetration, □□of an EM wave in copper at f = 60 KHz. For copper, □□□□5.8□10^7 mho/m, □r □□1, □r □□1. [7M]

(OR)

10. Derive E & H wave equations in free space. [14M]

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Code No: R2031042 **R20** SET - 2

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UNIT-I

1. a) Explain phase and group velocities in transmission line with supporting equations. [7M]
   b) A distortion less transmission line of length 20 m has an inductance of 20□H and a capacitance of 20 nF. Find (i) phase constant at an operating frequency of 10 kHz (ii) characteristic impedance [7M]

(OR)

2. a) Explain primary and secondary constants along with relations between them. [7M]
   b) List out propagation parameters of general transmission lines, loss less and distortion less lines. [7M]

UNIT-II

3. a) Discuss about VSWR and reflection coefficient and mention the relation between them. [7M]
   b) Derive a Z_{in} of a loss less transmission line of length 'L' meters and characteristic impedance Z_o ohms. [7M]

(OR)

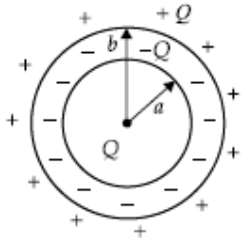
4. a) Write a notes on Single stub matching. [7M]
   b) Estimate the equivalent circuit element of a open load end transmission line of length $l < \lambda/4$. [7M]

UNIT-III

5. a) A charge, $Q1$ = -10 nC is at the origin in free space. If the x-component of **E** is to be zero at the point (3, 1, 1), what charge, Q_t should be kept at the point (2, 0, 0)? [7M]
   b) State Gauss's law and prove any one of it's application. [7M]

(OR)

6. a) A point charge, Q is at the centre of a neutral spherical conducting shell shown in figure. Find the surface charge density at the inner surface and at the outer surface. [7M]



   b) State Maxwell's two equations suitable for electrostatic fields and derive any one of the equation. [7M]

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Code No: R2031042 **R20** SET - 2

UNIT-IV

7. a) An electron has a velocity of 1 km/s along ax in a magnetic field whose magnetic flux density is B =2 a_x -3 a_y + 5 a_z Wb/m^2 [7M]
   i) Determine the electric field intensity if no force is applied to the electron
   (ii) Also find the force on the electron under the influence of both E and B when **E** □□(**a**x □□**a**y □□**a**z) KV/m.
   b) By using Biot-Savart's law, Derive H-field due to a finite current element. [7M]

(OR)

8. a) State Ampere's force law and explain each term. [7M]
   b) State Maxwell's two-equations in static magnetic field and derive any one of equation. [7M]

UNIT-V

9. a) Classify and explain polarization. [7M]
   b) Explain the differences between Oblique incidence and Normal incidence of EM waves between two mediums. [7M]

(OR)

10. a) Explain about Skin depth with suitable equations. [7M]
    b) If a wave with a frequency of 10 MHz propagates in free space, find the propagation constant. [7M]

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Code No: R2031042 **R20** SET - 3

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Time: 3 hours Max. Marks: 70

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UNIT-I

1. a) Define & Derive propagation constant equation of a transmission line. [7M]
   b) An air line has characteristic impedance of 70 Ω and phase constant of 5 rad/m at 1 MHz. Calculate the inductance per meter and the capacitance per meter of the line. [7M]

(OR)

2. a) Define and explain the properties of an Infinite line and Lossless line. [7M]
   b) A lossless transmission line of length 10 m and f_o is 5KHz has an inductance of 5□H and a capacitance of 10 nF. Find (i) propagation velocity (ii) characteristic impedance. [7M]

UNIT-II

3. a) Discuss the function of a Quarter wave transformer. [7M]
   b) A lossless transmission line is terminated in a load impedance of 30 – *j* 20Ω. Find the phase constant and the reflection coefficient of a line of length 10 m. Characteristic impedance, Z_o = 50 Ω. Wavelength on the line = 0.5 m. [7M]

(OR)

4. a) Estimate the input impedance of a transmission line of length l=λ/8 and an equivalent circuit element. [7M]
   b) Explain the relation between Z_L and reflection coefficient of a transmission line with suitable equations. [7M]

UNIT-III

5. a) An infinite sheet in *x*-*y* plane extending from – □□to □□in both directions has a uniform charge density of 10 nC/m^2. Find the electric field at Z □□2 cm. [7M]
   b) State Gauss law and Show that the Gauss's law in point form is $\nabla . D = \rho_v$ [7M]

(OR)

6. a) Prove that the electric field due to a surface charge density is [7M]
$$E = \frac{\rho_S}{2\varepsilon_o} a_n \, V/m$$
   b) A charge of 8 PC is at rest in free space. Find the potential at a point, *A* 12 cm away from the charge. [7M]

UNIT-IV

7. a) Discuss about force on a moving charge due to electric and magnetic fields. [7M]
   b) The region *y* < 0 contains a dielectric material for which $\in_{r1} = 2$ and the region *y* > 0 contains a dielectric material for which $\in_{r2} = 4$. [7M]
   If $\mathbf{E}_1 = -3\mathbf{a}_x + 5\mathbf{a}_y + 7\mathbf{a}_z$ V/m, find the electric field, $\mathbf{E}_2$ and $\mathbf{D}_2$ in medium 2.

(OR)

8. a) Given magnetic flux density, B = □□a□, find the total flux crossing the surface □□= □/2, 1 □□□□□□2 m and 0 □□*z* □□5 m. [7M]
   b) Write a notes on magnetic vector potential and its applications. [7M]

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UNIT-V

9. a) If **H** field is given by H(Z, t)=40 cos (10^8t+ 40z) a_y , A/ m, identify the amplitude, frequency and phase constant. Find the wavelength. [7M]

   b) Define Transmission Coefficient(TC). Derive the equations TC of uniform plane wave in Normal incidence between two dielectric mediums. [7M]

(OR)

10. a) Find the depth of penetration, □□of an EM wave in copper at *f* = 100 KHz. For copper, □□□□5.8□10^7 mho/m, □*r* □□□, □*r* □□1. [7M]

    b) When the amplitude of the magnetic field in a plane wave is 2 A/m, determine the magnitude of the electric field for the plane wave in free space. [7M]

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*****

UNIT-I

1. a) Derive the Z_o equation of a lossless transmission line. [7M]
   b) A distortion less transmission line of length 50 m has an inductance of 15mH and a capacitance of 20 μF. Find (i) V_p ii) β rad/m iii)Z_o [7M]

(OR)

2. a) Define distributed and conventional circuit elements. Draw an □-equivalent circuit of a two- wire transmission line. [7M]
   b) A lossy cable which has *R* □□2.5□/m, *L* □□1.0 □H/m, *C* □□1 pF/m, and *G* = 0 operates at *f* = 5 MHz. Find the attenuation constant of the line. [7M]

UNIT-II

3. a) Justify that UHF lines can be used as circuit elements. [7M]
   b) Discuss about SC and OC lines. [7M]

(OR)

4. a) Draw the input impedance variations w.r.to βl of transmission line. [7M]
   b) How smith chart construction is different from normal graph and discuss the applications. [7M]

UNIT-III

5. a) Estimate the potential (V) at a point due to a point charge Q C. [7M]
   b) List out the differences between Convection and Conduction currents. [7M]

(OR)

6. a) An infinitely long uniform line distribution of □$_L$ □□5 nC/m is at *y* □□3, *z* □□5. Determine E at (i) (0, 2, 1), (ii) (3, 2, 1). [7M]
   b) Show that Capacitance of a parallel plate capacitor is $C = \frac{\epsilon A}{d}$ [7M]

UNIT-IV

7. a) State boundary conditions on E and D in electrostatic fields between two different mediums. Prove any one of the stated boundary condition. [7M]
   b) State Ampere's circuital Law and listout its applications. [7M]

(OR)

8. a) If the magnetic field, H = *r* sin □□a*r* + 2.5*r* sin □□cos □□a□ A/m exists in a medium whose □*r* = 3.0, find the magnetic flux density. [7M]
   b) List out and explain Maxwell's equations in time varying fields. [7M]

UNIT-V

9. a) Identify frequency, phase constant when the electric field of an EM wave is given by E=6 sin(10^8t- 4x)a_z V/m . Also find λ. [7M]
   b) State and explain pointing vector theorem. [7M]

(OR)

10. a) If a wave with a frequency of 50 MHz propagates in free space, find the propagation constant. [7M]
    b) Derive wave equations at Normal incidence between dielectric and perfect conductor mediums. [7M]

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