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PAPER ID : 2021 Roll No.

B. Tech.

(SEM. IV) EXAMINATION, 2006-07

ELECTROMECHANICAL ENERGY CONVERSION - I

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

Note : *(1) Answer all the **five** questions.*
*(2) All questions carry **equal** marks.*

1 Answer any **Four** parts of the following : **5×4=20**

(a) Give block diagram representation of electromechanical energy conversion and explain it. Also write the energy balance equation in differential form.

(b) Define and explain the terms 'energy' and 'coenergy'. Also show that for a linear system, energy and co-energy are numerically equal.

(c) The λ-i characteristic of a magnetic circuit is shown in Fig. 1. Saturation parts of magnetic circuit from point A to point B is also described by a straight line and the circuit behaves linearly from origin to point A. Find the co-energy for the magnetic at point A and at point B.

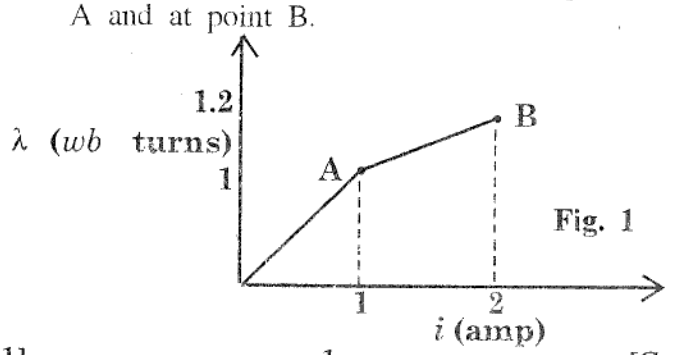

Fig. 1

(d) Two coupled coils have self and mutual inductance in henry of values

$$L_{11} = 2 + \frac{1}{2x} \quad L_{22} = 1 + \frac{1}{2x} \quad L_{12} = L_{21} = \frac{1}{2x}$$

over a certain range of linear displacement x. The first coil is excited by a constant current of 20A and the second coil is excited by a constant current of -10A. Determine the mechanical force if x changes from 0.5 m to 1 m.

(e) Explain d, q, o transformation and discuss its significance.

(f) Describe an idealized machine and explain etc. importance in analyzing an actual machine.

2 Answer any **four** parts of the following : **5×4=20**

(a) Define armature reaction in d.c. machine and explain its effects on machine performance.

(b) Calculate the number of conductor on each pole piece required in a compensating winding for a 6-pole, lap wound d.c. armature containing 236 conductors. The pole arc to pole pitch ratio is 0.7. The compensating winding carries full armature current.

(c) Explain commulator action in d.c. machines. Also describe two ways of achieving good commulation and compare them.

(d) State and explain following characteristic of d.c. generator :

(i) No-load magnetization characteristic and

(ii) External and internal characteristics.

(e) Derive electromagnetic torque equation of d.c. machines.

(f) A 440-V 4-pole, 25 kW d.c. generator has a wave connected armature winding with 486 conductors. The mean flux density in the air gap under the interepoles is 0.5 wb/m^2 on full load and radial gap length is 0.3 cms. Calculate the number of turns required on each interepole. Assume armature current equals to line current.

3 Answer any **four** parts of the following : **5×4=20**

(a) Explain why a d.c. motor draws high current at starting? Discuss its effects and method of restricting starting current to safe limit.

(b) Describe a 4-point starter. Compare and distinguish it with a three point starter.

(c) Describe Ward-leonard control. Discuss advantage and disadvantage of this scheme.

(d) A 200-V d.c. shunt motor with constant field drives a fan load whose torque varies as the square of the speed. When running at 600 rpm, it takes 30A. Find the speed at which it will run and the current it will draw if a 20 Ω resistor is connected in series with the armature. Neglect motor loss.

(e) Draw and explain power flow diagram in a d.c. motor and explain each components involved in power flow. Also write down expression for efficiency of d.c. motors.

(f) Describe Hopkinson's list method for efficiency determination of d.c. machine.

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

(a) Draw phasor diagram and equivalent circuit model of transformer on no-load.

A transformer on no-load has a coreloss of 50W, draws a current of 2A and has an induced emf of 230V. Determine (i) the no load power factor (ii) coreloss current and (iii) the magnetizing current.

(b) Explain the construction and working of an autotransformer. Discuss its comparative feature with identical rating two winding transformer.

(c) Define and explain efficiency and regulation of transformer. Describe open circuit and short circuit test methods of their determination.

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

(a) Explain multi circuit transformers and mention its desirability with examples. Also discuss various purposes which diclate the use of tertiary winding in 3-winding transformer.

(b) Two transformer having equal voltage ratio are operated in parallel. Obtain expressions for the maximum possible kVA loading of the two transformer in parallel. State assumptions made if any.

(c) Describe construction and working of welding transformer. Give distinguishing features of it, when compared with two winding transformer.