MACHAKOS UNIVERSITY

University Examinations 2017/2018

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

FOURTH YEAR SECOND SEMESTER EXAMINATIONS FOR BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONIC ENGINEERING
EEE 412: POWER SYSTEMS III

DATE:20/12/2017 **TIME: 8.30-10.30 AM**

INSTRUCTIONS

Answer Question One and Any Other Two Questions

QUESTION ONE (COMPULSORY) (30 MARKS)

a) State two advantages of corona (2 marks)

b) A three phase overhead line composing three conductors each of diameter 6.0cm and symmetrically spaced 2.0 m between centers has irregularity factor of 0.8. if the atmospheric pressure is 70.0cm of mercury and temperature is 20^{o}C, determine the disruptive critical voltage. (8 marks)

c) Determine the value of the reflected and transmitted voltages when an incident surge Vi travels on a transmission line terminated by a short circuit. (4 marks)

d) Define the following terms:
   i. Maximum demand
   ii. Load factor
   iii. Diversity factor (6 marks)

e) A power station is to supply loads of 15000KW, 12000KW, 8500KW, 6000KW and 450KW. The station has a maximum demand of 22000KW. The annual load factor of the station is 50%. Calculate:
   i. The number of units supplied annually

ii. The diversity factor
iii. The demand factor (10 marks)

QUESTION TWO (20 MARKS)

a) Define the following terms with respect to circuit breakers:
   i. Arc voltage
   ii. Restriking voltage
   iii. Recovery voltage (6 marks)

b) A three phase 11KV, 50Hz alternator with earthed neutral reajtance of 8 Ohm and is connected to a bus bars through a circuit breaker. The distributed capacitance up to the circuit breaker between phase and the neutral is 0.015μF. Determine:
   i. Peak restriking voltage across the contacts
   ii. Frequency of the oscillations
   iii. Average rate of rise of the restriking voltage up to the peak. (10 marks)

c) Define the following terms:
   i. Demand factor
   ii. Plant use factor (4 marks)

QUESTION THREE (20 MARKS)

a) Mention three mediums used to quench arc in circuit breakers. (3 marks)

b) A 3 phase, 30 MVA, 33KV alternator has internal reactance of 4% and negligible resistance. Find the external resistance per phase to be connected in series with the alternator so that steady current on short circuit does not exceed 10 times the full load current. (10 marks)

c) With aid of diagram discuss the working of shaded pole structure relay. (4 marks)

d) Sketch a typical curve of cost against transmission voltage. (3 marks)

QUESTION FOUR (20 MARKS)

a) Derive Kelvin's law. (6 marks)

b) A three phase 66KV overhead line is to be designed to transmit a balanced load of 14MVA over a distance of 80 kilometer for 3000 hours per annum, there being no load for the remainder of the year. The conductors are to be of copper costing 440 Ksh per kilogram and having a density of $0.886*10^4$ kg/m^3. The interest and depreciation charges total to 10% per annum and energy costs 6 Ksh/KWhr. The resistance of 1 kilometer of copper conductors of cross section area of 1cm^2 is 0.177 Ohms. Calculate:

i. The most economical conductor cross sectional area
ii. The current density (10 marks)

c) Briefly describe the following qualities of relays:
i. Speed
ii. Reliability (4 marks)

QUESTION FIVE (20 MARKS)

a) Define corona phenomenon. (2 marks)

b) With aid of diagrams show the three ways short circuit current limiting reactors may be connected to a power system. (3 marks)

c) An underground cable having a capacitance of 0.2μF per kilometer and an inductance of 0.4mH per kilometer is joined to an overhead line having a capacitance of o.o2μF per kilometer and inductance of 20.25mH per kilometer. If a surge having a value of 132 KV travels along the cable towards the joint with the overhead line, determine the value of:
i. Reflected voltage
ii. Reflected current
iii. Transmitted voltage
iv. Transmitted current (10 marks)

d) A generating station has a connected load of 80 MW and a maximum demand of 40 MW the units generated being 120 X 10^6. Calculate:
i. The demand factor
ii. The load factor (5 marks)