ELIZADE UNIVERSITY ILARA MOKIN, ONDO STATE

FACULTY OF ENGINEERING

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

SECOND SEMESTER EXAMINATION, 2017/2018 ACADEMIC SESSION

COURSE TITLE: POWER SYSTEM CONTROL AND COMMUNICATION

COURSE CODE: EEE 534

EXAMINATION DATE: 1st AUGUST 2018

COURSE LECTURER: DR K. O. TEMIKOTAN

HOD's Signature

TIME ALLOWED: 2 HOURS

INSTRUCTION

1. ANSWER ANY 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 DURING THE EXAMINATION.

Question 1

(a) Draw a clearly labelled nominal pi model of a medium length transmission line and explain each quantity labelled on the circuit. **(7 MARKS)**

(b) Derive the ABCD constants of the circuit. What assumptions are made in arriving at this model? **(8 MARKS)**

Question 2

(a) What is the Ferranti effect? Using appropriate diagram, explain this effect on a long transmission line. **(5 MARKS)**

(b) A three phase AC line has an inductance of 0.4H and a capacitance of 1.0 µF per phase. If the sending end voltage is 22kV and the system frequency is 50Hz What is the receiving end voltage at no load. **(8 MARKS)**

(c) In practice, how we can improve the regulation and the power transfer capacity of a line? **(2 MARKS)**

Question 3

(a) Under steady state conditions, how is increase in load (ΔP_D) of a power system met? **(2 MARKS)**

(b) Given that the primary automatic load frequency control parameters for a control area have the following data;

Total rated capacity = 1000MW
Inertia constant H = 5 kWs/kVA
Regulation R = 2 Hz/pu MW for all generators

Normal operating load = 500MW at a frequency of 50Hz.

Assuming a one percent change in load for one percent change in frequency, determine;

(i) The per unit rate of change of load with respect to frequency, B; **(2 MARKS)**
(ii) the power system time constant, T_{ps}; and **(3 MARKS)**
(iii) the power system gain, K_{ps} **(2 MARKS)**

(c) Two generators rated 200MW and 400MW are operating in parallel. The drop characteristics of the governors are 4% and 5% respectively from no-load to full load. If both generators are operating at 50Hz at no load, how would a load of 600MW be shared between them? What will be the system frequency at this load? (Assume free governor operation) **(6 MARKS)**

Question 4

(a) What are the advantages of synchronous capacitors over static capacitors? **(4 MARKS)**

(b) Using a neat diagram show how the voltage of a line varies with distance in the following scenarios

(i) $I^2 \omega L < V^2 \omega C$
(ii) $I^2 \omega L = V^2 \omega C$

(iii) $I^2 \omega L > V^2 \omega C$ **(3 MARKS)**

(c)   What are the advantages and disadvantages of booster transformer in voltage control? **(2 MARKS)**

(d)   Figure 1 represents a single-line diagram of a three phase System. The 230kV line is fed through 33/330kV transformer from a constant 33kV source. The impedance of the transformers and the line is $(30 + j\,80)\ \Omega$. The tap-changing facilities of the TFs are such settings is unity. If the load on the system is 150MW at a power factor of 0.9, determine the settings of the tap changers required to maintain the voltage of the load bus bar at 33kV.   **(6 MARKS)**
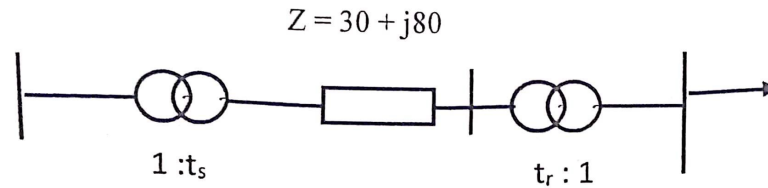
$$Z = 30 + j80$$

$$1 : t_s \qquad\qquad\qquad t_r : 1$$

Figure 1: Single line diagram for Question 4 (d)

Question 5

(a)   What is the purpose of the IEC 61850 and what are the functions described under the standard?   **(6 MARKS)**

(b)   The fuel inputs per hour of plants 1 and 2 are given as
$$F_1 = 0.2\,P1^2 + 40P_1 + 120 \text{ Naira per hour}$$
$$F_2 = 0.25\,P_2{}^2 + 30P_2 + 150 \text{ Naira per hour.}$$

The maximum and minimum loading of each unit are 100MW and 25Mw respectively. If the demand of 180MW, is shared by both units, determine

(i) the economic operating schedule and the corresponding cost of generation

(ii) the saving obtained by loading the units as per equal incremental production cost. **(9 MARKS)**

Question 6

(a)   What is power line carrier communication? State its advantages and major drawbacks.   **(5 MARKS)**

(b)   Explain how engineers at the National Control Centre, Oshogbo monitor in real time the status of the Nigeria power grid.   **(5 MARKS)**

(c)   Why would you recommend fibre optic as data transmission medium for the power system? Where has it found main application in the power system? **(5 MARKS)**