

14

B.Sc. in EEE, 6th Semester

May 9, 2023

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination
Course No.: EEE 4625
Course Title: Utilization of Electrical Energy

Summer Semester, A. Y. 2021-2022
Time: 3 Hours
Full Marks: 150

There are 6 (six) questions. Answer all 6 (six) questions. The symbols have their usual meanings. Programmable calculators are not allowed. Marks of each question and corresponding COs and POs are written in the brackets.

-
1. a) Briefly discuss about power factor tariff. 05
(CO1,
PO1)
- b) A power plant has a rated capacity of 402 MW and peak load on the plant is 351 MW. Certain consumer groups having maximum demands of 120 MW, 103 MW, 79 MW and 92 MW are connected to the plant. If annual load factor is 0.81, find 10
(CO3,
PO3)
- i. Average load
 - ii. Capacity factor
 - iii. Energy per year
 - iv. Demand factor
 - v. Diversity factor
- c) The yearly load duration curve of a certain power station can be approximated as a straight line. The maximum and minimum loads being 80 MW and 40 MW respectively. To meet this load, three turbine generator units, two rated at 20 MW each and one at 10 MW are installed. Determine 10
(CO3,
PO3)
- i. Installed capacity
 - ii. Plant factor
 - iii. KWh output per year
 - iv. Load factor
2. a) Write down the differences between dielectric heating and induction heating. 06
(CO1,
PO1)
- b) Sketch the basic arrangement of dielectric high frequency electronic heater and provide a brief explanation of its design and function. 07
(CO1,
PO1)
- c) Determine the loss factor and voltage necessary for dielectric heating of an insulating material with a relative permittivity of 5, a power factor of 0.05, and dimensions of 150 sq.cm area and 1 cm thickness, at a frequency of 30 MHz and with a power input of 400W. Make use of $\epsilon_0 = 8.854 \times 10^{-12} F/m$ in your calculations. 12
(CO3,
PO3)
3. a) Explain different types of power factor improvement equipment and describe how they work to correct power factor and reduce reactive power losses with proper phasor diagram. 12
(CO1,
PO1)

- b) A three phase 5 KW induction motor connected to a 220V, 60Hz supply has a p.f. of 0.75 lagging. A bank of capacitors is connected in delta across supply terminals and p.f. raised to 0.95 lagging. The induction motor costs 75,000 BDT and has a useful life of 30 years. The salvage value is 15,000 BDT and annual compound interest rate is 7%. From the given information stated above, 13
(CO3,
PO3)
- i. Determine the leading KVAR supplied by the capacitor bank.
 - ii. Calculate the value of the capacitance.
 - iii. Determine the value of the transformer at the end of 10 years using sinking fund method.
4. a) Write about the key properties of refrigerants and their impact on the performance and efficiency of refrigeration systems. Give examples of different refrigerants and describe their unique properties in relation to their application in refrigeration systems. 10
(CO2,
PO2)
- b) Explain how a vapor compression refrigeration system works and discuss the four main components involved in this process. Sketch the block diagram of the system as a part of your explanation. 15
(CO1,
PO1)
5. a) Sketch the block diagram of an electric drive system and explain the function of each component involved. 10
(CO1,
PO1)
- b) Explain the speed-torque relationship in each of the four quadrants of a multi-quadrant electric drive system used in hoist operations. Provide examples of load conditions, motoring and braking modes and corresponding speed-torque relationships for each quadrant. 15
(CO1,
PO1)
6. a) Briefly describe the commonly used tariff set by the electricity supply companies. 07
(CO1,
PO1)
- b) Formulate that the most economical power factor ($\cos\phi_2$) depends upon the relative costs of supply and p.f. correction equipment but is independent of the original p.f. ($\cos\phi_1$). 08
(CO2,
PO2)
- c) A motor has following duty cycle 10
(CO3,
PO3)

Load rising from 200 to 400 H.P.	-	4 min
Uniform load 300 H.P.	-	2 min
Regenerative braking- H.P. returned to supply from 50 to zero	-	1 min
Remaining idle for	-	1 min

Determine suitable H.P. rating of the motor.