National Examinations December 2019

16-Elec-B8, Power Electronics and Drives

3 hours duration

NOTES

1. **FIVE (5)** questions constitute a complete exam paper. All questions are of equal value.

2 Neatness is important. Start each question on a new page, and clearly indicate the question number. Only work written on the right-hand pages of the answer booklets will be marked. Use the pages on the left side for rough work only - ***work presented on the left hand side pages will NOT be marked***.

3. You may use one of the approved Casio or Sharp calculators.

4. This is a closed book exam but one aid sheet (8 ½″ by 11″) is allowed written on both sides. **No worked-out solutions or diagrams are allowed on this sheet.**

5. All ac voltages and currents are rms values unless noted otherwise. For three-phase circuits, all voltages are line-to-line voltages unless noted otherwise, and power is total real power unless noted otherwise.

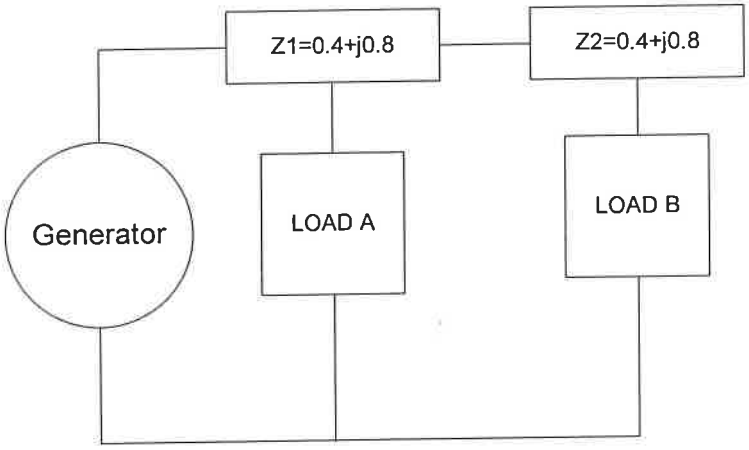
6. You are strongly encouraged to use a pencil and eraser for this exam.

If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper a clear statement of any assumptions made.

Question 1

The schematic diagram of a generator supplying two loads over a distribution system is shown below. Load A draws 8kW at a leading power factor of 0.8, while load B draws 10kW at a power factor of 0.6 lagging. The terminal voltage at load B is 215V.
Determine:

(a) The terminal voltage at load A; and
(b) The apparent power, p.f. and the terminal voltage of the generator.



Schematic Diagram for Question (1)

Question 2

A 3 phase, 3 wire system of 208V supplies an electrical heating unit of 1500W (unity power factor) and a 5 hp induction motor with an efficiency of 87% and pf of 0.85 lagging at full load. Determine the line current if the motor is operating at rated output power of 5hp.

Question 3

Briefly explain the following:

(a) What are the different operation regions of the SCR/thyristor?
(b) What is latching current?
(c) What is holding current?
(d) Why is the thyristor considered a charge-controlled device?
(e) What are the advantages of speed control using thyristor?

Question 4

A single phase, 220V (rms), 60Hz source supplies a full wave ac voltage controller. The controller powers a 20hp motor whose power factor is 20 degrees. The corresponding angle 160 degrees.

a. Verify that the delay angle is 40 degrees.
b. Find the effective (rms) output voltage of the controller.
c. Assume that the efficiency of the motor is 0.87; find the average current through each of the thyristors and the controller.

Question 5

The voltage to a basic chopper circuit is V=24V and the maximum allowed current is 20amps. The load consists of a series combination of R and an inductance with time constant τ.

Complete the entries in the following table.

Case	Chopper period (τ) ms	On-time (T_{on}) ms	Time constant τ (ms)	Load Resistance R (Ω)
1	2.4	1.8	1.5	?
2	?	2.4	1.45	1.25
3	1.8	?	1.5	0.9