UNIVERSITY COLLEGE TATI

UNIVERSITY COLLEGE TATI (UC TATI)

FINAL EXAMINATION QUESTION BOOKLET

COURSE CODE	: BET 4013
COURSE	: POWER SYSTEM & HIGH VOLTAGE
SEM/SESSION	: 2 – 2024/2025 & 2 – 2024/2025 (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 5 PRINTED PAGES INCLUDING COVER PAGE

QUESTION 1

a) Explain two (2) ways we can be at risk in electricity (2 marks)

b) Power system protection equipment need to fulfill the requirements for tripping the circuit breakers when faults occur.

i. List the three (3) requirement in power system protection (3 marks)
ii. Describe any two (2) type requirement in power system protection according to answer (i) (4 marks)

c) Discuss two type of parameter for setting relay which is current plug setting (PS) and time setting multiplier (TSM). (4 marks)

d) List the four (4) classes of relay time-current characteristics (4 marks)

e) Consider the radial system shown in Figure 1 below.

i. Calculate the fault currents for faults F_A, F_B, F_C, F_D, and F_E. (8 marks)
ii. Prepare relay setting on the basics of current grading, assuming a 50% relay error margin. (2 marks)

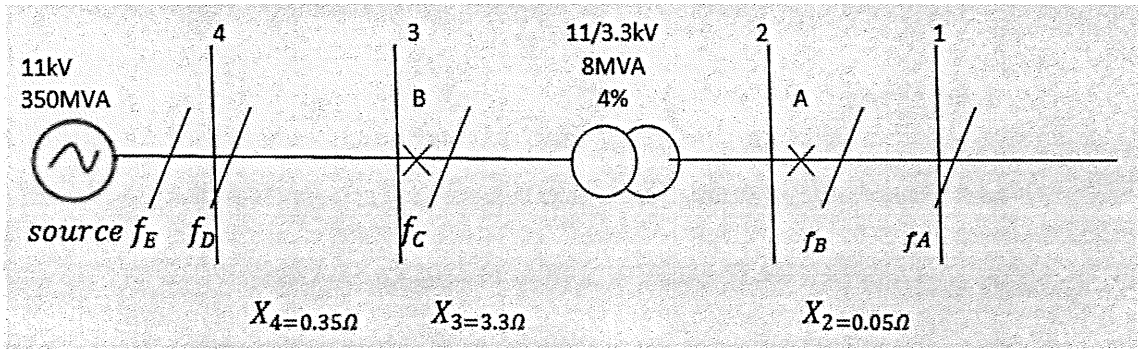

Figure 1

QUESTION 2

a) List two (2) components of protection in generator (2 marks)

b) Explain four (4) basic differential current system. Draw relevant diagram to support your answer. (6 marks)

c) Explain the basic principle of gas and oil actuated relay (Buchholz Relay) in transformer. (4 marks)

d) Consider a Δ / Y connected to a 33/11kV, 50Hz transformer with differential protection applied for the current transformer ratios shown in Figure 2. If the primary current is 282.4 A.Calculate the followings:

i. The apparent power (1 mark)
ii. The secondary current (1 mark)
iii. The CT primer current (1 mark)
iv. The CT secondary current (1 mark)
v. The relay current at full load (1 mark)
vi. The minimum relay setting to allow 115% overload (1 mark)

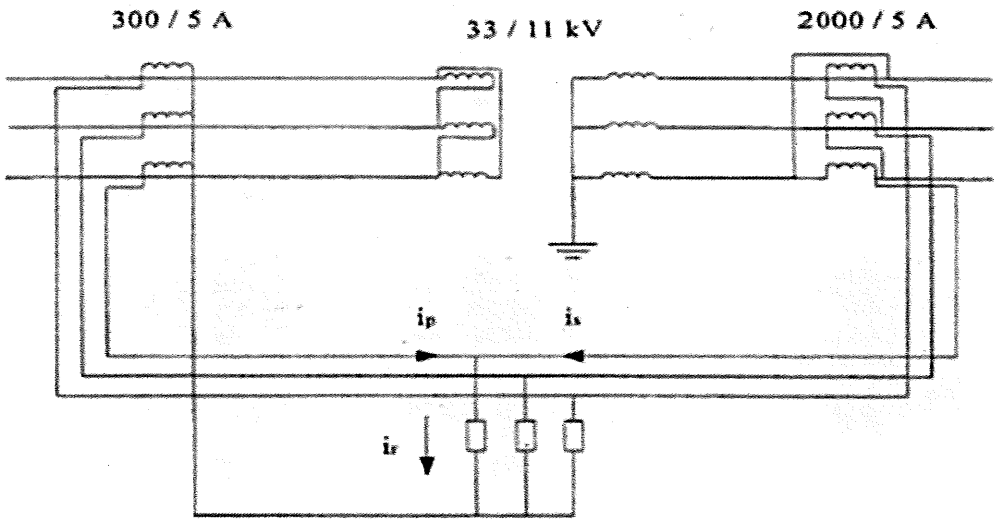

Figure 2

QUESTION 3

a) Define electrical substation. (2 marks)

b) State four (4) type of electrical substation in power system. (4 marks)

c) Describe four (4) selection criteria in substation. (4 marks)

d) Electrical power transmission networks are protected and controlled by medium and high voltage circuit breakers

i. List the four (4) types of classification of circuit breaker (4 marks)
ii. Describe any two (2) types of classification of circuit breaker according to answer (i) (2 marks)

e) Explain two (2) function of substation transfomer in power system. (2 marks)

QUESTION 4

a) List two (2) important material in high voltage apparatus. (2 marks)

b) Describe four (4) main areas where electrical insulation can be applied in high voltage equipment. (8 marks)

c) Explain the whole process of particles exchange mechanism in vacuum breakdown and relevant diagram to support your answer. (8 marks)

d) In an experiment, a certain gas was found to have a steady state current of $5.5 \times 10^{-8} A$ at 8 kV with distance of 6 mm between the plane electrodes. Keeping the field constant and reducing the plane electrodes distance to 0.2 cm, resulted in steady state current of $5.5 \times 10^{-9} A$. Calculate the followings;

i. The Townsend's primary ionization coefficient α. (3 marks)
ii. The breakdown strength of air for small gap (1mm) and large gaps (20cm) under uniform field condition and standard atmospheric condition (4 marks)

e) List four (4) theories have been proposed to explain the breakdown in liquids. (4 marks)

f) According to Figure 3 below ,explain the whole process of Townsend breakdown mechanism. (8 marks)

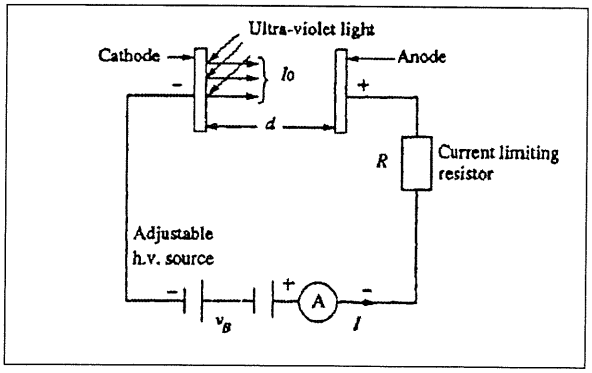

Figure 3

----------END OF QUESTION----------