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UNIVERSITY EXAMINATIONS 2024/2025

FOURTH YEAR, FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF EDUCATION TECHNOLOGY IN ELECTRICAL AND ELECTRONIC ENGINEERING

EET 3413: POWER SYSTEMS II

DATE: JANUARY 2025 **TIME: 2 HOURS**

INSTRUCTIONS: Answer Question ONE and any other TWO questions.

QUESTION ONE (30 MARKS)

(a) Discuss any four advantages of a three phase over a single-phase power supply system. [4 Marks]

(b) Outline three causes of low power factor and three disadvantages of low power factor in electrical power system networks. [6 Marks]

(c) A power station has the following daily load cycle: Plot the load curve and load duration curve. Also calculate (i) the energy generated per day, (ii) load factor. [7 Marks]

Time (Hours)	0-6	6-10	10-12	12-16	16-20	20-24
Load (MW)	40	50	60	50	70	40

(d) Each phase of a star-connected load consists of a non-reactive resistance of 100Ω in parallel with a capacitance of 31.8 μF. Draw the circuit and calculate the line current, the power absorbed, the total kVA and power factor when connected to a 416 V, 3-phase, 50 Hz supply. [7 Marks]

(e) An existing 400kV, 3-phase AC line transmitting a power of 1000MW is converted to bipolar DC line. Estimate the DC voltage/pole and DC line losses, if the resistance of each conductor is 0.01Ω. Assume p.f. = 0.90. [6 Marks]

QUESTION TWO (15 MARKS)

(a) Outline any three factors that are considered when deciding on the tariff structure. [3 Marks]

(b) A bipolar two terminal HVDC link is delivering 1000MW at ±500kV at the receiving end. The total losses in the DC circuit are 50 MW. Calculate the following:

i. Sending end voltage.

ii. Voltage in the middle of the line.

[5 Marks]

(c) A single-phase motor operating at 400V, 50 Hz draws 31.7A at a power factor of 0.7 lagging. Draw the circuit, phasor diagram and calculate the capacitance required in parallel to raise the power factor to 0.9 lagging. [7 Marks]

QUESTION THREE (15 MARKS)

(a) Outline any four advantages of high voltage DC transmission over AC transmission. [4 Marks]

(b) With aid of a clearly labelled diagram, explain the Bipolar HVDC direct link. [5 Marks]

(c) In the circuit shown in Fig. Q3(c), determine the line current and circuit total power. [6 Marks]

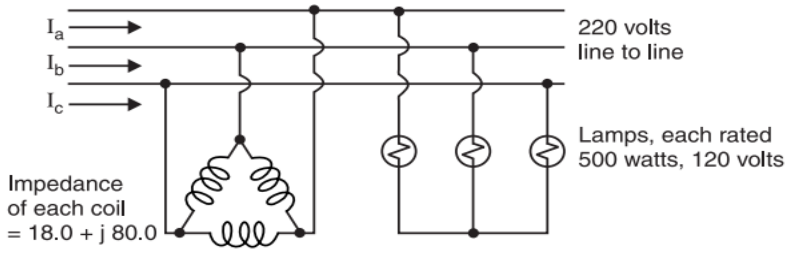

Fig. Q3(c)

QUESTION FOUR (15 MARKS)

(a) With the aid of a detailed diagram, explain the major components of HVDC transmission system. [8 Marks]

(b) The equipment in a power station costs Ksh1,560,000 and has a salvage value of Ksh 60,000 at the end of 25years. Determine the depreciated value of the equipment at the end of 20 years on the following methods :

i. Straight line method.

ii. Diminishing value method. [7 Marks]

QUESTION FIVE (15 MARKS)

(a) Briefly explain why electrical power generation station should have high load factor. [3 Marks]

(b) A factory operates at 0.8 p.f. lagging and has a monthly demand of 750 kVA. The monthly power rate is Ksh 8.50 per kVA. To improve the power factor, 250 kVA capacitors are installed in which there is negligible power loss. The installed cost of equipment is Ksh 20,000 and fixed charges are estimated at 10% per year. Calculate the annual saving effected by the use of capacitors. [6 Marks]

(c) A 50 km long transmission line supplies a load of 5 MVA at 0.8 p.f. lagging at 33 kV. The efficiency of transmission is 90%. Calculate the volume of aluminium conductor required for the line when a 3-phase, 3-wire system is used. The specific resistance of aluminium is 2.85×10^{-8} Ω m. [6 Marks]