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

PAPER ID : 0207 Roll No. | | | | | | | | | | |

B.Tech.

(SEM. IV) THEORY EXAMINATION 2010-11

ELECTRO-MECHANICAL ENERGY CONVERSION—I

Time : 3 Hours *Total Marks : 100*

Note :- (1) Attempt **ALL** questions.

(2) All questions carry equal marks.

1. Attempt any **FOUR** parts of the following :— **4×5=20**

(a) Explain the principles of Electro-mechanical. Energy Conversion in rotating machines.

(b) Write short notes on the following :—

(i) Singly excited systems.

(ii) Doubly excited systems.

(c) For the electromagnetic device shown in Fig. 1, the cross-sectional area normal to the flux is A and the reluctance is offered by air gap alone. Compute the average force on the movable member in terms of N, x, A etc., when

(i) $i = I_m \sin(wt + \alpha)$

(ii) $v = V_m \cos wt$.

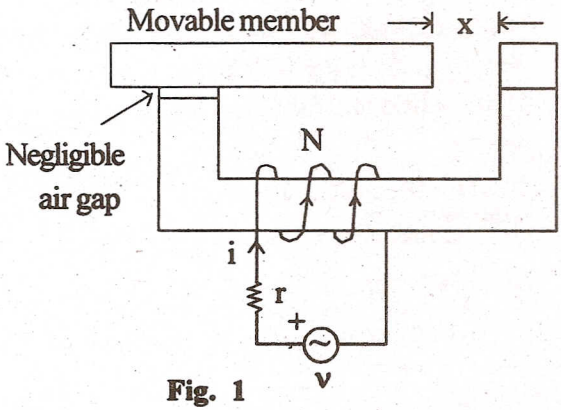

Fig. 1

(d) What do you mean by "energy" and "co-energy" in magnetic systems ? Also mention its importances.

(e) Give the physical concepts of the following :—

(i) Flux-density wave is sinusoidally distributed in space.

(ii) Pulsating stationary flux.

(f) Describe the advantages of providing field winding on the rotor and armature winding on the stator in case of large 3ϕ synchronous machines.

2. Attempt any **TWO** parts of the following :— **2×10=20**

(a) Discuss the constructional details and working principle of 2-pole and 4-pole D.C. machines. Also discuss the performance characteristics of d.c. generators.

(b) Derive an expression of back e.m.f. and torque in D.C. machines. Also mention the significances of back e.m.f. in d.c. machines.

(c) What do you understand by "ARMATURE REACTION" in D.C. Machines ? How it can be minimized ?

3. Attempt any **TWO** parts of the following :— **2×10=20**

(a) 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 if an additional 250 Ω resistance is inserted in the field circuit.

(b) Explain the following :—

(i) Hopkinson's Test on d.c. machines.

(ii) Swinburn's Test on d.c. machines.

Also mention the significances of above tests.

(c) A 4-pole dc motor runs at 600 rpm on full load and takes 25 A at 450 V. The armature is lap wound with 500 conductors and flux per pole is given by $\phi = 1{\cdot}7 \times 10^{-2} \sqrt{I}$ webers, where I is the motor current. If the supply voltage and torque both are halved, calculate the speed at which the motor will run. Neglect stray losses.

4. Attempt any **TWO** parts of the following :— **2×10=20**

(a) Draw and explain the phasor diagram of 1-ϕ transformer on the following :—

(i) Unity power factor load

(ii) Lagging power factor load

(iii) Leading power factor load.

Also mention its significances and limitations.

(b) What do you mean by "Voltage Regulation" and "Efficiency" of 1-ϕ transformers ?

Determine an expression for voltage regulation and efficiency in terms of equivalent circuit parameters of 1-ϕ transformers.

(c) The full load voltage drops in a single-phase transformer are 2% and 4% due respectively to resistance and leakage reactance. The full-load ohmic loss is equal to the iron loss. Calculate :—

(i) the efficiency on full load at unity p.f.

(ii) the full-load p.f. at which voltage drop is maximum and

(iii) the load p.f. at which voltage drop is zero.

5. Attempt any **TWO** parts of the following :— **2×10=20**

(a) What do you understand by "PHASOR GROUPS" of 3ϕ transformers ? Also mention its classifications and significances. Explain the following conversion in regarding with 3ϕ transformers :

(i) 3ϕ to 2ϕ connections.

(ii) 3ϕ to 6-ϕ or 12-ϕ connections.

(b) Explain the working principle and constructional details of three winding transformers. Also mention the importances of third winding in three winding transformers.

(c) What do you mean by "PARALLEL OPERATION of 3ϕ TRANSFORMERS" ? Also discuss the advantages/ disadvantages of parallel operation of 3ϕ transformers.

Also discuss the excitation phenomenon and harmonics in 3ϕ transformers.