R16

II B. Tech I Semester Regular/Supplementary Examinations, October/November - 2018
ELECTROMAGNETIC FIELDS
(Electrical and Electronics Engineering)

Time: 3 hours
Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**
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PART –A

1. a) Mention the relation between D, E and F terms? (2M)

    b) Calculate energy stored in Capacitor if Capacitance is 5 PF and voltage 5v? (3M)

    c) State the Biot-savart's law? (2M)

    d) Define Loretz force equation? (2M)

    e) Define mutual Inductance and coupling Coefficient? (3M)

    f) Give the significance of 4th Maxwell's equation? (2M)

PART -B

2. a) Three equal point charges of 2 µC are in free space at (0,0,0) ,(2,0,0) (7M)
    And (0,2,0) ,respectively find the force on Q_4 = 5µCat (2,2,0)

    b) Derive the Maxwell's first Equation Using Gauss's law (7M)

3. a) A pair of negative and positive charges of 10µC each are separated by (7M)
    A distance of 0.1m along the x-axis . Find the dipole moment.

    b) Derive the boundary conditions between dielectric to dielectric medium? (7M)

4. a) If the magnetic field, H= (r sin Φ a_r + 2.5 r sinθ cos Φ a_Φ)A/m exists in a (7M)
    Medium whose μ_r =3.0 , find the magnetic flux density..

    b) Define Ampere's law and explain any 2 applications? (7M)

5. a) Derive the expression for force on a current element in a magnetic field? (7M)

    b) A charge of 12 C has velocity of ($5a_x$+$2a_y$-$3a_z$) m/s .Determine F on the (7M)
    Charge in the field of i) E=18a_x+5a_y+10a_z V/m
    ii) B=4a_x +4a_y +3a_z wb/m^2

6. a) Prove that W_L= ½ LI^2 (7M)

    b) A rectangular coil is placed in a field of B=(2a_x +a_y) Wb/m^2.The coil is in y-z (7M)
    plane and has dimensions of 2m X 2m. It carries a current of 1 A. Find the
    torque about the z-axis.

7. a) State and explain the faradays laws of electromagnetic induction (7M)

    b) Derive the expression for the Poynting vector

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PART –A

1. a) Estimate the differential flux(φ) that passes positive differential area "dxdz" if displacement flux density is D=(ya$_x$+xa$_y$)mc/m^2 (3M)

   b) Define i) Dipole moment and ii) Polarization (2M)

   c) What is the current density which produces a magnetic field of H=28sinx a$_y$? (2M)

   d) Find the force on charge Q=12C when placed in E=(18a$_x$+5a$_y$+10a$_z$) v/m (3M)

   e) Define energy density and give its expresion (2M)

   f) Represent the 1st Maxwell's equation both in static and time varying EM Fields? (2M)

PART -B

2. a) If coulomb's force , F=(2a$_x$+a$_y$+a$_z$)N , is acting on a charge of 10C,find the electric field intensity , its magnitude and direction (7M)

   b) Derive the E-field due to infinite charge sheet? (7M)

3. a) If a dielectric material of ε$_r$ =4.0 is kept in an electric field E= 3.0a$_x$ +2.0a$_y$ + a$_z$, V/m, find the polarization. (7M)

   b) Derive the Capacitance equation of a parallel plate Capacitor with composite dielectrics (7M)

4. a) Determine the magnetic field intensity, H at the center of a square current Element. The length of each side is 2 m and the current, I=1.0 Amp. (7M)

   b) Derive the Maxwell's equation in point form and integral form using Ampere's Circuit law? (7M)

5. a) Explain about magnetic dipole and dipole moment (7M)

   b) An electron has a velocity of 1km/s along a$_x$ in magnetic field whose magnetic flux density is B=(0.2a$_x$-0.3a$_y$+0.5a$_z$) Wb/m^2.
   Determine the electric field intensity if no force is applied to the electron. (7M)

6. a) Derive and prove that Torque T= BIS a$_z$. (7M)

   b) If the magnetic field is H=0.01/μ$_0$a$_x$,A/m , What is the force on a charge of 1.0pC moving with a velocity of 10^{6}a$_x$ m/s (7M)

7. Derive and prove that the power flow per unit area P=E X H (14M)

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SET - 3

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PART –A

1. a) Define Poission's and Laplace's equations?   (3M)

    b) List out the properties of dielectric materials   (2M)

    c) Represent the Ampere's law in both differential and integral form?   (2M)

    d) Define magnetic dipole and dipole moment   (2M)

    e) Draw the structures of Toroid and solenoid?   (3M)

    f) States the Poynting Theorem?   (2M)

PART -B

2. a) The potential at a point A is 10 volts and at B it is 15 volts. If a charge ,   (7M)
       $Q=10\mu C$ is moved from A to B ,what is the work required to be done?

    b) Define Gauss's law and explain any 2-applications?   (7M)

3. a) Find the polarization, P in a homogenous and isotropic dielectric material   (7M)
       Whose $\varepsilon_r=3.0$ when $D=3.0a_r \mu C/m^2$

    b) Explain the behavior of Conductors in an Electric Field   (7M)

4. a) Determine the magnetic flux between the conductors of a coaxial cable   (7M)
       length 10m .The radius of the inner conductor is a=1cm and that of the
       Outer conductor is 2 cm. The current enclosed is 2A.

    b) Derive the H-field equation due to infinitely long current element.   (7M)

5. a) Derive the expression for torque on a current loop placed in a magnetic field   (7M)

    b) An electron has a velocity of 1km/s along a_x, in a magnetic field whose   (7M)
       Magnetic flux density is $B=(0.2a_x-0.3a_y+0.5a_z$) Wb/m^2.
       i) Find the force on the electron under the influence of both E and B when
       $E=(a_x+a_y+a_z)KV/m$

6. a) A charge of 2.0 C moving with a velocity of $V=(a_x+a_y)$ m/s experiences   (7M)
       no force in electric and magnetic fields. If the magnetic field intensity is
              $1/\mu_0[2a_x+2a_y+a_z]$,A /m, find the electric field.

    b) Derive the equation for energy density in a magnetic field   (7M)

7. The magnetic field, H of a plane wave has a magnitude of 5mA/m in a medium   (14M)
    Defined by $\varepsilon_r =4$, $\mu_r=1$. Determine a) the average power flow
    b) the maximum energy density in the plane wave.

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PART –A

1.　a)　State the Coulombs law and mention the units for each quantity　　　　(3M)

　　b)　Write the equation for conduction current density and continuity Equation?　　　　(2M)

　　c)　Define Magnetic flux and Magnetic flux density?　　　　(2M)

　　d)　Determine the torque on a square coil of 0.2m X 0.2 m carrying a current of 3.0 A in a field of 10 Wb/m^2　　　　(2M)

　　e)　Define self inductance and mutual inductance　　　　(2M)

　　f)　Write the Maxwell's equations in integral form　　　　(2M)

PART -B

2.　a)　Describe the work done in moving a point charge in an electrostatic field　　　　(7M)

　　b)　Define potential difference and prove that it is independent on the shape of the path?　　　　(7M)

3.　a)　The region y<0 contains a dielectric material for which ε_{r1} =2.0 and　　The region y>0 contains a dielectric material for which ε_{r2} =4.0. If E1=-3.0a$_x$ +5.0a$_y$+ 7.0a$_z$ V/m, find the electric field, E$_2$ and D$_2$ in Medium 2.　　　　(7M)

　　b)　Derive the continuity equation?　　　　(7M)

4.　a)　Given magnetic flux density , B=ρ a$_\Phi$,find the total flux crossing the Surface $\Phi = \pi/2$, $1 \le \rho \le 2$ m and $0 \le z \le 5$ m　　　　(7M)

　　b)　Derive positive H –field equation due to a circular loop current element　　　　(7M)

5.　a)　Derive the force equation , force on a long current carrying conductor in Magnetic field.　　　　(7M)

　　b)　In a magnetic flux density of B=(1.0a$_x$+ 3.0 a$_y$) Wb/m^2 , a current element, 10a$_z$ mA/m is placed. Find the force on the current element.　　　　(7M)

6.　a)　A Toroid has air core and has a cross–sectional area of 10 mm^2. It has 1000 turns and its mean radius is 10 mm. Find its Inductance.　　　　(7M)

　　b)　Define Inductance? Derive the Inductance equations in different forms?　　　　(7M)

7.　　　Represent the Maxwell's equations both in integral form and differential form for a) Static EM fields b) Time varying fields.　　　　(14M)

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