

2021

B.E. (Electrical and Electronics Engineering)

Third Semester

EE-301: Electric Machinery – I

Time allowed: 3 Hours

Max. Marks: 50

NOTE: Attempt five questions in all, including Question No. 1 which is compulsory and selecting two questions from each Part. Missing data (if any) can be appropriately assumed.

x-x-x

- Q1.a.** Define the terms back pitch, Y_b and front pitch, Y_f in the armature winding. (2)
- b.** What is the meaning of terminology Dd0 and Yy0 being used in three-phase transformer? (1)
- c.** The transformer is always designed such that its efficiency is generally maximum at a load slightly lower than its full load capacity. Why? (2)
- d.** What is the function of brush and commutator arrangement in DC motor? (1)
- e.** What are the numbers of parallel paths in the armature winding of a four-pole wave connected DC machine having 22 coil-sides? (1)
- f.** Draw the torque-slip characteristics of a single-phase induction motor. (1)
- g.** Write the governing equation for speed control of a three-phase induction motor. Also write the various methods of speed control. (1+1)

Part-A

- Q2a.** A 20 KVA, 50 Hz, 2000/200 V distribution transformer has resistance, $r_1=0.42$, inductive reactance, $x_1=0.52 \Omega$ and resistance, $r_2=0.004$ ohms and inductive reactance, $x_2=0.05 \Omega$. When seen from the low voltage side, the shunt branch admittance Y_o is $0.002 - j0.015$ mho. Determine the equivalent circuit referred to a) LV side and b) HV side, indicating all the impedances on the circuit. (3+3)
- b.** Develop the expression for efficiency of a single-phase transformer and hence develop the condition for maximum efficiency. (2+2)
- Q3.a.** Discuss the various methods for neutralizing the effect of armature reaction for better commutation. (5)
- b.** A DC series motor is rated 230V, 1000 rpm, 80 A. The series field resistance is 0.11 ohms. If the flux at an armature current of 20 A is 0.4 times of that under rated condition, calculate the speed at this reduced armature current of 20 A. (5)
- Q4.a.** Draw and explain the four point starter of a DC motor. (3+2)
- b.** Make a comparison in the weight of copper required in an autotransformer and two winding transformer of the same rating. (2)

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(2)

- c. Derive the expression for voltage regulation of a single-phase transformer at lagging power factor load. (3)

Part-B

- Q5.a.** A 50 Hz split phase induction motor has an impedance of $5+j20 \Omega$ in both main and auxiliary winding. Determine the value of resistance and capacitance to be added in series with the auxiliary winding to send the same current in each winding with a phase difference of 90 degrees. (05)

- b. Explain the principle of double-revolving field theory in a single phase induction motor. (05)

- Q6.a.** Derive the expression for torque of a three-phase induction motor. And, hence, develop the torque-speed characteristics in all the operating modes of the machine. (3, 1)

- b. Derive the expression for starting torque, T_s in terms of full load torque, T_f . (2)

- c. A three-phase, squirrel cage induction motor has a starting torque of 150% and a maximum torque of 300 % with respect to rated torque at rated voltage and frequency. Neglect the stator resistance and rotational losses. What will be the value of slip for this maximum torque. (4)

- Q7.** Write short notes on any two: (5×2)

- a. Grid connected induction generator
- b. Blocked rotor test of a single-phase induction motor.

x-x-x