Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

FOURTH SEMESTER BTECH. (E & C) DEGREE MAKEUP EXAMINATION

JULY 2022

SUBJECT: ELECTROMAGNETIC WAVES (ECE -2252)

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to candidates

- Answer **ALL** questions.
- Missing data may be suitably assumed.

Q. No.	Questions	M*	C*	A*	B*
1A.	State the Divergence theorem. Evaluate both the sides of the divergence theorem for the field $\boldsymbol{D} = 2xy\boldsymbol{a_x} + x^2\boldsymbol{a_y}\ C/m^2$ and the rectangular parallelepiped formed by the planes x = 0 and 1, y = 0 and 2, and z = 0 and 3. Show all intermediate steps.	4	1	1,2,3,4,18	4
1B.	If $V = 60sin\theta/r^2$ V in free space and point P is located at r=3m, $\theta = 60°$, $\emptyset = 25°$. Determine; (i) V_P (ii) $\boldsymbol{E_P}$ (iii)$\frac{dV}{dN}$ $at\ P$ (iv) $\overline{\boldsymbol{a_N}}$ at P and (v) ρ_V at P.	3	1	1,2,3,4,18	4
1C.	Four identical point charges of 4 pC each are located at the corners of a square 0.5 mm on a side in free space. How much work must be done to move one charge to a point equidistant from the other three and in the same plane?	3	1	1,2,3,4,18	4
2A.	Two extensive homogeneous isotropic dielectrics meet on plane z = 0. For z > 0, ε_{r1} = 4 and for z < 0, ε_{r2} = 3. A uniform electric field $\mathbf{E_1} = 5\mathbf{a_x} - 2\mathbf{a_y} + 3\mathbf{a_z}$ kV/m exists for z ≥ 0. Find (i) $\mathbf{E_2}$ for z ≤ 0 (ii) The angles E_1 and E_2 make with the interface (iii) The energy densities (in J/m^3) in both dielectrics (iv) The energy within a cube of side 2 m centered at (3, 4, -5)	4	1	1,2,3,4,18	4
2B.	Transform the vector $\mathbf{A} = y\mathbf{a_x} - x\mathbf{a_y} + z\mathbf{a_z}$ into cylindrical coordinates	3	1	1,2,3,4,18	4
2C.	Sketch the magnitudes of voltage and current for two wavelengths, on a dissipation less two wire transmission line when: (i) Load impedance is much less than characteristic impedance (ii)Load impedance is much greater than characteristic impedance	3	4	1,2,3,4,18	3

	(iii) load impedance is equal to characteristic impedance				
3A.	Explain the wave propagation in good conductors using skin depth.	2	1	1,2,3,4,18	2
3B.	Determine the boundary conditions for the magnetic field at the interface between two magnetic materials	3	2	1,2,4,18	3
3C.	In phasor form the electric filed intensity of a uniform plane wave in free space is expressed as E = $(40 - j30)e^{-j20z}$ a_x V/m. Find a) Angular frequency ω b) Phase constant β c) Frequency f d) Wavelength λ e) Magnetic field intensity H	5	2	1,2,4,18	4
4A.	Find the amplitude of displacement current density within a large oil filled power capacitor where relative permittivity is 5 and electric filed intensity E = 0.9 cos $[1.257x10^{-6}(3x10^{8}t - 2.23z)]$ a_x MV/m.	2	2	1,2,4,18	4
4B.	What is the inconsistency of Ampere's law with continuity equation? Derive the modified Ampere's law by Maxwell for time varying fields.	3	2	1,2,4,18	3
4C.	Derive the equations relating to the construction of smith chart and list any four salient features of smith chart.	5	4	1,2,3,4,18	3
5A.	A transmission line has the following parameters: R = 2Ω/m, G = 0.5 mmho/m, f = 1 GHz, L= 8nH/m and C = 0.23pF/m. Calculate: (a) The characteristic impedance (b) Propagation constant	2	4	1,2,3,4,18	4
5B.	With necessary equations, explain any two applications of quarter wave line at Radio frequencies	4	4	1,2,3,4,18	3
5C.	A lossless line with characteristic impedance of 50 ohms is terminated by a impedance Z_L. The voltage standing wave maximum and minimum are found 2.5V and 1V, respectively and distance between successive minima is 5 cm. The line is first terminated by a short and then the unknown load, so that a shift in the voltage minimum of 1.25 cm is observed towards the generator. Determine the load impedance using smith chart, showing all the steps.	4	4	1,2,3,4,18	4

M*--Marks, C*--CLO, A*--AHEP LO, B* Blooms Taxonomy Level