



(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 121312

Roll No.

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B. Tech.

(SEM. III) (ODD SEM.) THEORY
EXAMINATION, 2014-15

ELECTRO-MECHANICAL ENERGY CONVERSION – I

Time : 3 Hours]

[Total Marks : 100

- 1 Attempt any **four** parts : 5×4=20
- Explain how flow of energy takes place in electromechanical device.
 - The magnetic flux density on the surface of an iron face is 1.6 T which is a typical saturation level value for ferromagnetic material. Find the force density on the iron face.
 - Derive the expression for magnetic torque and force developed in doubly excited system.
 - Describe in detail account on energy stored in magnetic system.
 - Draw the circuit and explain the concept of a doubly excited magnetic system.
 - Define energy and Co-energy.

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2 Attempt any **two** parts : 10×2=20

- Discuss in detail the phenomenon of commutation in dc machines and also explain the methods adopted to improve commutation.
- Explain the effects of armature reaction on the operation of a dc machines. How the effects of armature reactions can be minimized?
- Derive an expression for the emf generated in the armature winding of a dc machine.

3 Attempt any **two** parts : 10×2=20

- A 15 kW, 250 V, 1200 rpm, shunt motor has 4 poles, 4 parallel armature paths and 900 armature conductors. Assume $R_a = 0.2 \Omega$. At rated speed and rated output the armature current is 75 A and $I_f = 1.5A$. Calculate :
 - the flux/pole
 - the torque developed
 - Rotational losses
 - Efficiency
 - the shaft load.
- Derive an expression for the torque developed in the armature of a d.c. motor.
- A 250 V d.c. shunt motor has a shunt field resistance of 200Ω and an armature resistance of 0.3Ω . for given load, motor runs at 1500 r.p.m. drawing a current of 22 A from the supply. If a resistance of 150Ω is added in series with the field winding, find the new armature current and the speed. Assume load torque constant and magnetization curve to be linear.

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4 Attempt any two parts : $10 \times 2 = 20$

- (a) The parameters of the equivalent circuit of a 150 kVA, 2400/240V transformer are :
 $R_1 = 0.2 \Omega$, $R_2 = 2 \times 10^{-3} \Omega$, $X_1 = 0.45 \Omega$,
 $X_2 = 4.5 \times 10^{-3} \Omega$, $R_i = 10 \text{ k}\Omega$, $X_m = 1.6 \text{ k}\Omega$
(as seen from 2400V side).

Calculate :

- (i) Open circuit current, power and power factor when LV is excited at rated voltage.
- (ii) The voltage at which the HV should be excited to conduct a short circuit test (LV shorted) with full load current flowing. What is the input power and is Power factor?
- (b) A 500 kVA transformer has an efficiency of 95% at full load and also at 60% of full load; both at Unity Power Factor.
- (i) Separate out the losses of the transformer.
- (ii) Determine the efficiency of the transformer at $3/4^{\text{th}}$ full load.
- (c) A 400/100V, 10kVA, 2-winding transformer is to be employed as an autotransformer to supply a 400 V circuit from a 500 V source. When tested as a 2-winding transformer at rated load, 0.85 Power factor lagging, its efficiency is 0.97%.
- (i) Determine its kVA rating as an autotransformer.
- (ii) Find its efficiency as an autotransformer.