Printed Pages : 7

TEE – 401

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

PAPER ID : 2051 Roll No.

B. Tech.

(SEM. IV) EXAMINATION, 2007-08

ELECTROMECHANICAL ENERGY CONVERSION - I

Time : 3 Hours] *[Total Marks : 100*

Note : *Attempt **all** questions.*

1 Attempt any **two** parts of the following : **2×10=20**

(a) (i) Show that the reaction of coupling magnetic field on the electrical or mechanical system is essential for the electromechanical energy conversion process.

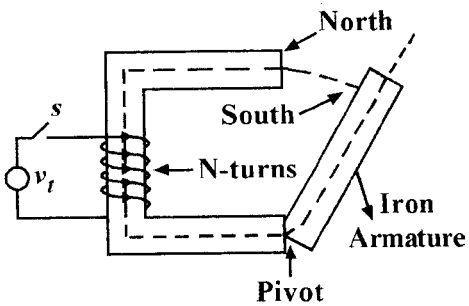
(ii) For an electromagnetic system, show that the mechanical work done is equal to the area enclosed between the two magnetization curves at open and closed positions of the armature and the $\psi - i$ locus during the armature movement.

(b) The simple magnetic relay of **Fig. 1(b)** gave the following $\psi - i$ characteristics.

(i) Open position, $\psi = 0.04i$ Wb-turn for all values of current

(ii) Closed position, $\psi = 0.06i$ for $0 \le i \le 20$

$\psi = 1.2 + 0.03(i - 20) \quad i > 20$.



For an armature movement from open to closed position, find the magnitude of average magnetic force. The air gap length is 2 cm and the current during armature is constant at 40 A.

(c) (i) Define field energy and coenergy. Give the significance of coenergy in the derivation of torque or force in an electromechanical energy conversion device.

(ii) All practical energy conversion devices make use of the magnetic field as a coupling medium rather than an electric field.

2 Attempt any **two** questions of the following : **2×10=20**

(a) (i) Explain how a.c., generated in the armature circuit of a d.c. machine is rectified to d.c. by means of a commutator.

(ii) Derive an expression for the emf generated in a dc machine.

(b) A 250 V compound generator has armature, series-field and shunt field of resistances **0.4** Ω **0.2** Ω and **125** Ω respectively. If this generator supplies 10 kW at rated voltage, find the emf generated in the armature where the machine is connected :

(i) long shunt

(ii) short shunt

Ignore armature reaction and allow 1 volt per brush for contact drop.

(iii) If a diverter of resistance **0.3** Ω is connected in parallel with series-field winding, find the percentage decrease or increase in series field ampere turns.

(c) (i) With the dc machines fitted with interpoles, draw the resultant flux density waveform and show, therefrom, the improvement in the commutation process of both the generator and motor.

(ii) Why does the terminal voltage fall more rapidly in a self-excited shunt generator than in a separately excited d.c. generator?

3 Attempt any **two** of the following : **2×10=20**

(a) (i) For a d.c. motor, the field flux speed control method is called a constant power drive method. Explain.

(ii) A 250 V dc shunt motor has an armature resistance of **0.5 Ω** and a field resistance of **250 Ω**. When driving a constant torque load at 600 rpm the motor draws 21 A. What will be the new speed of the motor is an additional **250 Ω** resistance is inserted in the field circuit ?

(b) (i) Two identical d.c. shunt machines when tested by Hopkinson's method, gave the following data:

Line voltage - 230V; Line current excluding both the field currents - 30 A; motor armature current - 230 A; field currents 5 A and 4 A.

If the armature resistance of each machine (including brushes) is **0.025 Ω** calculate efficiency of both the machines.

(ii) "Ward-Leonard method of speed control of a dc motor provides a smooth control in both the directions." Justify on the correctness or otherwise of thin statement.

(c) (i) A d.c. shunt motor is connected to a 3-point starter. Explain what would happen if the field circuit becomes open circuited with the motor running at no load.

(ii) Explain what would happen, if the d.c. motor is directly switched on to the supply without any starter.

(iii) Explain the function of no-volt release in a three point starter.

(iv) What would happen if the external resistance for starting the dc motor, is left in the armature circuit?

4 Answer any **two** of the following : **2×10=20**

(a) (i) What is the difference between 3 single phase transformer bank and a 3-phase transformer unit?

(ii) Compare the behaviour of star/star transformer with star/zig-zag transformer.

(b) (i) Explain the clock-method of angle designation for representing 3-phase transformers.

(ii) In Y_yO transformer, the polarities of phase winding B are reversed. Explain with phasor diagrams, its effect on the secondary output voltages.

(c) (i) One supply line feeding the primaries of D_y transformer gets disconnected. For a phase turns ratio equal to unity, determine the line to line and line to neutral output voltages.

(ii) It is desired to transform 2400 V, 5000 kVA three-phase power to 2-phase power at 600 V by Scott-connected transformers. Determine the voltage and current ratings of both primary and secondary of each transformer. Neglect the transformer no-load currents.

5 Answer any **two** of the following:

(a) (i) In back to back test, show that one transformer may have slightly less temperature rise than other. **2×5**

(ii) Explain the advantages of using a tertiary winding in a blank of star-star transformers.

(b) (i) Discuss the effect of circulating current at no-load, in two single-phase transformers operating in parallel. **2×5**

(ii) Explain why in testing large transformers the open-circuit test is carried out with the high-voltage winding open and the short circuit test with the low-voltage winding shorted. Write the parameters obtained from these tests.

(c) (i) Show that in case of an auto-transformer. **2×5**

$$\frac{\text{Inductively transferred power}}{\text{Total power}} = \frac{\text{High voltage-Low voltage}}{\text{High voltage}}$$

(ii) A 10 kVA, 2500/250V, single-phase two winding transformer is used as an auto-transformer to raise the supply voltage of 2500 V to an output voltage of 2625 V. The low voltage winding of the two winding transformer consists of two equal

parts of 125 V each. If both parts of low voltage winding are used, determine auto-transformer kVA output. Also calculate kVA transformed and kVA conducted.
