SE327

Total No. of Printed Pages:3

S.E. (Electrical & Electronics) (Sem-III) (Revised Course 2016-2017)
EXAMINATION MAY/JUNE 2019
Electrical Machines-I

[Duration : Three Hours] **[Max.Marks : 100]**

Please check whether you have got the right question paper.

Instructions:
1) Answer **any two** questions from Part – A.
2) Answer **any two** questions from Part – B.
3) Answer **any one** questions from Part – C.
4) Assume suitable additional data if necessary.

Part A

Q.1 a] Draw the block diagram of a dynamo operating in motoring mode as well as generating mode of operation and indicate clearly different torques experienced by it during its operation. **04**

b] Derive an expression for mechanical force produced in a singly excited magnetic field system. **07**

c] A doubly excited rotating machine has self and mutual inductances as follows: **09**
$r_s = 40\Omega, Ls = 0.16H, r_r = 2\Omega, L_r = 0.04 + 0.02Cos2\theta\ H, M_{sr} = 0.08\ Cos\theta\ H$, where θ is the space angle between rotor coil and stator coil. Rotor rotates at a speed of 100 rad/sec. For $i_s = 10A(dc)$ and $i_r = 2A(dc)$, obtain an expression for electromechanical torque developed and corresponding electrical power.

Q.2 a] Using general expression for electromagnetic torque developed in a round rotor machine, derive an expression for torque developed by DC machine indicating clearly the terms used in the expression. **07**

b] What is armature reaction? State its effects. Also state its detrimental effects on the operation of the DC machine. **07**

c] Brushes of a certain lap wound, 400KW, 6 pole, DC generator are given a lead of 18°electrical. Calculate: (i) demagnetizing armature ampere turns, (ii) cross-emagnetizing armature ampere turns, for full load current of 750A and total number of armature conductors are 900. **06**

Q.3 a] What is the cause of delayed commutation. Also explain in brief methods of overcoming it. **06**

b] Draw the performance characteristic curves of different types of DC generators and explain them in brief. **05**

c] The magnetizing curve for a 4 pole, 110V, 1000 rpm, DC shunt generator is as follows: **09**

Field current (A)	0	0.5	1	1.5	2	2.5	3
Open Circuit voltage (V)	5	50	85	102	112	116	120

Armature is lap wound with 144 conductors. Field resistance is 45Ω. determine : (i) the voltage which the machine will build up at no load. (ii) critical resistance, (iii) speed at which the machine just falls to excite, (iv) residual flux per pole.

Part B

Q.4 a] Under same load conditions, rating of DC series motor is less as compared to DC shunt motor. Comment on this statement and justify your choice. **05**

05

b] State the advantages of Ward-Leonard method of speed control over other methods. How is Ward-Leonard Ilgner system different from Ward-Leonard method of speed control? **05**

05

c] Draw Torque v/s armature current characteristics of DC shunt motor, Dc series motor and DC cumulative compound motor and explain each in brief. **03**

03

d] Calculate the value of starting current for DC shunt motor having following specifications: Output power= 14920W, supply voltage = 240V, armature resistance = 0.25Ω, efficiency at full load = 86%. Starting current is limited to 2.5 times full load current. **07**

07

Q.5 a] Explain with the help of neat sketch, constructional features of drum type controller. Also state the function of each of its parts. **06**

06

b] What is the significance of heat run test performed on DC machine? What are the other methods used for the measurement of temperature rise in DC machines. **04**

04

c] A 230V, DC series motor runs at 500 rpm taking a current of 40A. Calculate the speed and percentage change in torque if the load is reduced so that the motor is taking 30A. Total resistance of armature and field circuit is 0.8Ω. **05**

05

d] A Dc series motor takes 40A at 220V and runs at 800 rpm. The armature resistance is 0.2Ω and field resistance is 0.1Ω respectively. Iron and frictional losses are 0.5KW. Find the torque developed in armature and also determine the output of machine. **05**

05

Q.6 a] Distinguish between open type armature winding with respect to closed type armature winding. State the advantages of double layer winding with respect to single layer winding. **06**

06

b] Two identical DC shunt machines when tested by Hopkinson's test method gave the following data: line voltage = 220V, line current excluding both field currents = 30A, motor armature currents = 220A, field resistance of motor = 5Ω, Armature resistance of each machine (including brushes) = 0.02Ω, calculate efficiency of both machines. **08**

05

06

c] For a simplex two layer wave winding having 26 conductors and 4 poles, write down the winding table. Also determine front pitch and back pitch. **06**

06

Part C

Q.7 a] Derive an expression for magnetic field energy stored in a singly excited magnetic field system given by **06**

$$W_{fld} = \frac{1}{2}\frac{B^2}{\mu} J/m^3$$

Where symbols have their usual meaning.

b] Draw the external characteristics of different types of compound generators and give one application of each case. **04**

c] Explain with the help of neat circuit diagram, methods by which flux is varied to control speed of DC series motor. **05**

d] A Commutator machine working as motor is rated at 5KW, 250V, 2000 rpm. The armature resistance is 1Ω and field resistance is 250Ω. The no load power input to armature is 1.2A at 250V when driven at 2000 rpm and field current is 1A. Estimate efficiency of machine as 5 KW generator. **05**

Q.8 a] With the help of a neat diagram explain the mechanical work done during slow movement of armature of a singly excited magnetic field system. **05**

b] State the causes of failure of self-excited DC generator to build up voltage. Hence state the necessary conditions for voltage build up in such generators. **05**

c] Explain in brief methods used in starting of low and medium speed DC shunt motor, with the help of neat sketch of the device used for this purpose. Also give function of its main parts. **06**

d] What is the significance of heat run test performed on DC machine? While performing load test on DC shunt motor using brake pulley arrangement following readings were obtained: spring balance loading = 10 kg and 40kg, speed of motor = 950rpm, diameter of pulley = 40cm, applied voltage = 200V, line current = 30A. Calculate output power and efficiency of the motor. **04**