MACHAKOS UNIVERSITY

University Examinations for 2019/2020Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

THIRD YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONICS ENGINEERING

EEE 308 POWER SYSTEMS 1

DATE: 27/11/2020 **TIME: 8.30-10.30 AM**

INSTRUCTIONS

Answer Question One and Any Other Two Questions

QUESTION ONE (30 MARKS)

a) A distribution system generally consists of feeders, distributors and the service mains. Differentiate the three. (6 marks)

b) What are the key elements of a conventional power system? (4 marks)

c) *A Y-connected balanced three*-phase source has a voltage of $V_{an} = 120 \angle 40°V$. Compute the line-to-line voltage of the transmission line (6 marks)

d) A 12 kVA transformer has a voltage ratio of 13.8 kV(Y)/416 V(Y). Compute the following:

i. Ratio of the phase voltages

ii. Turns ratio

iii. Rated current of the primary and secondary winding (6 marks)

e) Using a simple generalised diagram, explain how power is obtained from the different sources of energy. (4 marks)

f) A commercial load is connected to the grid through a demand meter. The meter shows a load of 1,000 kW and 450 kvar of reactive power. Calculate the power factor and apparent power (S) of the load (4 marks)

QUESTION TWO (20 MARKS)

a) The voltage of a three-phase, Y-connected source is V_{an} = 120∠ - 40°V The source is energizing a three-phase load connected in delta The load impedance is Z = 10∠ - 30°Ω Compute: a) the currents of the load and b) transmission line currents (10 marks)

b) A transformer has 4000 turns in the primary winding and 100 turns in the secondary winding.

i) If 120 V is applied to the primary winding, compute the voltage across the secondary winding and the voltage per turn for the transformer

ii) If the load of a transformer is 3 VA, compute the reflected impedance of the load as seen from the primary winding (8 marks)

c) Define power factor. (2 marks)

QUESTION THREE (20 MARKS)

a) A (medium) single phase transmission line 100 km long has the following constants:
Resistance/km = 0·25 Ω; Reactance/km = 0·8 Ω
Susceptance/km = 14 × 10−6 siemen; Receiving end line voltage = 66,000 V
Assuming that the total capacitance of the line is localised at the receiving end alone, determine (i) the sending end current (ii) the sending end voltage (iii) regulation and (iv) supply power factor.
The line is delivering 15,000 kW at 0.8 power factor lagging. Draw the phasor diagram to illustrate your calculations. (15 marks)

b) List 5 disadvantages of a low power factor (5 marks)

QUESTION FOUR (20 MARKS)

a) Assume that the source voltage in Figure 1 is *Van* □□□□□∠□□° V, the load impedance of the wye load is *Z*1 □□□□∠□□□°Ω, and the load impedance of the delta load is *Z*2 □□□□∠□□□□□°Ω Compute the transmission line currents at the source (7 marks)

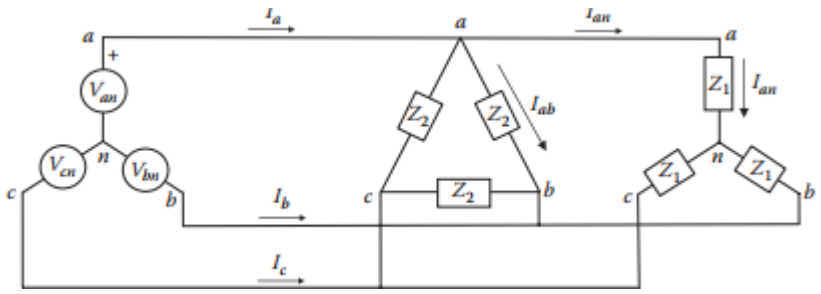

Figure 1

b) A Y-connected three-phase source of V_{an} = 120∠ 0°V is powering a delta-connected load of Z = 15∠ 20° Ω. Compute the real and reactive power consumed by the load (7 marks)

c) what are the advantages of three-phase system over the single-phase system? (6 marks)

QUESTION FIVE (20 MARKS)

a) A 25-kVA transformer has a voltage ratio of 20 kV(Y)/10 kV(Δ). Compute the following:

i. Winding voltages

ii. Turns ratio

iii. Line currents in the primary and secondary circuits

iv. Phase currents of the transformer (7 marks)

b) Differentiate star and delta load connections (8 marks)

c) A three-phase source of *Van* □□□□□∠ 0□V delivers 10 kW and 5 kVAr to a wye-connected load. Compute the load impedance

(5 marks)