5. (a) A 3-phase induction motor has a synchronous speed of 1500 rpm and 4% slip at full load. The rotor has a resistance of 0.04Ω per phase and a standstill leakage reactance of 0.30Ω per phase. Calculate 7

(i) the speed at which the maximum torque is developed.

(ii) the ratio of maximum torque to starting torque and ratio of maximum torque to full load torque. (CO3)

(b) Explain the construction of squirrel cage and phase wound induction motors. Give two industrial uses of a 3-phase induction motor. 8 (CO3)

6. (a) What are the types of alternators? Explain the term synchronous impedance. 4 (CO4)

(b) The stator of a 3-phase, 8-pole alternator has 288 slots and there are 4 conductors per slot connected in two layers and the conductors of each phase are connected in series. If the speed of the alternator is 375 r.p.m., calculate the e.m.f. induced per phase. The resultant flux in the air gap is 0.05 webers per pole sinusoidally distributed. Assume the coil span is 150° electrical. 7 (CO4)

(c) Why are 1-phase induction motors not self-starting? How it can be made self-starting? 4 (CO3)

7. (a) What is a universal motor? Why it is called so? Describe the construction and operation of a universal motor. 5 (CO3)

(b) With a neat sketch explain the principle of working of a single-phase induction type energy meter. 5 (CO5)

(c) Explain the working principle of a synchronous motor. Why is a synchronous motor not self-starting? 5 (CO4)

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3. (a) What is a starter? What is the function of no-volt release in a three-point starter? 4

(CO1)

(b) A 220 V DC shunt motor has an armature resistance of 0.2 Ω and field resistance of 110 Ω. At no load, the motor takes 5 A and runs at 1500 rpm. If the motor draws 52 A at the rated voltage and rated load, calculate the motor speed and its rated shaft torque in Nm. The rotational losses at no-load and full load are the same. Neglect armature reaction. 6

(CO1)

(c) What are a DC shunt motor's three important characteristic curves? Draw and explain. 5

(CO1)

4. (a) Voltage regulation of a transformer varies with power factor. Validate this statement. 5

(CO2)

At what power factor will the regulation be (i) maximum and (ii) zero? Derive the conditions,

(b) 1.A 10 kVA, 2500/250V, single-phase transformer gave the following test results: 6

(CO2)

Open circuit test: 250 V, 0.8 A, 50 W

Short circuit test: 60V, 3A, 45W.

(i) Calculate the efficiency at ¼, ½, 1, and 5/4 of full load at 0.8 p.f.

(ii) Calculate the load (kVA output) at which maximum efficiency occurs and also the value of maximum efficiency at 0.8 p.f. (CO2)

(c) The parameters of a single phase 50 Hz, 2200/220 V transformers are as follows: 4

h.v. side: r1=0.21 Ω, x1 = 3.84 Ω, Rc = 4800 Ω, Xm = 3500 Ω

l.v. side: r2 = 0.006 Ω, x2 = 0.022 Ω.

Find the equivalent parameters referred to h.v. side.

(CO2)

(vi) The frequency of rotor current in a 6-pole, 50 Hz, 3-phase induction motor running al 950 rpm is

(a) 2.5 Hz (b) 1.5 Hz

(c) 5 Hz (d) 0.05 Hz

(vii) What will happen if the relative speed between the rotating flux of the stator and rotor of the induction motor is zero?

(a) The slip of the motor will be 5%

(b) The rotor will not run

(c) The rotor will run at a very high speed

(d) The torque produced will be very large

(viii) The V-curves of a synchronous motor show the relationship between

(a) Applied voltage and back emf

(b) Back emf and armature current

(c) Armature current and rotor field current

(d) Back emf and power factor

(ix) For full pitch coil, the pitch factor k_p is

(a) 1 (b) greater than 1

(c) less than 1 (d) none of these

(x) The one "unit" of energy measured in an AC circuit is equivalent to

(a) One watt-hour

(b) One kilowatt-hour

(c) One watt

(d) One kilowatt

2. (a) What are the main parts of a d.c machine? State the function of each part and the materials used for each part. 7 (CO1)

(b) Explain the terms critical resistance and critical speed as applied to a DC generator. 3 (CO1)

(c) A separately excited DC generator has armature circuit resistance of 0.1 Ω and a total drop at brushes is 2 V. When running at 1000 rpm, it delivers a current of 100 A at 250 V to a load of constant resistance. If the generator speed drops to 700 rpm, with the field current unaltered, find the current delivered to the load. 5 (CO1)

Total No. of printed pages = 4

EE 181302

2024

B.Tech. 3rd Semester End-Term Examination

ELECTRICAL TECHNOLOGY

Full Marks – 70 Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer question No. 1 and any *four* from the rest.

1. Answer all : 1×10

(i) Field coils of D.C. machine are usually made of

(a) Mica (b) Copper

(c) Carbon (d) Cast iron

(ii) The armature power developed by a DC motor is given by

(a) VI_a (b) $E_b I_a$

(c) $I_a R_a$ (d) all of the above

(iii) The direction of a D.C motor can be reversed

(a) By reversing the connections of both armature and field windings with supply

(b) By reversing the connections of the armature or field windings with the supply

(c) By reducing the field flux

(d) By introducing an extra resistance in the armature circuit

(iv) When the secondary load current of a 400/200 V transformer changes by 10 A, the primary current changes by

(a) 10 A (b) 20 A

(c) 5 A (d) 2.5 A

(v) The open-circuit test in a transformer is used to measure

(a) Copper loss (b) Winding loss

(c) Total loss (d) Core loss

[Turn over