ELIZADE UNIVERSITY ILARA MOKIN, ONDO STATE

FACULTY OF ENGINEERING

DEPARTMENT OF ELECTRICAL AND ELECTRICAL ENGINEERING

FIRST SEMESTER EXAMINATION, 2018/2019 ACADEMIC SESSION

COURSE TITLE: SWITCHGEAR AND HIGH VOLTAGE ENGINEERING

COURSE CODE: EEE 535

EXAMINATION DATE: 11TH MARCH, 2019

COURSE LECTURER: DR K. O. TEMIKOTAN

HOD's Signature

TIME ALLOWED: 2 HOURS

INSTRUCTIONS

1. ANSWER FOUR QUESTIONS.
2. SEVERE PENALTIES APPLY FOR MISCONDUCT, CHEATING, POSSESSION OF UNAUTHORIZED MATERIALS DURING EXAM.
3. YOU ARE NOT ALLOWED TO BORROW ANY WRITING MATERIALS AND CALCULATOR DURING THE EXAMINATION.

QUESTION ONE

a. The following observations were made in an experiment for determination of dielectric strength of transformer oil. Determine the power law equation. 6 marks

Gap spacing	4	6	8	10
Breakdown Voltage (kV)	88	135	165	212

b. List and discuss briefly the methods of purifying liquid dielectrics 5 marks

c. State the differences between pure and commercial liquid dielectrics? 4 marks

QUESTION TWO

a. State five requirements of a good circuit breaker? 5 marks

b. A three phase 20 MVA, 11 kV alternator connected through a 5-cycle circuit breaker has sub-transient, transient, and synchronous reactances of 8%, 12% and 75% respectively. It is running on load with rated voltage developed across its terminals, when a three-phase short circuit occurs just beyond the circuit breaker.

Determine;

i. The steady state short circuit current;
ii. The initial symmetrical current that can be broken on all poles;
iii. The maximum DC component;
iv. Making capacity in kA;
v. Symmetrical breaking current;
vi. Asymmetrical breaking current;
vii. Interrupting capacity in MVA 10 marks

QUESTION THREE

A three-phase line has conductor of 1.5 cm in diameter spaced one metre apart in equilateral formation. Neglecting resistance and leakage reactance, calculate;

i. The natural impedance of the line;
ii. The line current if a voltage wave of 11 kV travels along the line;
iii. The rate of energy absorption, the rate of reflection and the state and form of reflection if the line is terminated through a star connected load of 1kΩ per phase;
iv. The value of terminating resistance for no reflection; and
v. The amount of reflected and transmitted power if the line is connected to a cable extension with inductance and capacitance per phase per cm 5×10^{-9}H and 1pF respectively

15 marks

QUESTION FOUR

a. List the three basic steps involved in insulation coordination 3 marks

b. The protection level provided for a 750-kV line is 1700 kV. The characteristic impedance of the line is 300 Ω. If a voltage having a crest of 3000 kV is travelling on the line, calculate;

   i. The current in the line before reaching the protecting arrestor;
   ii. The current through the arrestor;
   iii. The value of arrestor resistance for this condition;
   iv. The reflected and refracted voltages; and
   v. Verify your result in (iv) using formulae for the coefficients. 12 marks

QUESTION FIVE

a. List and describe briefly five factors affecting corona loss 5 marks

b. A 250 km long, 330 kV transmission line consists of 22,26 mm diameter conductor in a 6 m delta configuration.

   i. Find the disruptive critical voltage (V_d) and visual corona voltage (V_v) if the temperature is 25 °C, pressure 73 cm Hg, a surface factor 0.82, irregularity factor for local corona is 0.72 and irregularity factor for general corona is 0.82.
   ii. Find the total loss in fair weather and in bad weather. (Take critical field intensity for breakdown in air to be 30 kV/cm at STP) 10 marks

QUESTION SIX

a. What makes high voltage measurement a necessity? 3 marks

b. A peak reading voltmeter is required to measure 150 kV. It uses an RC circuit a microammeter, and a capacitance voltage divider. If the potential divider has a ratio 1200:1 and microammeter can read up to 10 μA, determine the value of R and C if the time constant of the RC circuit is 8s. 5 marks

c. An electrostatic voltmeter has two parallel plates. The movable plate is 10 cm in diameter. With 10 kV between the plates, the pull is 3×10^{-3} N. Determine the change in capacitance for a movement of 1mm of the movable plate. 7 marks