PP2

TECHNICAL UNIVERSITY OF MOMBASA

SCHOOL OF ENGINEERING AND TECHNOLOGY

ELECTRICAL AND ELECTRONICS ENGINEERING

UNIVERSITY EXAMINATION FOR:

DEGREE

EEE 4418: POWER SYSTEM II.

END OF SEMESTER EXAMINATION

SERIES: NOVEMBER 2024

TIME: 2 HOURS

DATE:

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of FIVE questions. Attempt Question 1, Compulsory and any other Two Questions.

Do not write on the question paper.

Question ONE [Compulsory 30 Marks]

Question ONE

a) Define the following terms as used in power systems **[2 MARKS]**

i. Economics of power generation

ii. Interest

iii. Depreciation

iv. Tariff

b) Highlight and explain three methods of determining depreciation **[3 MARKS]**

c) Explain the nature of classification of DC distribution **[3 MARKS]**

d) Highlight and explain two advantages of high load factor **[4 MARKS]**

e) The equipment in a power station costs Rs 15,60,000 and has a salvage value of Rs 60,000 at the end of 25 years. Determine the depreciated value of the equipment at the end of 20 years on the following methods : **[4 MARKS]**

(i) Straight line method ;
(ii) Diminishing value method ;
(iii) Sinking fund method at 5% compound interest annually.

f) Highlight and explain four objectives of the tariff **[4 MARKS]**

g) Highlight and explain 5 characteristics of a tariff **[4 MARKS]**

h) Highlight and discuss three types of tariff **[6 MARKS]**

Question TWO

a) Using equations show how the following parameters are affected by high voltage transmission **[3MARKS]**

i. Transmission efficiency
ii. Line drop
iii. Conductor material

b) Highlight and explain two limitations of high transmission voltage **[2 MARKS]**

c) Explain the following terms as used in power systems **[3 MARKS]**

i. Variable load
ii. Load curve
iii. Connected load

d) Deduce the expression for the volume of the conductor material for the following **[4 MARKS]**

i. 2 wire DC system with midpoint earthed
ii. 2 phase 4 wire system

e) A DC 2 wire system is to be converted to AC 3 phase 3 wire system by the addition of a third conductor of the same cross sectional area as the two existing conductors. Calculate the percentage additional load which can now be supplied if the voltage between the

wires and the percentage loss remains unchanged. Assume a balanced load of unity power factor. **[4 MARKS]**

f) An electric supply company having a maximum load of 50 MW generates 18×107 units per annum and the supply consumers have an aggregate demand of 75 MW. The annual expenses including capital charges are :For fuel = Rs 90 lakhs,Fixed charges concerning generation = Rs 28 lakhs, Fixed charges concerning transmission= Rs 32 lakhs and distribution. Assuming 90% of the fuel cost is essential to running charges and the loss in transmission and distribution as 15% of kWh generated, deduce a two-part tariff to find the actual cost of supply to the consumers**.**

[4 MARKS]

Question THREE

a) Describe **four** principle elements of a transmission line **[2 MARKS]**

b) Using the graphical representation of the Kelvins law, deduce the expression of the annual cost of energy wasted in an overhead transmission line **[6 MARKS]**

c) A substation supplies power at 11kV, 0.8 pf lagging to a consumer through a single phase transmission line having total resistance (both go and return) of 0.15Ω. The voltage drop in the line is 15%. If the same power is to be supplied to the same consumer by two wire DC system by a new line having a total resistance of 0.05 Ω, and if the allowable voltage drop is 25%, calculate the DC supply voltage.

[4 MARKS]

d) Using correct diagrams and equations explain the expression of the most economical power factor **[4 MARKS]**

e) A consumer has an average demand of 400 kW at a p.f. of 0·8 lagging and annual load factor of 50%. The tariff is Rs 50 per kVA of maximum demand per annum plus 5 paise per kWh. If the power factor is improved to 0·95 lagging by installing phase advancing equipment, determine; **[4 MARKS]**

i. the capacity of the phase advancing equipment
ii. the annual saving effected

The phase advancing equipment costs Rs 100 per kVAR and the annual interest and depreciation together amount to 10%.

Question FOUR

a) Using well labeled diagrams explain THREE connection schemes of distribution systems **[6 MARKS]**

b) The cost of a 3 phase overhead transmission line is Kshs(25000a+2500) per km where 'a' is the cross-sectional area of the conductor material in cm^2. The line is supplying a load of 5MW at 33kV and 0.8 pf lagging assumed to be constant throughout the year. Energy costs 4P per kWh and interest and depreciation rates are 10% per annum. Find the most economical size of the conductor material, given the specific resistance of the conductor is 10^{-6} Ωcm. **[4MARKS]**

c) A sub-station supplies power at 11 kV, 0·8 p.f. lagging to a consumer through a single phase transmission line having total resistance (both go and return) of 0.15 Ω. The voltage drop in the line is 15%. If the same power is to be supplied to the same consumer by two wire d.c. system by a new line having a total resistance of 0·05 Ω and if the allowable voltage drop is 25%, calculate the d.c. supply voltage**.**

[4 MARKS]

d) List FOUR advantages of the per unit system **[4 MARKS]**

e) Mention and explain FOUR importance of load curves **[2 MARKS]**

Question FIVE

a) Using a well labeled diagram describe the Kenyan supply system depicting all the voltages from generation to consumption **[4 MARKS]**

b) The annual load duration curve of a certain power station can be considered as a straight line from 20 MW to 4 MW. To meet this load, three turbine-generator units, two rated at 10 MW each and one rated at 5 MW are installed. Determine

[7 MARKS]

(i) installed capacity

ii) plant factor

(iii) units generated per annum

(iv) load factor and

(v) utilisation factor.

c) Describe DC and AC transmission system mentioning two advantages and disadvantage of each **[4 MARKS]**

d) Describe the FOUR types of loads in power systems **[2 MARKS]**

e) A generating station has a maximum demand of 25MW, a load factor of 60%, a plant capacity factor of 50% and a plant use factor of 72%. Find **[3 MARKS]**

(i) the reserve capacity of the plant

(ii) (ii) the daily energy produced and

(iii) (iii) maximum energy that could be produced daily if the plant while running as per schedule, were fully loaded.