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MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

III SEMESTER B. TECH (ELECTRICAL & ELECTRONICS ENGINEERING)
END SEMESTER EXAMINATIONS, DECEMBER 2022

ELCTRICAL MACHINERY-1 [ELE 2154]
REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 13 DEC 2022** **Max. Marks: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A. Consider a 100kVA, 11kV/440V, Delta-Star, Distribution transformer. Calculate the line values and per-phase values of voltages and currents in the primary and secondary sides of the transformer assuming full load unity power factor load. What is the advantage of this configuration as a distribution transformer? **(04)**

1B. Find the all-day efficiency of a 50 kVA distribution transformer with a core loss of 395 W and full load copper loss of 750 W.

During the whole day the transformer is loaded as follows:

6.00 AM - 9.00 AM	25 kW	@ 0.6 pf lagging
9.00 AM - 5.00 PM	20 kW	@ 0.8 pf lagging
5.00 PM - 11.00 PM	30 kW	@ 0.95 pf lagging
11.00 PM-6.00 AM	No-load	

(04)

1C. A 60 kVA, 11.5/2.3 kV, 50 Hz, two-winding transformer is to be employed as an autotransformer with a voltage ratio of 13.8/11.5 kV. Calculate the KVA rating of the autotransformer. **(02)**

2A. A 3-phase, 20kW, 400 V, 50 Hz, 6-pole, star-connected induction motor gave the following test results (line values):

No load test: 400 V, 10 A, 1.4 kW

Blocked rotor test: 150 V, 40 A, 4.2 kW

Find the per-phase equivalent circuit parameters of this motor.

Calculate the gross power developed at 940rpm. Assume the stator winding resistance as 2Ω/phase. **(04)**

2B. A 4-pole, 50 Hz, 3-phase induction motor, with star connected rotor, has a rotor resistance of 3.5 Ω/phase and a standstill leakage reactance of 7.5 Ω/phase. With no external resistance in the rotor circuit, the starting torque of the motor is 80 N-m. Calculate the gross torque developed at a slip of 2.5 %.

If 2 Ω resistance were added in each rotor phase, calculate the starting torque. Comment on the change in torque **(04)**

2C. Can the alternators in a 200MVA power plant be replaced with induction generators? Justify your answer **(02)**

3A. Draw and explain the typical torque-slip characteristics of a three-phase squirrel cage induction motor. On the characteristics, indicate the starting torque & maximum torque, and highlight the steady state operating region in the motoring mode. **(03)**

3B. A 3-phase, 50 Hz, 6 pole star connected induction motor on full-load develops a useful torque of 280Nm. If the rotor EMF makes 100 alternations per minute and torque lost in friction is 50 Nm, determine (a) the net power output (b) Power lost due to friction and windage (c) the gross power output (d) rotor copper loss (e) total power input (f) efficiency. Assume stator losses to be 2kW. Also draw the power flow diagram. **(04)**

3C. A three-phase induction motor running at 4% slip develops 17 kW of power. Calculate the rotor copper loss and power input to the rotor as a percentage of developed power. Does rotor copper loss depend on the speed of the rotor? Justify your answer. **(03)**

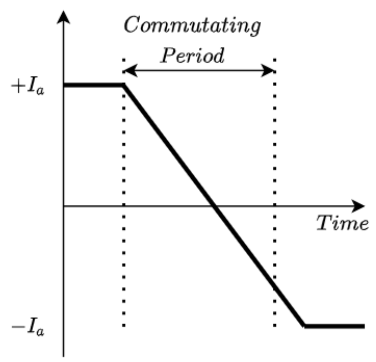
4A. A single-phase induction motor used in a ceiling fan has a 20 microfarad capacitor connected in one of its windings. The capacitor is removed before turning ON the fan. When the supply to the fan is switched ON, will the ceiling fan start/rotate? Justify your answer with necessary diagrams and explanations **(03)**

4B. Is it possible to construct a three-phase squirrel cage induction motor with higher starting torque capability than conventional squirrel cage construction? Justify your answer with the help of the necessary schematic diagrams and explanations. **(04)**

4C. A DC shunt generator supplies a 20 kW load at 200 V through cables of resistance R=100 mΩ. If the field winding resistance is 50Ω and the armature resistance equals 40 mΩ, determine the (a) e.m.f. generated in the armature (b) power developed and (c) copper losses in the windings **(03)**

5A. "Armature reaction has effects on the generated voltage in a DC generator." Justify the statement with necessary schematic diagrams and explanations. **(04)**

5B. The current through the commutating coil in a DC shunt generator is as shown in the figure. Comment on the nature of commutation. Can this be rectified? Justify your answer.



(04)

5C. A self-excited DC generator has zero residual flux in its poles. If the armature is rotated at 1500 rpm, will the generator develop rated voltage at its terminals? Is 'yes' how? If 'no' why? **(02)**