ELIZADE UNIVERSITY, ILARA-MOKIN, ONDO STATE
FACULTY OF ENGINEERING
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

FIRST SEMESTER EXAMINATION 2022/2023 ACADEMIC SESSION

COURSE TITLE: ELECTRIC POWER SYSTEM ENGINEERING PRINCIPLE

COURSE CODE: EEE 415

EXAMINATION DATE: 31ST MARCH, 2023

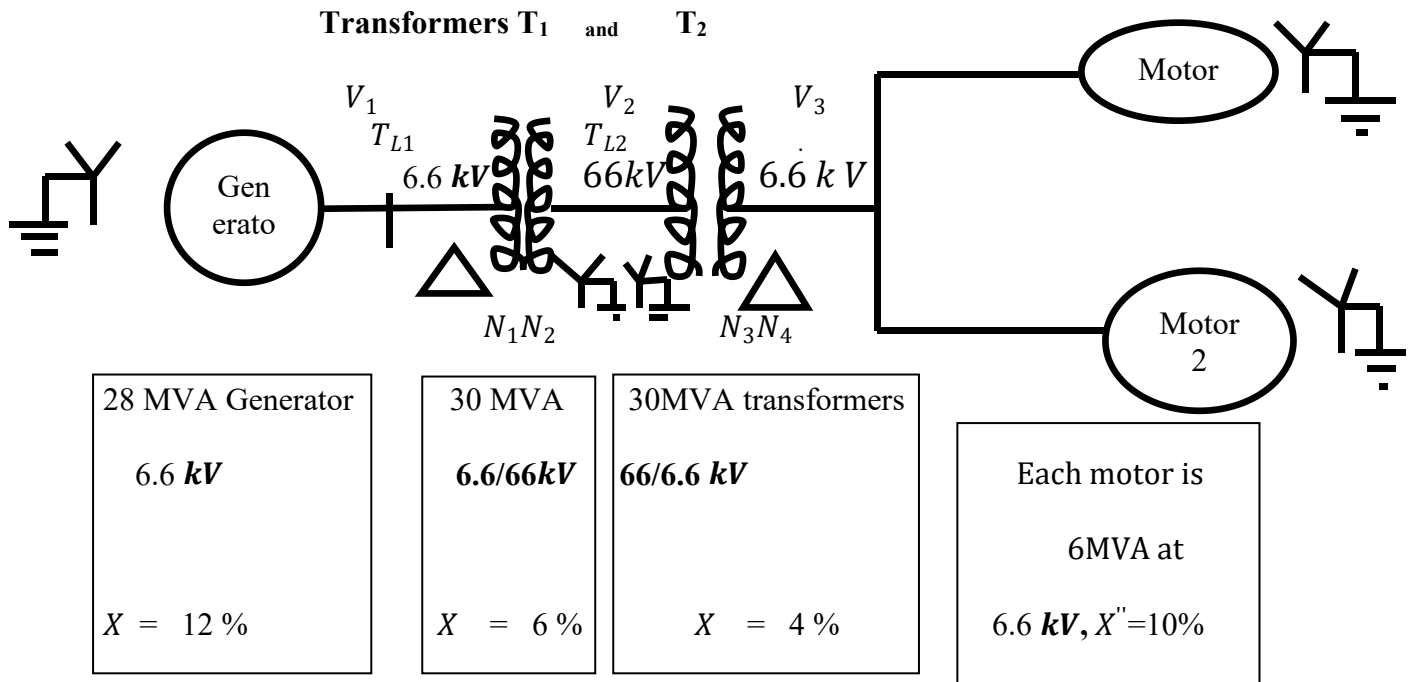**COURSE LECTURER: ENGR. OSHIN OLA A**

HOD'S SIGNATURE

TIME ALLOWED: 3 HOURS

INSTRUCTIONS:

1. ANSWER ANY FIVE QUESTIONS ONLY

2. SEVERE PENALTIES APPLY FOR MISCONDUCT, CHEATING, POSSESSION OF UNAUTHORIZED MATERIALS DURING EXAM.

3. YOU ARE **NOT** ALLOWED TO BORROW ANY WRITING MATERIAL DURING THE EXAMINATION.

QUESTION 1

a. State three benefits of per-unit system in power system analysis (3 marks)

b. The ratings of typical power system components are as shown in Fig. Q1a.Given that transmission line reactanceX_{actual} is j84Ω. and the base MVA is 25MVA.

Draw the reactance diagram of the power system.

Transformers T₁ and **T₂**

28 MVA Generator	30 MVA	30MVA transformers	Each motor is
6.6 *kV*	**6.6/66kV**	**66/6.6 *kV***	6MVA at
$X = 12\%$	$X = 6\%$	$X = 4\%$	6.6 *kV*, $X'' = 10\%$

(17 marks)

QUESTION 2

a. With the aid of a schematic diagram, explain the construction of Hydro Electric Power Plant

(6 marks)

b. State the disadvantage of a run-of –river power plant   (2 marks)

c. Using a suitable diagram, describe the construction of a radial distribution system using suitable diagram where appropriate.   (3marks)

d. A hydro-electric power station has a reservoir area of 2·4 square kilometers and capacity 5 x10⁶ m³. The effective head of water is 100 meters. The penstock, turbine and generation efficiencies are respectively 95%,90% and 85%.

(i) Calculate the total electrical energy that can be generated from the power station.

(ii) If a load of 15,000 kW has been supplied power for 3 hours, find the fall in reservoir level.   (9 marks)

QUESTION 3

a. What do you understand by i. Demand factor, ii. plant use factor and iii. diversity factor? (3 marks)

b. The daily demand of 3 consumers A, B and C are as follows:

TIME	CONSUMER A	CONSUMER B	CONSUMER C
12 midnight – 8am	No load	300 W	No load
8am – 2pm	600 W	No load	300 W
2pm -4 pm	200 W	1200 W	1400 W
4pm – 10 pm	800 W	300 W	No load
10 pm – midnight	No load	300 W	300 W

i. Plot the load curve

ii. Plot the load duration curve

iii. Determine the maximum demand of each customer

iv. Find the load factor of individual consumer

v. Determine the diversity factor

vi. Determine the load factor of the power station

QUESTION 4

a. Mention four major components of an overhead line (4 marks)

b. List any four types of insulators (4 marks)

c. A single phase overhead transmission line delivers 1200 kW at 33 kV at 0·8 p.f. lagging. The total resistance and inductive reactance of the line are 12Ω and 16Ω respectively.

Determine: (i) Sending end voltage

(ii.) Sending end power factor and

(iii.) Transmission efficiency   (12 marks)

QUESTION 5

a. List three conventional power generators   (3 marks)

b. With the aid of a suitable diagram, describe the construction of an interconnected system in a   distribution system (5 marks)

c. The weekly discharge of a typical hydroelectric plant are as follows:

Days	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Discharge(m^3/sec)	530	475	850	900	685	940	535

The plant has an effective head of 22 m and an overall efficiency of 80%. If the plant operates
on 32 % load factor, determine(i) the average daily discharge (ii) pondage required and (iii) installed capacity of proposed plant. (12 marks. 4 marks each)

QUESTION 6

a. Draw the layout of a typical A.C. power supply scheme using a single line diagram (4 marks)

b. State two advantages of D.C over A.C in transmission of Electricity (2 marks)

c. What are the functions of feeder pillar and a Ring Main Unit in a distribution Sub-station? (4 marks)

d. A 3-phase 50 Hz overhead transmission line is 120 km long and it has the following constants

   Resistance/ km/phase = 0.1 Ω

   Reactance/ km/phase = 0.4 Ω

   Capacitive susceptance / km/phase = 0.05x 10^{-4} siemens

   Assuming a nominal T method, determine:

   i.   the sending end current

   ii.   Sending end voltage

   iii.   Sending end power factor

   iv.   Transmission efficiency when supplying a balanced load of 11,000 kW at 66kV and 0.85 power factor lagging

   v.   Draw the transmission line phasor diagram (10 marks, 2 marks each)

QUESTION 7

a. What do you understand by the constants of an overhead transmission line? (2marks)

b. Distinguish between a feeder, a distributor and service main with a schematic diagram (2 marks)

c. What do you understand by cyber-security in power system automation? State its two advantages (2 marks)

d. What is Broad-Over Power Line BPL? State two benefits of Power Line Communication (2 marks)

e. A diesel power station has the following data:

        I. Fuel consumption per day = 1200 kg

        II. Unit generated per day = 4800 kWh

        III. Calorific value of fuel = 12,000 kcal/kg

        IV. Alternator efficiency = 95 %

        V. Engine mechanical efficiency = 94 %

Determine (i) the specific fuel consumption (ii) overall efficiency and (iii) thermal efficiency   (12 marks)