Printed Pages : 4

EEE-501

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

PAPER ID : 121503

Roll No.

B. Tech.

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

ELECTRO-MECHANICAL ENERGY CONVERSION – II

Time : 3 Hours] [Total Marks : 100

1 Attempt any **four** parts : 5x4=20

(a) The following data were obtained for the OCC of a 10 MVA, 13 kV, 3- phase, 50 Hz, star connected synchronous generator.

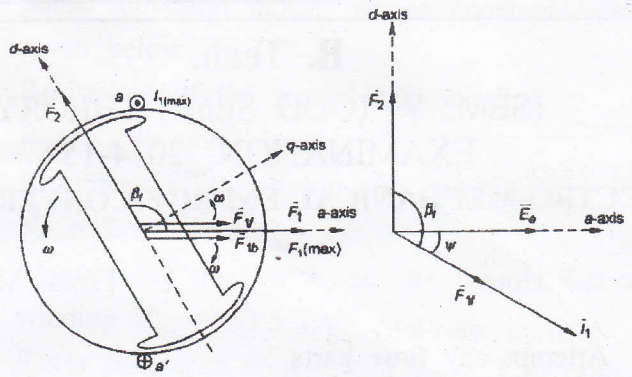
I_f (A)	50	75	100	125	150	162.5	200	250	300
V_{oc}(line)kV	6.2	8.7	10.5	11.8	12.8	13.2	14.2	15.2	15.9

An -excitation of 100A causes the full-load current to flow during the short –circuit test. The excitation required to give the rated current at zero pf and rated voltage is 290 A. Calculate the adjusted synchronous reactance of the machine.

(b) Illustrate in detail about the parallel operation of the synchronous generator.

(c) Enumerate the procedure to find the voltage regulation using synchronous impedance method.

(d) For a single phase synchronous generator the peak value of rotor and stator mmfs are F_2, F_{1f} and F_{1b}. Fundamental frequency is ω rad/s. Using other appropriate symbols, derive an expression for the emfs induced in the stator winding by d-axis flux. Take $t=0$ when F_2 is directed along the stator axis. Refer the figure below



(e) Write the significance of synchronising power.

(f) Give a technical note on Potier's triangle method.

2 Attempt any **two** parts : **10x2=20**

(a) A 3300 V, star – connected synchronous motor is operating at constant terminal voltage and constant excitation. Its synchronous impedance is $0.8 + j5\,\Omega$. It operates at a power factor of 0.8 leading when drawing 800kW from the mains. Find its power factor when the input is increased to 1200 kW, excitation remaining constant.

(b) Elaborate the effect of varying field current at different loads in the synchronous motor.

(c) The synchronous generator has direct axis synchronous reactance is 0.8 pu and quadrature axis synchronous reactance is 0.5 pu. It is supplying full load at rated voltage at 0.8 lagging pf. Draw the phasor diagram and calculate the excitation emf. Calculate power angle with and without X_q.

3 Attempt any **two** parts : **10x2=20**

(a) A 3 phase star connected 400V, 50 Hz 4 pole induction motor has the following per phase parameters in ohms referred to the stators. $R_1 = 0.15$ ohm, $X_1 = 0.45$ ohm, $R_2' = 0.12$ ohm, $X_2' = 0.45$ ohm, $X_m = 28.5$. Compute the stator current and power factor when the motor is operated at rated voltage and frequency with $s = 0.04$.

(b) Draw a neat sketch and explain the working principle and operation of the three phase induction motor.

(c) Brief note on the torque slip characteristics of the three phase induction motor with a neat sketch.

4 Attempt any **two** parts : **10x2=20**

(a) Illustrate in detail about the cogging and crawling of the three phase induction motor.

(b) What is the purpose of controlling the speed of the induction motor and how it can be controlled?

(c) With a neat sketch, explain the construction and working of double cage rotors.

5 Attempt any **two** parts : **10x2=20**

(a) Calculate the pulse rate required to obtain a rotor speed of 2400 rpm for a stepper motor having a resolution of 200 steps/rev.

(b) Find the mechanical power output at a slip of 0.05 of the 185 W, 4 pole, 110 V, 60 Hz single phase induction motor, whose constants are given below :

Resistance of the stator main winding R_1 = 1.86 ohm

Reactance of the stator main winding X_1 = 2.56 ohm

Magnetizing reactance of the stator main winding X_m = 53.5 ohm

Rotor resistance at standstill R_2 = 3.56 ohm

Rotor reactance at standstill X_2 = 2.56 ohm

(c) A universal series motor, when operating on 220 V dc draws 10 A and runs at 1400rpm. Find the new speed and power factor, when connected to 220V, 25 Hz supply, the motor current remaining the same. The motor has total resistance of .1 ohm and total inductance of 0.1 H.