MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

UNIVERSITY ORDINARY EXAMINATION

2017/2018 ACADEMIC YEAR

THIRD YEAR **SECOND** SEMESTER EXAMINATION FOR THE DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING

SEE 1324 – POWER SYSTEMS II

DURATION: 2 HOURS

DATE: 16TH APRIL, 2018

TIME: 9.00 – 11.00 A.M.

Instructions to Candidates:

1. Answer **Question 1** and **Any Other Two** questions.
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.
4. You should have a **scientific calculator** for this examination

SECTION A – ANSWER ALL QUESTIONS IN THIS SECTION

QUESTION ONE

a) State three causes of high voltage surges in overhead transmission lines. (3 marks)

b) Derive an expression for surge impedance of a loss-free overhead transmission line. (4 marks)

c) Outline the factors that affect the transient stability of a power system (3 marks)

d) Explain the following terms as applied to power system stability

i. Dynamic stability

ii. Stability limit (4 marks)

e) Explain any two basic standard parameters that exist in power systems under no-load conditions. (2 marks)

f) With the aid of network sketches, illustrate the configurations applied to determine transmission line parameters. (3 marks)

g) Discuss the significance of symmetrical components when analyzing power system conditions. (3 marks)

h) (i) Outline the main types of transformers applied to regulate the supply of electrical energy. (3 marks)

(ii) A 1-Ø transformer 400/600V draws a no-load current of 4A at a power factor of 0.2 lagging, if the secondary supplies a load of 280A at a power factor of 0.8 lagging. Determine the current and the power factor of the primary circuit. (5 marks)

SECTION B – ANSWER ANY TWO QUESTIONS IN THIS SECTION

QUESTION TWO

a) State three properties of overhead line conductor materials used for transmission and distribution of electrical energy (3 marks)

b) With reference to transmission lines, explain the following

i. Skin effect

ii. Ferranti effect

iii. Transposition of overhead line conductors (6 marks)

c) With the aid of an equivalent circuit and phasor diagram, show that for a short transmission line, the sending end voltage

$V_s = [(V_s Cos\emptyset_R + IR)^2 + (V_R Sin\emptyset_R + IR)^2]^{½}$ (4 marks)

d) A three-phase, overhead line delivers power to a star-connected load of 75MVA at 132KV and 0.8 lagging power factor. The series impedance of the line is (28+j63) ohms per phase and the shunt admittance are 4 x 10^{-4}<90° siemens per phase. Use normal – π method to determine the:

i. Sending-end voltage

ii. Sending-end line current and its power factor

iii. Transmission efficiency (7 marks)

QUESTION THREE

a) State three types of unsymmetrical faults on a three-phase power system. (3 marks)

b) With the aid of phasor diagrams, show that the expression for zero sequence current I_o of a three-phase unbalanced system is given by: $I_o = \frac{1}{3}(\bar{I}_R + \bar{I}_Y + \bar{I}_B)$ where I_R, I_Y and I_B are phasor currents in the red, yellow and blue phases respectively. (8 marks)

c) In a 3-Ø four wire system, currents in the red, yellow and blue phases under fault conditions are $I_R = (10 + j20)A, I_Y = (12 - j10)A$ and $I_B = (-3 - j5)A$ respectively

Determine the

i. Zero

ii. Positive

iii. Negative

Sequence components of currents on the red phase (9 marks)

QUESTION FOUR

a) (i) Outline the advantages of instrument transformers. (3 marks)

(ii) Explain the basic construction features of a transformer. (4 marks)

b) (i) An auto-transformer is used to reduce the voltage from 500V to 400V to a supply of 20KW at a unity power factor. Assuming a no losses and a no magnetizing current condition, determine the current in each part of the transformer winding. (5 marks)

(ii) Explain the term voltage regulation as applied to transformers. (2 marks)

c) (i) With the aid of sketches, outline the groupings of 3-Ø transformers. (2 marks)

(ii) A 3-Ø 415V load takes a line current of 800A from a 3300/415V star-delta transformer. If the whole system is supplied from 11000/3300V star-star transformer, determine the:

I. Value of current and voltage in each part of the circuit

II. Turns ratio of both transformers (4 marks)