UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2017/2018

COURSE NAME : INDUSTRIAL POWER SYSTEM

COURSE CODE : BNE 41003

PROGRAMME CODE : BNE

EXAMINATION DATE : JUNE / JULY 2018

DURATION : 3 HOURS

INSTRUCTION : ANSWER ALL QUESTIONS

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THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES

Q1 (a) Power system plays an important role in a plant operation, where production are depend on a safe and reliable power system.

    (i) Identify **FIVE (5)** of the consideration that should be taken to ensure the reliability of distribution system in the system planning and design stage.

(5 marks)

    (ii) Based on the IEEE Gold Book [S8] which provides guidelines for the design of reliable power systems, summarize any **THREE (3)** of key steps to increase the reliability of plant distribution system.

(6 marks)

  (b) Distribution systems commonly used in industrial system plants are simple radial system, expanded radial scheme, primary selective arrangement, secondary selective arrangement and sparing transformer scheme. Sketch and discuss the following distribution system.

    (i) Simple Radial System

(4 marks)

    (ii) Expanded radial Scheme

(5 Marks)

Q2 (a) Outline **TWO (2)** advantages of load characteristic in power system.

(4 marks)

  (b) With the aid of diagram, evaluate the differences between load curve and load duration curve.

(6 marks)

  (c) A residential consumer has a connected of 6 lamps each of 100 W and 4 fans of 60 W at his premises. His demand are as follows:

From 12 am to 7 am	: 120 W
From 7 am to 6 pm	: No load
From 6 pm to 7 pm	: 380 W
From 7 pm to 9 pm	: 680 W
From 9 pm to 12 am	: 420 W

    (i) Based on the given demand above, construct the load curve.

(3 marks)

    (ii) Determine the total energy consumption in 24 hours.

(3 marks)

    (iii) Estimate the maximum load, average load and load factor.

(4 marks)

Q3 (a) Assess why the usage of High Efficiency Motors (HEMs) is now a trend in industries motor impelementation.

(4 marks)

(b) Referring to **Figure Q3(b)**, outline any **TWO (2)** components that may improve the efficiency of an AC induction motor.

(2 marks)

(c) A DC compound motor having a rating of 10 kW, 1150 rev/min, 230 V, 50 A, has the following losses:

At no load:
Bearing friction loss = 40W
Brush friction loss = 50W
Windage loss = 200W
Iron loss = 420W
Copper loss in the shunt field = 120W
At full load:
Copper loss in the armature = 500W
Copper loss in the series field = 25W
Copper loss in commutating winding = 70W

(i) Determine the power losses and the efficiency at 25%, 50%, 75%, 100% and 150% of nominal rating of the machine.

(10 marks)

(ii) Illustrate a graph showing efficiency as a function of mechanical load (neglect the losses due to the brush contact)

(4 marks)

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Q4 (a) State **TWO (2)** industrial equipment that should be protected by overload protection scheme.

(2 marks)

(b) Based on the answer in **Q4(a)**, propose **TWO (2)** protective device for each of the mentioned equiment and outline its function.

(4 marks)

(c) The function of protective relay is to promptly remove from service any element of the power system that starts to operate in an abnormal manner. In general, relay do not prevent damage to equipment, but their purpose to limit and to remove the faulted equipment from the power system as quickly as possible to that integrity and stability of the remaining system are maintained.

(i) Evaluate design criterion of protective relaying.

(10 marks)

(ii) Modern digital protection relay is now a very popular tool in protection system compared to the traditional electromechanical relay. Justify this statement.

(4 marks)

Q5 (a) Power supply for monitoring and control systems shall be reliable, unaffected by voltage dip or sag and transients and shall meet the requirement of load characteristic including voltage , frequency and harmonics. Thus, uninterruptible power supply (UPS) is required.

(i) With the aid of diagram, propose the non-redundant UPS system and explain the system throughly.

(6 marks)

(ii) Evaluate the differences between redundant UPS and non-redundant UPS.

(4 marks)

(b) Low Voltage Switchboard (LVSB) system is a key part of any industrial electrical installation. It incorporates devices designed to distribute electrical power and protect the circuit at the same time. Briefly discuss components that works to protect LVSB and load.

(5 marks)

(c) Recent development in the control and monitoring function of low voltage switchboard have made the LVSB even more vital to installation. The dependability of the entire installation is largely determined by the dependability of the switchboard. Justify the meaning of *dependability* in the LVSB electrical distribution.

(5 marks)

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- END OF QUESTIONS -
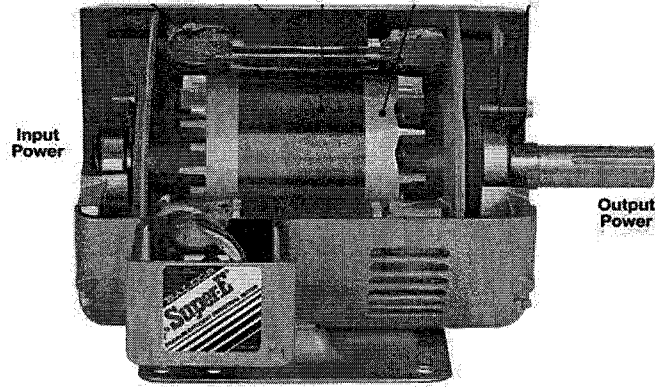
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Figure Q3(b)

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