**Q. Code: 634263**

**Reg. No.** | | | | | | | | | |

# B.E. / B.TECH. DEGREE EXAMINATIONS, DEC 2019

Third Semester

## EC18302 – ELECTROMAGNETIC FIELDS AND WAVES

***(Electronics and Communication Engineering)***

**(Regulation 2018)**

**Time: Three Hours** **Maximum : 100 Marks**

Answer **ALL** questions

**PART A - (10 X 2 = 20 Marks)**

| | | CO | RBT |
|---|---|---|---|
| 1. | State the Coulomb's law in vector form. | 1 | U |
| 2. | Express the electric flux density at a point in a field in the vector form. | 1 | R |
| 3. | State Biot-Savart's law. | 2 | R |
| 4. | What is vector magnetic potential? | 2 | R |
| 5. | State Poisson's and Laplace's equations. | 3 | U |
| 6. | What is self inductance? | 3 | U |
| 7. | What is the significance of displacement current density? | 4 | U |
| 8. | State Faraday's law of electromagnetic induction. | 4 | R |
| 9. | Write expressions for instantaneous and complex poynting vector. | 5 | R |
| 10. | What is skin effect? | 5 | R |

**PART B - (5 X16 = 80 Marks)**

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|---|---|---|---|---|---|---|
| 11. | (a) | (i) | Derive the expression for the electric field due to infinite sheet of charge placed in xy plane, having surface charge density of $\rho_s$ C/m$^2$. | **(10)** | 1 | AP |
| | | (ii) | A point charge $Q_1$=300μC located at (1,-1,-3)m experiences a force $F_1=8\vec{a_x}-8\vec{a_y}+4\vec{a_z}$(N) due to point charge $Q_2$ at (3,-3,-2)m. Find the charge $Q_2$. | **(6)** | 1 | AP |
| | | | **(OR)** | | | |
| | (b) | (i) | Point charges Q and –Q are located at (0,0,d/2) and (0,0,-d/2). Show the potential at a point (r,θ,φ)is inversely proportional to $r^2$ and r >>d. | **(8)** | 1 | AP |

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|---|---|---|---|---|---|---|
| | | (ii) | State Gauss's law. Also explain any two applications of Gauss's law. | **(8)** | **1** | **U** |
| 12. | (a) | (i) | Using Bio-Savart's law, derive the magnetic field intensity on the axis of a circular loop carrying a steady current I. | **(10)** | **2** | **AP** |
| | | (ii) | A circular loop located on $x^2+y^2=9$, z=0 carries a direct current of 10A along $\vec{a_\varphi}$. Determine magnetic field intensity at (0,0,4) and (0,0,-4). | **(6)** | **2** | **AP** |
| | | | **(OR)** | | | |
| | (b) | | Derive the magnetic field intensity in the different regions of co-axial cable by applying Ampere's circuital law. | **(16)** | **2** | **AP** |
| 13. | (a) | (i) | Derive Poisson's and Laplace's equation. | **(6)** | **3** | **AP** |
| | | (ii) | Use Laplace's equation to find the capacitance per unit length of a co-axial cable of inner radius 'a' m and outer radius 'b' m. Assume $V=V_0$ at r=a and V=0 at r=b. | **(10)** | **3** | **AP** |
| | | | **(OR)** | | | |
| | (b) | (i) | Derive the magnetic boundary condition at the interface between two magnetic medium. | **(10)** | **3** | **AP** |
| | | (ii) | Derive the expression for inductance of a toroidal coil carrying current I, with N turns and the radius of toroid R. | **(6)** | **3** | **U** |
| 14. | (a) | | Derive Maxwell's equation in point form and integral form from basic laws and mention the significance of point form. | **(16)** | **4** | **AP** |
| | | | **(OR)** | | | |
| | (b) | (i) | Given the fields $E=E_m \sin x \sin t\ \vec{a_y}$ and $H = E_m/\mu_0 \cos x \cos t\ \vec{a_z}$ satisfy Maxwell's equation? | **(8)** | **4** | **AP** |
| | | (ii) | If electric field intensity in free space is given by $\vec{E}=1.5\cos(10^8 t-10z)a_\rho$ V/m. Find the magnetic field intensity $\vec{H}$. | **(8)** | **4** | **AP** |
| 15. | (a) | | Discuss about Poynting vector and power flow in a Co-axial cable. | **(16)** | **5** | **U** |
| | | | **(OR)** | | | |
| | (b) | (i) | Derive the general wave equation. | **(8)** | **5** | **U** |
| | | (ii) | Derive the wave equation for plane waves in free space. | **(8)** | **5** | **U** |