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IV SEMESTER **B.Tech [EE]**

MID SEMESTER EXAMINATION *MARCH -2019*

PAPER CODE: EE-202 **SUBJECT: ELECTROMAGNETIC FIELD THEORY**

Time: 1.30 hrs ***Max. Marks: 25***

Note: Answer all question. All questions carry marks on the top. Assume suitable missing data, if any.

Q No.1 (3Q X 2.5= 7.5)

a) A point P moves so that its position vector r relative to another point O satisfies the equation $\frac{dr}{dt} = \omega \times r$. where ω is constant velocity. Prove that P describes circle with constant velocity

b) The direction of the vector A is radially outwards from the origin and its magnitude is kr^n Where $r^2 = x^2 + y^2 + z^2$. Find the value of n for which div A = 0

c) If V is a scalar function of x and y , show that the divergence of the vector field F = a_zX grad V is always zero

QNo.2 (3Q X2.5 =7.5)

a) Derive Coulomb's law, starting from Guass theorem. State any reasonable assumptions which you think are necessary for the derivation

b) Eight identical spherical drops of mercury charged to 12 V above the earth potential are made to coalesce into single spherical drop. What is the new potential?

c) Find the electrical field intensity due to a dipole at any point other than the point along and across the axis of it position

Q No.3 (2Q X 3= 6 marks)

a) Each ball has mass M in the gravity field g and when charged can be considered a Charge

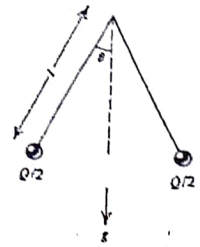

fig 1

A total charge Q is deposited on the two identical balls of the electroscope when they are touching. The balls then repel each other and the string is at an angle θ from the normal which obeys a relation of the form tan θ sin 2 θ = constant what is the constant?

P.T.O.

b) Given vector $A = 3\,a_x + 4\,a_y + 5\,a_z$. Convert the vector in spherical coordinate system. Find: 1) curl and divergence of the vector in spherical coordinates (2) Check whether stokes theorem and Gauss divergence satisfies for the spherical vector with coordinates varying $2<r<5$, $30<\Phi<70$, $0<\theta<20$ (assume if any more data is required)

Q No.4) (1Q X4= 4 marks)

Electrostatic voltmeters are often constructed as shown in the figure above. N pairs of pie-shaped plates form the stator and rotor of a variable capacitor (the figure shows six pairs of rotor plates and six pairs of stator plates). The rotor plates are attached to a conducting shaft that is free to rotate through an angle θ. In the electrostatic voltmeter a pointer is attached to this shaft so that the deflection θ is indicated on a calibrated scale (not shown).

a) Determine $q(v,\theta)$, where q is the charge on the stator and v is the voltage applied between the rotor and the stator. The device is constructed so that fringing fields can be ignored and the area of the plates is large compared with the cross section of the shaft. In addition, it is operated in a region of θ in which the plates overlap but not completely.

b) Find the torque of electrical origin on the rotor.

c) The shaft is attached to a torsional spring with torque-angle relationship

$$T = -K\theta$$

What is the static angular deflection θ as a function of voltage?

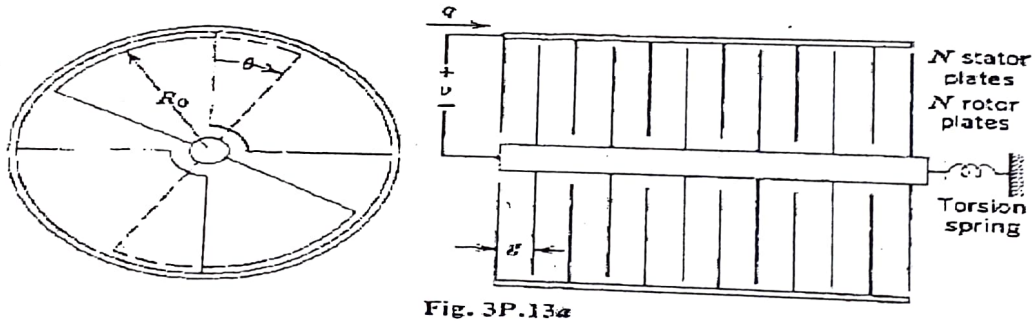

Fig. 3P.13a