International Islamic University Chittagong

Department of Electrical and Electronic Engineering

B.Sc. Engineering in EEE

Final Exam, Autumn 2021

Course Code: **EEE 2401** Course Title: **Electrical Machine II**

Time: 2 hours 30 minutes Full Marks: 50

(i) The figures in the right-hand margin indicate full marks

(ii) Course Outcomes and Bloom's Levels are mentioned in additional Columns

Course Outcomes (COs) of the Questions	
CO1	Understand and mastery of the basic concepts of 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	**R**	**U**	**App**	**An**	**E**	**C**
Meaning	Remember	Understand	Apply	Analyze	Evaluate	Create

Part A

[Answer the questions from the followings]

1.	a)	For constant normal excitation, discuss the effect of increased load in a synchronous motor.	CO2	An	4
1.	b)	i. Represent the different power stages of a synchronous motor in a block diagram.	CO2	E	2
		ii. Draw the equivalent circuit of a synchronous motor.		Ap	2
		iii. Mention few features of a synchronous motor which are different from that of an induction motor.		An	2
2.	a)	Why parallel operation of the Alternators is needed in our power system? Explain separately what will happen if you do not follow the conditions for parallel operation?	CO2	An	5
2.	b)	A 70-KVA, 440-V, 50 Hz, star connected, 3-phase Alternator has the effective armature resistance 0.24 ohm per phase. The leakage reactance is 0.51 ohm per phase. A field current of 30A gives the full load current of 150A on short circuit condition, and open-circuit e.m.f. of 1200V on open circuit condition. Considering unity power factor at rated load, calculate: (a) Internal e.m.f. Ea (b) No load e.m.f. E0 (c) Percentage regulation on full load (d) Value of synchronous reactance which replaces armature reaction.	CO3	C	5

Or

2.	a)	Derive the equations to calculate the 'average emf per conductor' and the 'rms value of emf per phase'. Why it is important to consider the design factors in order to calculate the actual rms value of emf per phase?	CO2	An	5
2.	b)	A 100-kVA, 3000 V, 50 Hz, 3-phase star-connected Alternator has effective armature resistance of 0.2 ohm. The field current of 40 A produces short-circuit current of 200 A and an open-circuit emf of 1040 V (line value). Calculate the full-load voltage regulation at 0.8 p.f. lagging and 0.8 p.f. leading. Draw phasor diagrams.	CO3	C	5

Part B

[Answer the questions from the followings]

3.	a)	What is a universal motor? With proper diagram, explain various methods for speed control of universal motor.	CO1	R, An	1+3
3.	b)	i. What are the problems of the conventional brushes of DC motors? What are the advantages of brushless DC motor? ii. Mention some applications of permanent magnet DC motor. How can a universal motor be reversed?	CO1	An, R R, An	3+3
4.	a)	Explain how torque transmission works in Synchros.	CO1	Un	4
4.	b)	What is magnetic levitation? How can we achieve magnetic levitation from Linear Induction Motor?	CO2	R/An	2+4
5.	a)	Explain the 2-phase ON mode operation of the Variable Reluctance Stepper Motor	CO1	Ap	4
5.	b)	What are advantages of permanent magnet DC (PMDC) motors over the typical DC motors? How can you control the speed of PMDC motor?	CO2	Un/An	3+3
		Or			
5.	a)	Explain the half-step operation mode of the Variable Reluctance Stepper Motor.	CO1	An	4
5.	b)	Compare the 1-phase ON mode operation of the Variable Reluctance Stepper Motor with the 2-phase ON mode operation	CO2	E	6