ELIZADE UNIVERSITY ILARA MOKIN,
ONDO STATE

FACULTY OF ENGINEERING

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

SECOND SEME:

COURSE TITLE: POWER SYSTEMS ENGINEERING

COURSE CODE: EEE 528

EXAMINATION DATE: 18th July, 2109.

COURSE LECTURER: DR K. O. TEMIKOTAN

HOD's Signature

TIME ALLOWED: 3 HOURS

INSTRUCTION

1. ANSWER ANY FIVE 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 CALCULATORS DURING THE EXAMINATION.
4. SMART WATCHES ARE NOT ALLOWED IN THE EXMINATION HALL

QUESTION ONE

A single circuit transmission line delivering a load of 50 MVA at 110 kV and p.f. 0·8 lagging: Determine; (i) sending end voltage (ii) sending end current (iii) sending end power (iv) efficiency of transmission. Given A = D = 0·98 ∠ 3°; B = 110 ∠ 75° ohm; C = 0·0005 ∠ 80° Siemen. (12 MARKS)

QUESTION TWO

a. What are the causes of voltage variation in consumers' premises? (2 MARKS)
b. What methods are available for ensuring that system voltages are within approved limits? (7 MARKS)
c. Discuss the advantages and disadvantages of each method. (3 MARKS)

QUESTION THREE

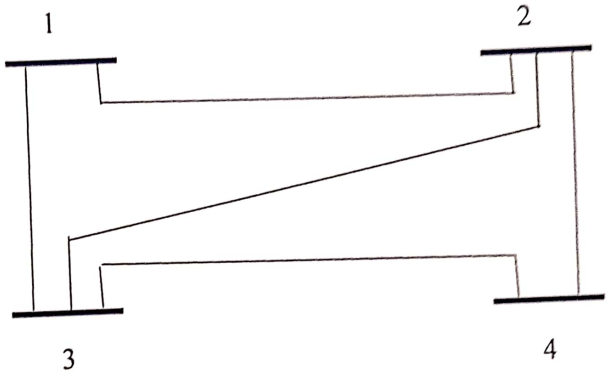

Figure Q 3: Single Line Diagram for Question Three

Determine the $\mathbf{Y}_{bus}$ of the network in Figure Q 3 given that the following impedances of the lines.

Bus Code	Line Impedances
1 – 2	0.025 + j0.10
1 - 3	0.10 + j0.40
2 - 3	0.02 + j0.08
2 – 4	0.04 + j0.18
3 – 4	0.05 + j0.0.2

Neglect the shunt admittances of the buses. (12 MARKS)

QUESTION FOUR

a. State five advantages of using the per unit system in network analysis. (5 MARKS)
b. A 90 MVA, 11kV 3-phase generator has a reactance of 25%. The generator supplies two motors through transformers and transmission line as shown in Figure Q 4. The transformer T_1 is a three-phase 100 MVA, 10/132 kV, and has a reactance of 6%. The transformer T_2 is composed of three single phase units each rated at 30 MVA, 66/10 kV with 5% reactance. The connections of T_1 and T_2 are as shown. The motors are rated 50 MVA both 10 kV and 20% reactance. Taking the generator

rating as base, draw the reactance diagram and indicate the reactances in per unit. The reactance of the line is 100 Ω. (7 MARKS)

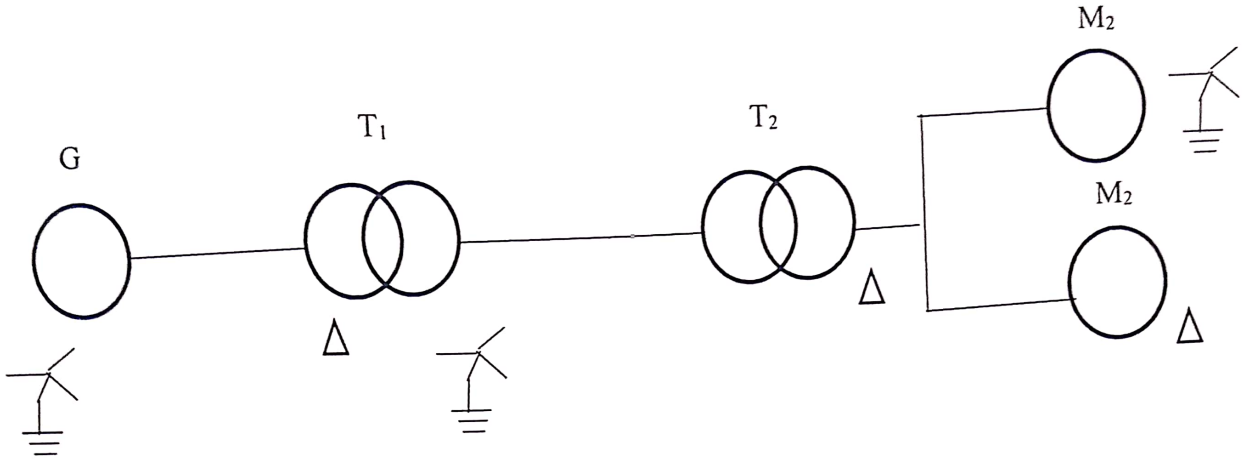

Figure Q 4: Diagram for Question 4

QUESTION FIVE

a. What are symmetrical components?
b. Complete the following table given that the operator $a = 1\angle 120^0 = 1e^{j2\pi/3} = -0.5 + j0.8660$

a	$1\angle 120^0$	$1e^{j2\pi/3}$	$-0.5 + j0.8660$
a^2			
a^3			
a^4			
$1 + a^2$			
$1 + a + a^2$			

a. The line currents in a 3-phase system are $I_a = 5\angle 60^0 A;\ I_b = 5\angle -60^0 A$ *and* $I_c = 0$.

Find the symmetrical components.

QUESTION SIX

a. Express the swing equation in terms of the angular momentum, M power angle δ, the input and the output power P_m and P_e respectively.
b. A four-pole steam turbine-generator unit is rated 13.2 kV, 50 Hz and 100 MW at 0.8 pf. If the moment of inertia is 36,000 kg-m^2; Calculate;
   i. The kinetic energy in MJ at rated speed,
   ii. The inertia constant H.
   iii. The inertia constant M in MJ-s per electrical degree.
   iv. M in per unit on 100 MVA base.

QUESTION SEVEN

a. A 5-ampere, 3-second overcurrent relay having a current setting of 125% and a time setting multiplier (PSM) of 0·6 is connected through a 400/5 current transformer to a supply circuit. Determine the time of operation when the circuit carries a fault current of 4000 A. Use the curve shown in Figure Q7. (5 MARKS)

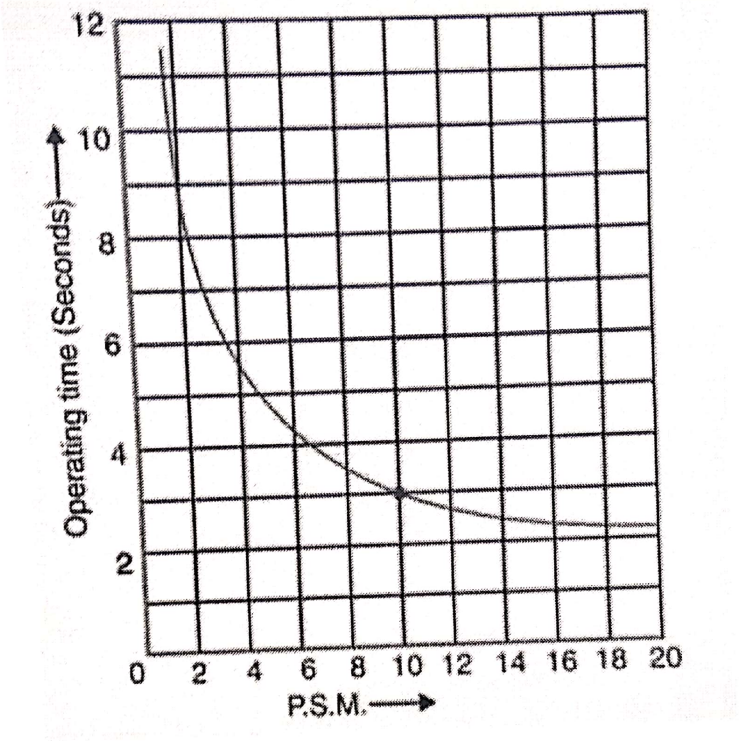

Figure Q7: Time/P.S.M. Curve of the Relay

b. What may happen to a power system if the system parameters of a power system go out of system allowed limits? (1 MARK)

c. State the system allowed limits for voltage and frequency at the transmission level in the Nigeria power grid. (1 MARK)

d. What steps can be taken to ensure that the system remains within the allowed limits. (5 MARKS)