

**UNIVERSITY COLLEGE TATI (UC TATI)****FINAL EXAMINATION QUESTION BOOKLET**

COURSE CODE : BET 4013

COURSE : POWER SYSTEM &amp; HIGH VOLTAGE

SEM/SESSION : 2 – 2023/2024 (FLEXIBLE)

DURATION : 3 HOURS

**Instructions:**

1. This booklet contains **4** questions. Answer **ALL** questions.
2. All answers should be written in answer booklet.
3. Write legibly and draw sketches wherever required.
4. If in doubt, raise your hands and ask the invigilator.

**DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO****THIS BOOKLET CONTAINS 6 PRINTED PAGES INCLUDING COVER PAGE**

**QUESTION 1**

- a) List three (3) system layout in distribution system (3 marks)
- b) Power system protection equipment need to fulfill the requirements for tripping the circuit breakers when faults occur. Discuss three (3) requirements of power system protection (6 marks)
- c) Relay time- current characteristic can be divided into four classes.
- List the four (4) classes of relay time-current characteristics (4 marks)
  - Describe any two (2) classes of relay time-current characteristics according answer (i) (4 marks)
- d) Consider the radial system shown in Figure 1 below.
- Calculate the fault currents for faults  $F_A$ ,  $F_B$ ,  $F_C$ ,  $F_D$ , and  $F_E$ . (8 marks)
  - Prepare relay setting on the basics of current grading, assuming a 50% relay error margin. (2 marks)

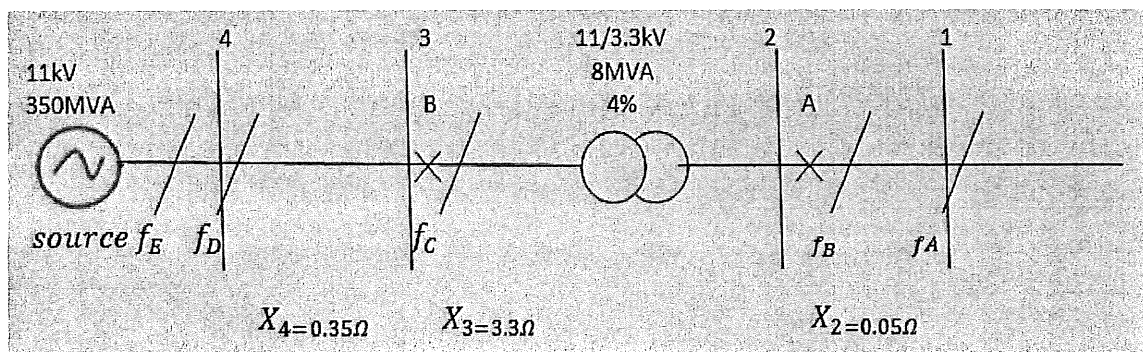


Figure 1

**QUESTION 2**

- a) List four (4) components of protection in transformer. (4 marks)
- b) A fault is deemed to exist as soon as the differential current appears in electrical equipment like transformer.
- State TWO (2) types of transformer faults. (2 marks)
  - Explain any THREE (3) transformer faults according to their types. (6 marks)
- c) Consider a  $\Delta / Y$  connected to a 33/11kV, 50Hz transformer with differential protection applied for the current transformer ratios shown in Figure 2 below. If the primary current is 262.4 A. Calculate:
- The apparent power (1 mark)
  - The secondary current (1 mark)
  - The CT primer current (1 mark)
  - The CT secondary current (1 mark)
  - The relay current at full load (1 mark)
  - The minimum relay setting to allow 135% overload (1 mark)

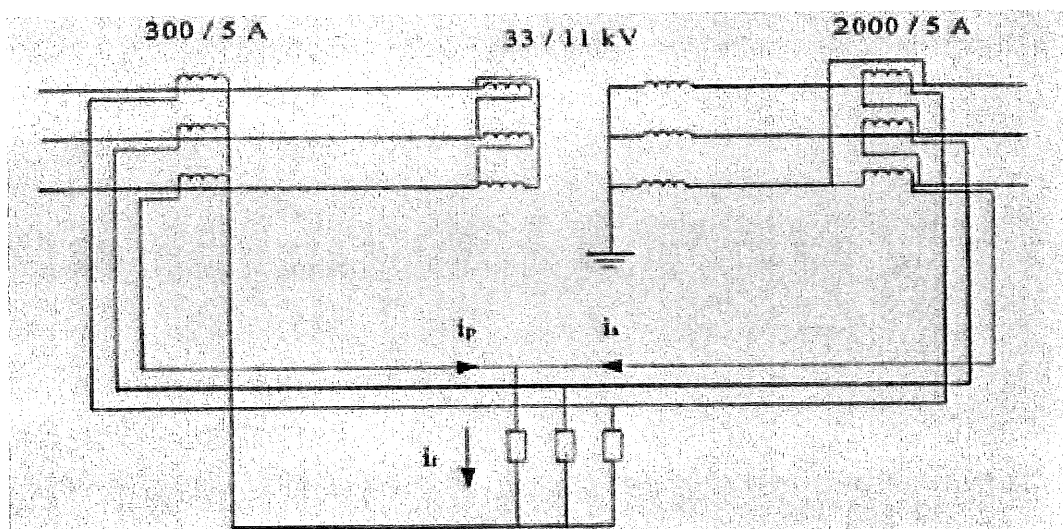


Figure 2

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**QUESTION 3**

- a) Define circuit breaker. (2 marks)
- b) State four (4) main types of oil circuit breaker. (4 marks)
- c) Describe three (3) function of switchgear in power system (6 marks)
- d) Electrical power transmission networks are protected and controlled by medium and high voltage circuit breaker which is vacuum circuit breakers and SF6 circuit breaker. Differentiate between vacuum circuit breakers and SF6 circuit breaker. (6 marks)

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**QUESTION 4**

- a) Define dielectric (2 marks)
- b) List four (4) factor to be considered in choosing gases for insulation purposes (4 marks)
- c) Give two (2) important material in high voltage apparatus (2 marks)
- d) Describe four (2) main areas where electrical insulation can be applied in high voltage equipment (4 marks)
- e) Explain the process of conduction and breakdown in commercial liquid (8 marks)
- f) Give the function of transformer oil which are used in transformer (2 marks)
- g) In an experiment, a certain gas was found that the steady state current is  $5.5 \times 10^{-8}A$  at 8 kV in a distance of 6 mm between the plane electrodes. Keeping the field constant and reducing the distance to 0.2 cm, resulting the current of  $5.5 \times 10^{-9}A$  .Calculate;
- The townsend's primary ionization coefficient  $\alpha$ . (3 marks)
  - The breakdown strength of air for small gap (1mm) and large gaps (20cm) under uniform field condition and standard atmospheric condition. (4 marks)

h) According to figure 3 below, explain the whole process of streamer's breakdown mechanisms method

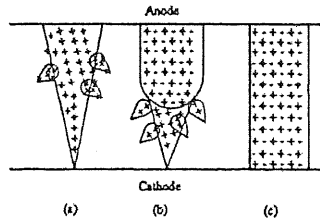


Figure 3

(8 marks)

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