International Islamic University Chittagong
Department of Electrical and Electronic Engineering

Final Examination, Autumn-2022
Course Code: EEE 2303
Time: 2 hours 30 minutes

Program: B.Sc. Engg. (EEE)
Course Title: Electrical Machine I
Full Marks: 50

(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.

S/N	Course Outcomes (COs):
CO1	Reflect a basic understanding of Transformer.
CO2	Develop the idea regarding the electrical equivalent circuit of different machines and will be able to solve related mathematical problems.
CO3	Demonstrate basic proficiency in building transformers and operating motors and generators.

Bloom's Levels of the Questions						
Letter Symbols	R	U	Ap	An	E	C
Meaning	Remember	Understand	Apply	Analyze	Evaluate	Create

Part A

[Answer the questions from the followings]

1(a). Derive the E.M.F. equation of a DC generator. **CO1 An 05**

1(b). A long-shunt compound generator delivers a load current of 100A at 500 volt and has armature, series field and shunt field resistances of 0.2Ω, 0.1Ω and 400 Ω respectively. Calculate the generated voltage and armature current. Allow 4V brush contact drop. **CO3 E 05**

2(a). Briefly describe the losses in a DC generator. **CO2 R 5**

2(b). The open circuit characteristics of a dc shunt generator driven at rated speed is as follow: **CO3 E 5**

Field Amperes:	0.5	1.0	1.5	2.0	2.5	3.0	3.5	3.5
Induced Voltage:	60	120	138	145	149	151	152	152

If the resistance of the field circuit is adjusted to 53 Ω, calculate the open circuit voltage and load current when the terminal voltage is 100V. Neglect armature reaction and assume an armature resistance of 0.1 Ω

OR

2(a). Classify dc generator and draw the circuit diagram of each type. **CO2 An 5**

2(b). A long shunt dc generator running at 1500 r.p.m. supplies 20kW at a terminal voltage of 380V. The resistances of armature, shunt field and series field are 0.15Ω, 150Ω and 0.1Ω respectively. The overall efficiency at the above load is 90%. **CO3 An 5**
Find (a) Cu losses and (b) iron & friction losses.

Part B

[Answer the questions from the followings]

3(a). Proof that $\mathbf{T_a \propto I_a}$ for shunt motor; where T_a is armature torque and I_a is armature current. **CO2 An 4**

3(b). (i) Explain the relationship between torque, speed and armature current of a DC series motor from its characteristics curves. **CO1 U 6**

(ii) A dc motor takes an armature current of 110A at 480V. The armature circuit resistance is 0.2 Ω. The machine has 6 poles and the armature is lap connected with 864 conductors. The flux per pole is 0.05Wb. Calculate the speed of the rotor in rpm. **CO3 E**

4(a).	Explain the production of rotating magnetic field in case of two phase supply in an induction motor.	**CO2**	**An**	**5**
4(b).	A 4-pole 3-phase induction motor operates from a supply whose frequency is 50 Hz. Calculate (i) synchronous speed of the rotor, (ii) actual speed of the rotor when slip is 0.05, (iii) frequency of the rotor current when speed is 600rpm.	**CO3**	**Ap**	**5**
5(a).	Draw the equivalent circuit of an induction motor.	**CO2**	**An**	**5**
5(b).	Show that the no load tests of induction motor is analogous to the open circuit test of transformer and the block rotor test is equivalent of short circuit test.	**CO3**	**Ap**	**5**

OR

5(a).	What is the significance of back emf in a dc motor?	**CO2**	**An**	**5**
5(b).	Write down the advantages and disadvantages of an induction motor? What is the rotation principle of an induction motor?	**CO2**	**An**	**5**