B.E. Electronics Engineering Fourth Semester

EN 405 - Basic Electrical Machines

P. Pages : 3 **GUG/W/18/1558**

Time : Three Hours * 1 2 2 7 * Max. Marks : 80

Notes : 1. All questions carry equal marks.
2. Answer **five** questions as per the instructions given.
3. Due credit will be given to neatness.
4. Assume suitable data wherever necessary.
5. Illustrate your answers wherever necessary with the help of neat sketches.
6. Use of slide rule, Drawing Instruments, non programmable calculator is permitted.

1. a) Draw and explain in brief the phasor diagram of single phase transformer considering winding resistance and leakage reactance for lagging and leading power factor load. **8**

b) A 5 KVA, 200/1000 V, 50 Hz, single phase transformer gave the following test results: **8**
O. C. Test (L.V.Side) :- 200 V, 1.2 A, 90 W.
S.C. Test (H.V. side) :- 50 V, 5A, 1.10 W.
i) Compute the parameter of the approximate equivalent circuit referred to its L.V. side.
ii) Draw the equivalent circuit referred to the L.V. side.

OR

2. a) State the conditions for the parallel operation of 3-phase transformer. Discuss the necessity of the parallel operation. **4**

b) A 140 KVA, 6000/400 V, star-star connected 3-phase transformer has an iron loss of 1750 W. The maximum efficiency occurs at the $\frac{3}{4}$th full load. Find the efficiencies of the transformer at- **8**
i) Full load and 0.8 p.f. lugging.
ii) Half load and upf.
iii) The maximum efficiency.

c) Derive the emf equation of transformer. **4**

3. a) Classify d. c. generator according to the manner in which field winding is exited. Draw circuit diagram and write their voltage equations. **8**

b) The following data is obtained for magnetisation curve of d. c. shunt generator at 400 rpm. **8**

I_f (Amp)	2	3	4	5	6	7	8
E_g (Volt)	110	155	186	212	230	246	260

For this generator obtain:
i) Voltage on open circuit to which machine will build up for shunt resistance of 34Ω
ii) Resistance of shunt circuit to reduce the open circuit voltage to 220 V.
iii) The speed at which the machine just fails to excite.
iv) Residual flux per pole.

OR

4. a) Derive the condition for maximum efficiency of d.c. shunt generator. **4**

b) What do you mean by mechanical, electrical and commercial efficiency of d. c. generator. **4**

c) A shunt generator delivers 195 Amp at terminal voltage of 220 V. The armature and shunt field resistances are 0.02Ω and 50Ω respectively. The iron and friction losses equals 900 watt. Find:- **8**

i) EMF generated, ii) Copper losses
iii) Output of the prime mover iv) Overall efficiency.

5. a) Derive the torque equation of d. c. motor. Hence justify in series motor, $T_a \propto I_a^2$ & in shunt motor, $T_a \propto I_a$. **5**

b) A 4-pole, 240 volt, wave connected shunt motor gives 11.19 kW when running at 1000 rpm and drawing armature current and field current of 50 Amp and 1 Amp respectively. It has 540 conductors, its resistance is 0.1Ω. Assuming a drop of 1 volt per brush. Find:- **8**

i) Total torque ii) Useful torque
iii) Flux per pole, iv) Rotational losses and
v) Efficiency.

c) What is the significance of back emf in d. c. motor. **3**

OR

6. a) Explain the various methods of speed control of d. c. shunt motor. **8**

b) A d. c. shunt motor with an armature resistance of 0.4Ω and field resistance of 100Ω drives a load at 500 rpm taking 27 Amp. from the line. It is desired to drive the same load at 750 rpm. The load torque is constant. Calculate the value of resistance to be used as field regulator. Assume that the field core is not saturated. **8**

7. a) A 3-phase 4-pole, 50 Hz induction motor has a full load speed of 1440 rpm. For this motor calculate the following- **8**

i) Full load slip and rotor current frequency.
ii) Speed of the stator field w.r.t.
a) Stator and b) Rotor.
iii) Speed of the rotor field w.r.t.
a) Rotor b) Stator and c) Stator field.

b) Write short notes on **8**

i) Shaded pole induction motor.
ii) Capacitor start induction motor.

OR

8. a) Why starter is necessary in 3-phase inductor motor. Which are the various starters in induction motor? Explain one method each for squirrel cage and slip ring induction motor. **8**

b) Draw and explain the exact equivalent circuit of 3-phase induction motor.

c) A 6-pole, 3-phase induction motor runs at a speed of 960 rpm when shaft torque is 136 N.m and frequency 50 Hz. Calculate the rotor copper losses if friction and windage losses are 150 watt. **8**

9. a) Explain hunting in synchronous motor. What is the purpose of damper windings in synchronous machine? **8**

b) Why the synchronous motor is not self starting? How it is made self started? Explain both the issues in detail. **8**

OR

10. a) What do you mean by regulation? Why the terminal voltage decreases when the load is connected to it? **3**

b) An alternator requires an excitation of 2 Amp to produce a full load short circuit current of 60 Amp. The same excitation on open circuit gives an emf of 260 V. If resistance of armature is 0.8Ω; find full load regulation:- **8**

i) On resistive load.
ii) On 0.8 leading p.f. load.

c) When 3-phase alternator is connected to unity power factor load, explain how the armature flux has cross magnetizing effect. **5**

******