



KENYATTA UNIVERSITY
UNIVERSITY EXAMINATIONS 2011/2012
SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF
SCIENCE IN ELECTRICAL AND ELECTRONICS ENGINEERING

EEE 303: POWER SYSTEMS I

DATE: Thursday 12th April, 2012

TIME: 11.00 a.m. – 1.00 p.m.

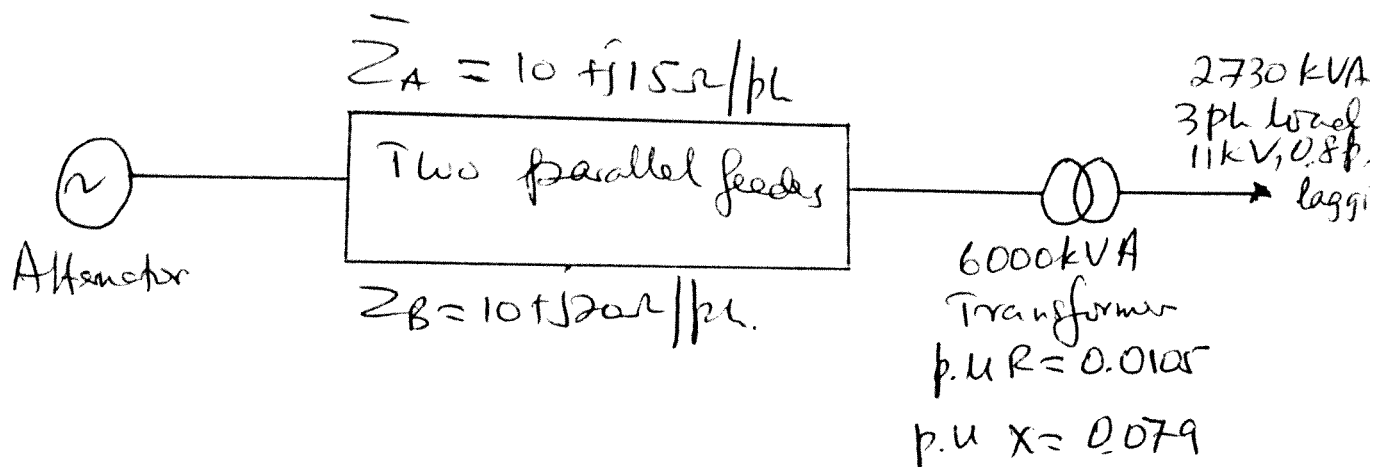
Q1

- (a)
- (i) Describe the main source of electrical energy. (4 marks)
 - (ii) Explain the basic principles of force production in electromechanical energy conversion systems. (2 marks)
- (b)
- (i) Explain why it is necessary to use high voltage in order to transmit electrical energy economically over long distances. (2 marks)
 - (ii) A two-conductor, single-phase, short line has a total resistance of 0.4Ω and a total inductive reactance of 0.15Ω . The line supplies a load of 100A at 400V and 0.8pf lagging. Calculate the sending end, voltage per unit regulation and the transmission efficiency. (3 marks)
- (c) Discuss the advantages and disadvantages of high voltage direct current transmission compared with high voltage three-phase transmission. (4 marks)
- (d)
- (i) Explain the principle of operation of a transformer. (3 marks)
 - (ii) A three-phase transformer has 630 turns on the primary winding and 54 turns on the secondary winding. The supply voltage is 4950 volts. Calculate the secondary line voltage on no-load when the windings are connected in star/delta. (4 marks)
- (e)
- (i) Derive the expression for the most economical c.s.a to transmit a three-phase balanced load. (4 marks)
 - (iii) Explain how the maximum demand in a power system may be reduced. (4 marks)

Q2

- (a) Explain how synchronous generators are operated in an infinite bus bar system in a power system. (8 marks)
- (b) For the system shown in fig. Q 2(b) calculate
- Alternator terminal voltage
 - Current in each feeder
- (12 marks)

Fig. Q2 (b)



Q3

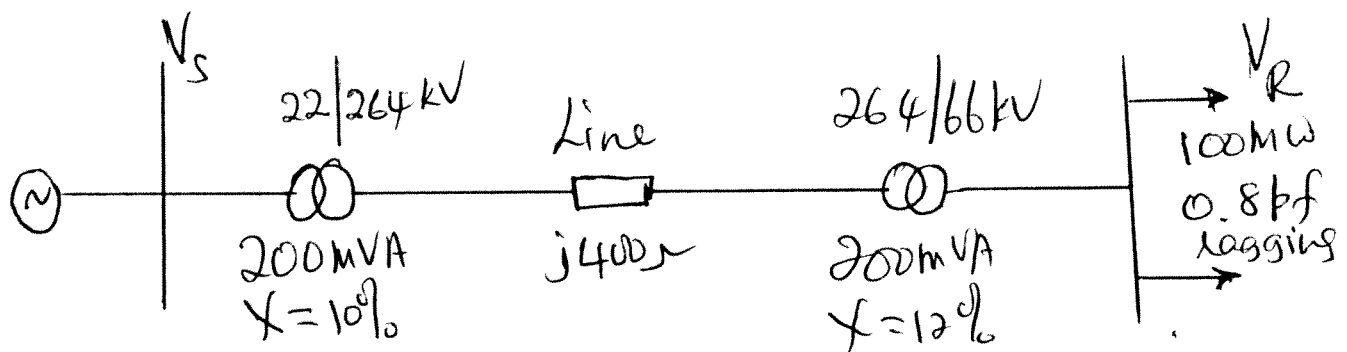
- (a)
- Explain the voltage regulation of a transformer. (2 marks)
 - Describe the test which should be conducted for energy losses in a transformer to be determined and explain how the efficiency can be determined from the tests. (4 marks)
- (b) A 200 KVA transformer has 800 turns on the primary and 160 turns on the secondary. The primary and secondary resistances are 0.6Ω and 0.02Ω respectively. The corresponding leakage resistances are 2.2Ω and 0.07Ω respectively. The supply voltage is 4400v. calculate
- Equivalent impedance referred to the primary circuit. (4 marks)

- (ii) Voltage regulation and secondary voltage for the full load having a power factor of 0.8 lagging. (6 marks)
- (iii) Per-unit, the % resistance and % leakage reactance drops of the transformer. (4 marks)

Q4

- (a)
 - (i) Describe the components of the power system. Briefly explain why different line voltages are used in various parts of the system and indicate typical values for the Kenya Power System Network. (8 marks)
 - (ii) A three-phase schematic diagram of a radial transmission system is shown in Fig.Q5. A load of 100MW at 0.8 pf lagging is taken from a 66kV substation which is to be maintained at 60kV. Calculate the terminal voltage of the synchronous machine. (12 marks)

Fig. Q5



Q5

- (i) Explain how the synchronous motor can be used to improve the power factor of a plant. (8 marks)
- (ii) A load of 360kW at 0.8 power factor lagging is supplied from a substation transformer. Calculate the KV Ar rating of the loss-free static capacitors for constant kW correction and the KVA rating of synchronous motor required for constant kVA correction to 0.95 lagging. (12 marks)

