Roll No. _____ Total Pages : 4

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BT-3/D07

Electromechanical Energy Conversions

PAPER - ELE-201E

Time : 3 Hrs. Maximum Marks : 100

Note : Attempt any five questions, selecting at least one question from each unit.

UNIT- I

1. a. Develop the phasor diagramof a single phase transformer under lagging p.f. load. 8

   b. The maximum effiiciency of a 500 kVA, 3300/500V, 50 Hz single phase transformer is 97% and occurs at 3/4 full load, unity power factor. If the impedance is 10% calculate the regulation at full load and 0.8 p.f. lagging. 12

2. a. Discuss the relative merits and demerits of a auto-transformer. Distinguish between potential divider and autotransformer. 10

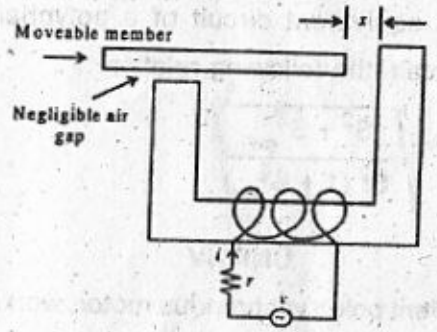
   b. A 400/100V, 5 kVA, 1-ϕ ,two winding transformer is to be used as an autotransformer to supply 400V from 500V source. When tested as a two-winding transformer at rated load and 0.8 p.f. (lag), its efficiency was found to be 0.95. Determine its kVA rating as an autotransformer. Also calculate the transformed kVA and conducted kVA 10

UNIT- II

3. For the electromagnetic device shown below, the cross-section area normal to the flux is A and reluctance is offered by air gap alone. Calculate the average force on a moveable member in terms of N, x, A etc, when

   (a) $i = I_m \cos \omega t$

   (b) $v = V_m \cos \omega t$. 20



4. a. Develop suitable equations for D.C. shunt motor for speed-current, torque-current and speet-torque characteristics and draw the characteristics. 10

   b. A 250V, D.C. shunt motor has an armature resistance of 0.5Ω and a fixed resistance of 250Ω. When driving a constant torque load at 600 rpm, the motor draws 21A of current. What will be the speed of the motor if an additional 250Ω resistance is inserted in the field circuit? 10

UNIT-III

5. a. a 3-ϕ induction motor with $\frac{r_2}{x_2} = 0.5$ has a starting torque of 25.0 Nm. For negligible stator impedance and no-load

current, determine starting torque in case rotor circuit resistance per phase is (i) doubled, (ii) halved. 14

b. Draw the phasor diagram of a 3- ϕ induction motor loading with lagging p.f. load. 6

6. a. Why starting is required for induction motors ? Compare stator resistance and autotransformer starting methods. Develop suitable equations. 14

b. From an equivalent circuit of a polyphase induction motor, obtain the following relation :

$$\frac{I_{2st}}{I_2} = \sqrt{\frac{S^2 + S^2_{mt}}{S^2 (1 + S^2_{mt})}}$$ 6

UNIT-IV

7. a. For a salient pole synchronous motor, working at lagging p.f., show that

$$\tan\delta = \frac{I_a (X_q \cos\theta - \gamma_a \sin\theta)}{V_t - I_a (X_q \sin\theta + \gamma_a \cos\theta)}$$

symbols have suitable meanings. 10

b. A 433 v, 3-ϕ Y-connected synchronous motor has a X_s = 5Ω/ phase. For a power output of 15kW, find its minimum armature current, excitation voltage and power angle. R_a is negligible. 10

8. a. Show that the q-axis synchronous reactance X_q can be determined from a maximum lagging current test. Armature resistance and rotational losses are neglected. 10

b. Find an expression for reactive power as a function of load angle δ for a synchronous motor (salient pole) working at a lagging p.f. 10