MACHAKOS UNIVERSITY

University Examinations 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

FOURTH YEAR SPECIAL/SUPPLEMENTARY EXAMINATION FOR

BACHELOR OF SCIENCE (ELECTRICAL AND ELECTRONIC ENGINEERING)

EEE 412 POWER SYSTEMS III

DATE: 27/9/2019 **TIME: 8:30 – 10:30 AM**

INSTRUCTIONS

This paper consists of **Five** questions. Answer question **One** and any other **Two**

1

a) Explain the term switch gear as applied in power system (3 marks)

b) List Three components of a switch gear (3 marks)

c) Briefly explain the application of the following switches

i. Knife switch

ii. Disconnecting switch

iii. Air-break switch

iv. Control Switch (4 marks)

d) Explain using a well labelled diagram the operation of a protective relay circuit (10 marks)

e) Explain using well labelled diagram the Differential protection of Station bus bar (10 marks)

2

a) Explain using a well labelled diagram the operation of the following relays

i. Current Differential Relay

ii. Distance Relays (8 marks)

b) A star connected 3-phase, 12 MVA, 6.6kV alternator has a per phase reactance of 12 percent. It is to be protected by Merz-Price circulating current principle which is set to operate to a fault current not less than 180A. Calculate the value of earthing resistance to be provided in order to ensure that only 12 percent of the alternator winding remains unprotected (12 marks)

3

a) List five causes of over-voltages in Power System (5 marks)

b) Explain the protection of Electrical equipment from over-voltages using the following devices

i. Ground wire

ii. Earthing Screen

iii. Rod-gap arrester (10 marks)

c) Explain the factors affecting the corona (5 marks)

4

a) Explain the following terms as applied in Power System circuit breakers

i. Arc voltage

ii. Restriking Voltage

iii. Recovery Voltage (3 marks)

b) Explain the following types of Circuit breakers

i. Oil Circuit breakers

ii. Air Circuit breakers

iii. Air Blast circuit breakers

iv. Gas Circuit breakers

v. Vacuum Circuit breakers (10 marks)

c) A circuit breaker is rated as 1500A, 1000 MVA, 33 kV, 3-second, 3-phase oil circuit breaker. Find the following

i. Rated normal current

ii. Breaking Capacity

iii. Rated symmetrical breaking current

iv. Rated making current

v. Short-time rating

vi. Rated service voltage (7 marks)

5

a) Explain the arc phenomenon in circuit breakers (4 marks)

b) Explain using a well labelled diagram the following terms as applied in Power Systems

i. Pre-arching time

ii. Arching time

iii. Operating time

iv. Cut-off current (8 marks)

c) In a short circuit on 132 kV 3-phase system, the breaker gave the following results: Power factor of the fault = 0.45; Recovery voltage = 0.9 time full line voltage; the breaking current is symmetrical and the restriking transient had a natural frequency of 15 kHz. Determine the rate of rise of restriking voltage (RRRV) in the following types of fault:

i. Grounded fault

ii. Ungrounded fault (8 marks)