International Islamic University Chittagong
Department of Electrical and Electronic Engineering
B. Sc. Engineering in EEE

Midterm Examination, Spring 2024

Course Code: **EEE 2401** Course Title: **Electrical Machines II**
Time: 1 hour 30 minutes Full Marks: 30

(i) Answer all the questions. The figures in the right-hand margin indicate full marks.
(ii) Course Outcomes (COs) and Bloom's Levels are mentioned in additional Columns.

CO	CO Statements
CO1	Understand and mastery of the basic operations of different types of DC, AC motors and special machines.
CO2	Knowledge of machine control and electrical drives and their applications.
CO3	Ability to calculate and design electrical machines.

Bloom's Levels of the Questions						
Letter Symbols	C1	C2	C3	C4	C5	C6
Meaning	Remember	Understand	Apply	Analyze	Evaluate	Create

1)	a)	Find the relationship between torque and rotor power factor with a suitable diagram. Consider both inductive and non-inductive cases. Also, explain the torque/speed characteristics of a 3-phase induction motor.	CO1	C2	5
1)	b)	A 3-phase, slip-ring, induction motor with star-connected rotor has an induced e.m.f of 120 volts between slip-rings at standstill with normal voltage applied to the stator. The rotor winding has a resistance per phase of 0.3 ohm and standstill leakage per phase of 1.5 ohm. Calculate: (i) Rotor current/phase when running short-circuited with 4% slip and (ii) The slip and rotor current per phase when the rotor is developing maximum torque.	CO3	C5	5
		OR			
1)	a)	Derive the equation of Starting Torque. Also derive the condition for maximum Starting Torque.	CO1	C2	5
1)	b)	The power input to the rotor of a 440 V, 50-Hz, 6-pole, 3-phase Induction Motor is 100 kW. The rotor induced emf is observed to make 120 cycles per minute. Calculate i) the slip ii) the rotor speed iii) mechanical power developed iv) the rotor copper loss per phase, v) speed of stator field with respect to rotor.	CO3	C5	5
2)	a)	Describe why starters are necessary for starting 3-phase induction motors. Describe the Star-Delta Starter procedure for controlling the starting current of an induction motor.	CO2	C4	5
2)	b)	A100-KW, 3300V, 50Hz, 3-phase, star connected induction motor has a synchronous speed of 500r.p.m. the full load slip is 1.8% and F.L. power factor 0.85. Stator copper loss = 2400W, Iron loss = 3500W. Rotational losses = 1200W. Calculate: i) rotor copper loss, ii) line current, iii) full-load efficiency.	CO3	C5	5
3)	a)	By using the Double Field Revolving theory explain why the rotor of a single-phase Induction motor rotates if the rotor is given an initial start by any means in either direction?	CO2	C3	5
3)	b)	With proper sketch justify the need for a resistance or a capacitor with the starting winding of a single-phase Induction Motor. Also plot the torque versus speed curve for these two cases.	CO2	C4	5