BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: BE **SEMESTER : IV**
BRANCH: ECE **SESSION : SP/19**

SUBJECT: EC4207 ELECTROMAGNETIC THEORY

TIME: 3 Hours **FULL MARKS: 60**

INSTRUCTIONS:
1. The question paper contains 7 questions each of 12 marks and total 84 marks.
2. Candidates may attempt any 5 questions maximum of 60 marks.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

Q.1(a) Differentiate between transformer EMF and Motional EMF. [2]

Q.1(b) In a region of free space, the electric field $E = E_0 \cos(110t - kx)\, a_z$. Determine J_c and J_d [4]

Q.1(c) State Faraday's law. A circular loop of ***10*** turns of conducting wire of radius $r = 5$ *cm* and resistance $R = 10\ \Omega$ is placed in a slowly varying uniform magnetic field. The magnetic field makes an angle of 45^0 with respect to the direction of the surface of the loop. The magnetic field magnitude is given as $B = \cos(2\pi t)\ T$. Find the emf and the current generated in a wire. [6]

Q.2(a) Discuss the role of loss tangent in distinguishing between the good conductors and lossy dielectrics. [2]

Q.2(b) Over what frequency range may dry soil, with $\epsilon_r = 3$, $\mu_r = 1$, and $\sigma = 10\text{-}4$ *S/m*, be regarded as a low-loss dielectric medium? [4]

Q.2(c) In a three dimensional space, divided into region ***1*** $(x < 0)$ and region ***2*** $(x > 0)$, $H_1 = 4.0\, a_x + 1.5\, a_y - 3\, a_z$, *A/m*. Find H_2 .Relative permeabilities of the two medium are ***3*** and ***5*** respectively. [6]

Q.3(a) Describe the characteristics of plane waves. [2]

Q.3(b) Which parameter measures the penetration of the EM wave in the medium? What are the factors on which it depends on and how? [4]

Q.3(c) A uniform plane wave propagating in a medium has $E = 2e^{-\alpha z} \sin(10^8 t - \beta z) a_y$ *V/m*. If the medium is characterized by $\epsilon_r = 1$, $\mu_r = 20$, and $\sigma = 3$ *S/m* Find α, β and H. [6]

Q.4(a) Distinguish between reflection coefficient and transmission coefficient [2]

Q.4(b) What are the characteristics of the standing waves? How they can be used to find unknown impedance? [4]

Q.4(c) Define Brewster's angle. A uniform plane wave is incident from air on a dielectric with $\epsilon_r = 10$. If the angle of incidence is 75^0, find reflection coefficient for both polarizations. Also find the power reflected and transmitted in both cases. [6]

Q.5(a) Differentiate between a lossless line and a distortion less line. [2]

Q.5(b) A telephone line has $R = 30\ \Omega/km$, $L = 100mH/km$, $G = 0$, and $C = 20\mu F/km$. At ***1 kHz*** obtain the characteristic impedance and the propagation constant of the line. [4]

Q.5(c) A load of $100 + j150\ \Omega$ is connected to a $75\ \Omega$ lossless line. Find the reflection coefficient, SWR, the load admittance, and input impedance at the generator. [6]

Q.6(a) Compare any two impedance matching techniques. [2]

Q.6(b) Calculate source and load reflection coefficients Γ_s and Γ_L and plot the bounce diagram of voltage, for an EM wave which travels down an open circuited transmission line of characteristic impedance Z_0 and dies down after reflecting from source. The source impedance is ¼ th of the characteristic impedance. [4]

Q.6(c) A load of $Z_L = (60 - j40)\ \Omega$ is to be matched with a $50\ \Omega$ transmission line. Design a short circuit stub for this purpose using a Smith Chart. Why short circuit stub is preferred over open circuit stub for matching? [6]

Q.7(a) Distinguish between the transmission lines and the waveguides.) [2]

Q.7(b) What are the conditions for ***TE*** and ***TM*** mode of propagation in Rectangular waveguide? Which is the lowest mode of propagation in a rectangular waveguide and how it is determined? [4]

Q.7(c) Plot the field configurations for lowest ***TE & TM*** modes of propagation. Find the broad wall dimension of an air filled rectangular waveguide when the cut-off frequency for TE_{10} mode is ***1 GHz*** and ***10 GHz***. [6]

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