



Daffodil International University
Department of Electrical and Electronic Engineering
Faculty of Engineering
Final-Term Examination, Summer – 2026

Course Code: **0713-213**

Section: **A/B/C/D/E/F/G**

Full Marks: **40**

Course Title: **Energy Conversion I**

Level-Term: **L2-T1**

Exam Date: **August 19, 2026**

Teacher's Initial: **DRA / PA/ RS**

Time: **2.0 Hours**

Attempt to Answer all 4 Questions

- Q1. a) Explain the production of a rotating magnetic field in a two-phase supply using vector diagram of flux. [4]**
- b) The rotor resistance and reactance per phase of a 4-pole, 50-Hz, 3-phase induction motor are 0.025Ω and 0.12Ω , respectively. The full-load slip is 5%. Find the additional rotor resistance per phase that must be inserted so that the starting torque is equal to one-half of the full-load torque. [4]**
- Q2. a) Prove the condition for maximum full-load torque and hence determine the maximum full-load torque. CO-2 [3]
C(2)**
- b) A 746-kW, 3-phase, 50-Hz, 16-pole induction motor has a rotor impedance of $(0.02 + j0.15) \Omega$ at standstill. The full-load torque is obtained at 360 rpm. Calculate: CO-2 [6]
C(4)**
- i. The ratio of maximum torque to full-load torque.
 - ii. The speed at maximum torque.
 - iii. The rotor resistance to be added to obtain maximum starting torque.
- Q3. a) Show the condition for maximum efficiency of a transformer and determine the output current at which maximum efficiency occurs. CO-2 [3]
C(2)**
- b) A 50-kVA, 2200/220-V, single-phase transformer has a full-load copper loss of 800 W and an iron (core) loss of 500 W. The transformer operates at a power factor of 0.8 lagging. Calculate: CO-2 [6]
C(4)**
- i. The output current at which maximum efficiency occurs.
 - ii. The maximum efficiency of the transformer at 0.8 power factor.
 - iii. The efficiency of the transformer at half-load and 0.8 power factor.

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Q4. Answer any 2 (Two) from the following 4 questions:

- a) A 220-V, 3-phase, 4-pole, 50-Hz, Y-connected induction motor is rated 3.73 kW. The equivalent circuit parameters are: $R_1 = 0.5 \Omega$; $X_1 = 0.9 \Omega$; $R'_2 = 0.8 \Omega$; $X'_2 = 1.25 \Omega$; $X_m = 30 \Omega$. The stator core loss is 50 W and rotational loss is 150 W. For a slip of 0.04, find: (i) Input current, (ii) Power factor, (iii) Air-gap power, (iv) Mechanical power, (v) Output power, and (vi) Efficiency. CO-3 [7] C(5)
- b) A 3-phase, 400-V, Y-connected induction motor has an equivalent T-circuit consisting of: $R_1 = 1 \Omega$, $X_1 = 2 \Omega$. Equivalent rotor values: $R'_2 = 1.2 \Omega$, $X'_2 = 1.5 \Omega$. The exciting branch has an impedance of $(4 + j40) \Omega$. Assume friction loss to be 250 W. If the slip is 5%, find: (i) Input current, (ii) Power factor, (iii) Output power, and (iv) Efficiency. CO-3 [7] C(5)
- c) Two 100-kW transformers each have a maximum efficiency of 98%, but in one transformer the maximum efficiency occurs at full-load, while in the other it occurs at half-load. Each transformer is on full-load for 4 hours, on half-load for 6 hours, and on one-tenth load for 14 hours per day. Determine the all-day efficiency of each transformer. CO-3 [7] C(5)
- d) A 5 kVA, 220/400-V, single-phase transformer has equivalent resistance and reactance referred to LV side equal to 1.0Ω and 1.5Ω respectively. Find the terminal voltage on the HV side when it supplies $3/4$ th full-load at power factor of 0.8, the supply voltage being 220V. Hence, find the output of the transformer and its efficiency if the core losses are 130 W. CO-3 [7] C(5)