Seat No.: _____  Enrolment No. 

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER– III (New) EXAMINATION – WINTER 2019**

**Subject Code: 2131005** **Date: 5/12/2019**

**Subject Name: Electrical Machines**

**Time: 02:30 PM TO 05:00 PM** **Total Marks: 70**

**Instructions:**

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

| | | | MARKS |
|---|---|---|---|
| **Q.1** | **(a)** | State how the LV and HV windings are arranged in a core-type transformer. Justify the answer with reason? | **03** |
| | **(b)** | Differentiate between core and shell-type transformers | **04** |
| | **(c)** | With the help of connection diagrams explain Scott-connection of transformer in details. | **07** |
| **Q.2** | **(a)** | What is the phase relationship between the core flux; the magnetizing current and the induced emfs in the primary and secondary winding of a transformer? Draw the phasor diagram | **03** |
| | **(b)** | State and prove the condition from maximum efficiency of a transformer | **04** |
| | **(c)** | A 500 kVA transformer has an efficiency of 95% at full load and also at 60% of full load; both at upf (a) Separate out the losses of the transformer. (b) Determine the efficiency of the transformer at 3/4th full load. | **07** |
| | | OR | |
| | **(c)** | What is armature reaction in dc machines? How it affects the main flux distribution and how can armature reaction be reduced? | **07** |
| **Q.3** | **(a)** | What determines the maximum value of flux in a transformer core when it is excited from the primary side? Does the value of flux change substantially when the secondary is loaded? Explain the reason why | **03** |
| | **(b)** | Write the expression for phasor emf in a synchronous machine. Use standard symbols and explain what each symbol stands for. | **04** |
| | **(c)** | A 240V/120V, 12 kVA transformer has full-load unity pf efficiency of 96.2%. It is Connected as an auto-transformer to feed a load at 360 V. What is its rating and full-load efficiency at 0.85 pf lagging? | **07** |
| | | OR | |
| **Q.3** | **(a)** | Justify the statement that in the circuit model of a transformer in a power system, the magnetizing branch can be ignored. | **03** |
| | **(b)** | Explain sumpner's method of testing transformers. | **04** |
| | **(c)** | A 3-phase transformer bank consisting of three 1-phase transformers is used to step down the voltage of a 3-phase, 6600 V transmission line. If the primary line current is 10 A, calculate the secondary line voltage, line current and output kVA for the following connections: (a) Y/D and (b) D/Y. The turns ratio is 12. Neglect losses. | **07** |
| **Q.4** | **(a)** | Explain the terms, coil span, coil pitch, short pitching and cording of coils. | **03** |

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| | **(b)** | Define the terms critical resistance and critical speed and bring out their roles in the process of self-excitation in dc machines? | **04** |
| | **(c)** | A 3-phase, 50 Hz induction motor runs at a speed of 576 rpm at full load.<br>(a) How many poles does the motor have?<br>(b) What is its slip and frequency of rotor currents at full load? Also find rotor speed with respect to the rotating field.<br>(c) What is the motor speed at twice full-load slip?<br>(d) By what factor should the rotor resistance be increased for the motor to run at a speed of 528 rpm at full-load torque? | **07** |

OR

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| **Q.4** | **(a)** | List out conditions for synchronization of alternators. | **03** |
| | **(b)** | Explain the process of how an induction motor develops torque when ac supply is connected to its stator. Why it cannot develop torque at synchronous speed? Define slip of an induction motor. At full-load what is the range of the value of slip. | **04** |
| | **(c)** | A 3-phase, 400 kVA, 50 Hz, star-connected alternator (synchronous generator) running at 300 rpm is designed to develop 3300 V between terminals. The armature consists of 180 slots, each slot having one coil side with eight conductors. Determine the peak value of the fundamental mmf in AT/pole when the machine is delivering full-load current. | **07** |
| **Q.5** | **(a)** | Explain why a single phase single winding induction motor produces no starting torque. | **03** |
| | **(b)** | Write short note on Ferranti effect. | **04** |
| | **(c)** | The stator of a slip-ring induction motor with slip-ring terminals open-circuited has a stator excited from 3-phase source. The rotor is run by a prime mover. What will be the frequency of rotor induced emf at the following speeds?<br>(a) Half synchronous speed in the same direction as the air-gap field (AGF)<br>(b) Half synchronous speed in opposite to AGF<br>(c) At synchronous speed in opposite direction to AGF | **07** |

OR

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| **Q.5** | **(a)** | Define the term load factor, diversity factor and plant utilization factors. | **03** |
| | **(b)** | What methods are used in starting squirrel cage induction motor? Which method is used in what size of motor? Which is the most common method and what is its superiority? | **04** |
| | **(c)** | Neglecting stator impedance derive the expression for the starting torque of an induction motor. Show that it increases with rotor resistance. At what resistance value it reaches the maximum. Resistance added to the rotor of a slip-ring induction motor. | **07** |

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