KATHMANDU UNIVERSITY
End Semester Examination
March/April, 2017

Marks Scored:

Level : B.E.
Year : IV

Course : EPEG 413
Semester: I

Exam Roll No. :

Time : 30 mins.

F. M. : 20

Registration No. :

Date : MAR 2 6 2017

SECTION "A"

[20 Q.×1=20 marks]

Choose and **encircled** the most appropriate answer.

1. The power system should operate with
   a. highest reliability standards, maximum operating costs and minimum environment impact.
   b. highest reliability standards, lowest operating costs and minimum environment impact.
   c. lowest reliability standards, lowest operating costs and minimum environment impact.
   d. highest reliability standards, lowest operating costs and maximum environment impact.

2. Advantages of high voltage transmission line are
   a. lower transmission losses per MW transfer, lower line voltage drop per Km, high transmission capacity per Km and lower capital and operating cost per MW transfer.
   b. higher transmission losses per MW transfer, lower line voltage drop per Km, high transmission capacity per Km and lower capital and operating cost per MW transfer.
   c. lower transmission losses per MW transfer, lower line voltage drop per Km, high transmission capacity per Km and higher capital and operating cost per MW transfer.
   d. lower transmission losses per MW transfer, higher line voltage drop per Km, high transmission capacity per Km and lower capital and operating cost per MW transfer.

3. Operation and control of power system is done through centralized and decentralized basis. Centralized (based on system wide data) handles the _____ events and decentralized (based on local data) acts _____ to tackle the problems.
   a. medium, slow b. slow, fast c. fast, slow d. slow, medium

4.

$$V_i^{(k+1)} = \frac{\dfrac{P_i^{sch} - jQ_i^{sch}}{V_i^{*(k)}} + \sum_{j=1, j\neq i}^{n} Y_{ij} V_j^{(k)}}{\sum_{j=0, j\neq i}^{n} Y_{ij}}$$

In the above equation P_i^{sch} and Q_i^{sch} are the net power flows into bus I due to the current entering the bus. For generator buses the value of P_i^{sch} and Q_i^{sch} is _____ when power is going into the bus and for load buses P_i^{sch} and Q_i^{sch} are _____ when the power is leaving the bus.

a. negative, positive b. positive, positive c. negative, negative d. positive, negative

5.

Node	U_{pu}	δ^0	P_{pu}	Q_{pu}
1	1.0	0	---	---
2	1.0	---	-1.0	---
3	---	---	-0.8	-0.6

From the table given above node 1, 2 and 3 represents

a. slack bus, load bus and PV bus respectively.
b. load bus, slack bus and PV bus respectively.
c. slack bus, PV bus and load bus respectively.
d. reference bus, slack bus and load bus respectively.

6. The unbalanced currents are $I_a=1.6\angle 25^0$, $I_b=1.0\angle 180^0$ and $Ic=0.9\angle 132^0$. The symmetrical components of these unbalanced currents are

a. $I_{ao} = 0.55\angle 96.5^0$, $I_{a1} = 0.94\angle -0.1^0$, $I_{a2} = 0.70\angle 22.3^0$
b. $I_{ao} = 0.45\angle 96.5^0$, $I_{a1} = 0.45\angle -0.1^0$, $I_{a2} = 0.60\angle 22.3^0$
c. $I_{ao} = 0.45\angle 96.5^0$, $I_{a1} = 0.94\angle -0.1^0$, $I_{a2} = 0.60\angle 22.3^0$
d. $I_{ao} = 0.45\angle 96.5^0$, $I_{a1} = 0.55\angle -0.1^0$, $I_{a2} = 0.70\angle 22.3^0$

7. The positive sequence network is composed of an emf in series with the positive sequence Impedance of the generator because
   a. the generated voltages are of zero sequence only as the generator is designed to supply balanced three phase voltages.
   b. the generated voltages are of positive sequence only as the generator is designed to supply balanced three phase voltages.
   c. the generated voltages are of negative sequence only as the generator is designed to supply balanced three phase voltages.
   d. the generated voltages are of positive sequence only as the generator is designed to supply unbalanced three phase voltages.

8. When adding $\mathbf{Z_b}$ from a new bus **p** to the reference bus then
   a. the column matrix of the currents multiplied by the new Z_{bus} will alter the voltages of the original network and will result in the **correct** voltage at the new bus p.
   b. the column matrix of the currents multiplied by the new Z_{bus} will not alter the voltages of the original network but will result in the ***same*** voltage at the new bus p.
   c. the column matrix of the currents multiplied by the new Z_{bus} will alter the voltages of the original network and will result in the ***same*** voltage at the new bus p.
   d. the column matrix of the currents multiplied by the new Z_{bus} will ***not*** alter the voltages of the original network and will result in the ***correct*** voltage at the new bus p.

9. Which of the following results in a symmetrical fault?
   a. single phase to earth
   b. phase to phase
   c. all three phases to earth
   d. two phases to earth

10. In a load flow analysis, the load connected at a bus is represented as
   a. constant current drawn from the bus
   b. constant impedance connected at the bus
   c. voltage and frequency dependent source at the bus
   d. constant real and reactive power drawn from the bus

11. In power system stability H stands for
   a. Stored kinetic energy in mega joules at synchronous speed/ machine rating in MVA
   b. machine rating in MVA /Stored kinetic energy in mega joules at synchronous speed
   c. Horse power
   d. Stored kinetic energy in mega joules at rated speed/ machine rating in MVA

12. The reactance of a generator designated X" is given as 0.25 per unit based on the generator's nameplate rating of 18kV, 500MVA. The base for calculations is 20 kV,100 MVA. The new base value for X" is
   a. 0.25 b. 0.50 c. 0.0405 d. 0.405

13. A power system network consists of three elements 0-1, 1-2 and 2-3 of per unit impedances j1.2, j0.2 and j0.15 respectively. It's bus impedance matrix is given by

a. $\begin{bmatrix} j1.2 & j0.2 & j0.15 \\ j0.2 & j0.2 & j1.2 \\ j0.15 & j1.2 & j1.55 \end{bmatrix}$

b. $\begin{bmatrix} j1.2 & j1.2 & j0.15 \\ j1.2 & j0.2 & j1.2 \\ j0.15 & j1.2 & j1.55 \end{bmatrix}$

c. $\begin{bmatrix} j1.2 & j1.2 & j1.2 \\ j1.2 & j1.4 & j1.4 \\ j1.2 & j1.2 & j1.55 \end{bmatrix}$

d. $\begin{bmatrix} j1.2 & j0.2 & j0.15 \\ j0.2 & j0.2 & j0.2 \\ j0.15 & j0.2 & j1.55 \end{bmatrix}$

14. For a load flow solution the quantities normally specified at a voltage controlled bus are
a. P and Q b. P and |V| c. Q and |V| d. P and δ

15. Zero sequence currents doesn't exist in the following fault
a. L-G b. L-L c. L-L-G d. L-L-L-G

16. The method of neutral grounding affects the
a. positive sequence network
b. negative sequence network
c. zero sequence network
d. both positive and zero sequence network

17. The impedance elements of Z_{bus} on the principle diagonal are called_____
a. transfer impedances of the nodes. b. driving point impedance of the nodes.
c. zero impedance of the nodes. d. real impedance of the nodes.

18. For a typical power system with high X/R ratio, which of the following observation is made?
a. Small changes in δ_1 and δ_2 will have significant effect on real power flow and small changes in voltage magnitude will not have appreciable effect on the real power flow.
b. Small changes in δ_1 and δ_2 will have less effect on real power flow and small changes in voltage magnitude will not have appreciable effect on the real power flow.
c. Small changes in δ_1 and δ_2 will have significant effect on real power flow and small changes in voltage magnitude will also have appreciable effect on the real power flow.
d. Small changes in δ_1 and δ_2 will have less effect on real power flow and small changes in voltage magnitude will also have appreciable effect on the real power flow.

19. A symmetrical fault on a power system is _____an unsymmetrical fault
a. More severe and more occurrence than b. More severe and less occurrence than
c. less severe and more occurrence than d. less severe and less occurrence

20. Load flow study is carried out for
a. load frequency control b. planning of power system
c. fault calculations d. study of stability of the system

KATHMANDU UNIVERSITY
End Semester Examination
March/April, 2017

MAR 2 6 2017

Level : B.E.
Year : IV
Time : 2 hrs. 30 mins.

Course : EPEG 413
Semester: I
F. M. : 55

SECTION "B"

Attempt ***any five*** questions. Each question carries 11 marks. Assume relevant values if necessary.

Question 1 (Basic concept and system modelling)

1.1. A single phase inductive load draws 10MW at 0.6 power factor lagging. Draw the power triangle and determine the reactive power of a capacitor to be connected in parallel with the load to raise the power factor to 0.85. [4 Marks]

1.2 Briefly explain the power apparatus modeling of power system. [3 Marks]

1.3 What are the advantages of per unit representation? [4 Marks]

Question 2 (Load Flow Solutions and Control)

2.1 A three bus power system is shown in figure 2. The relevant per unit line admittances on 100MVA base are indicated on the diagram and bus data are given in the table 2.

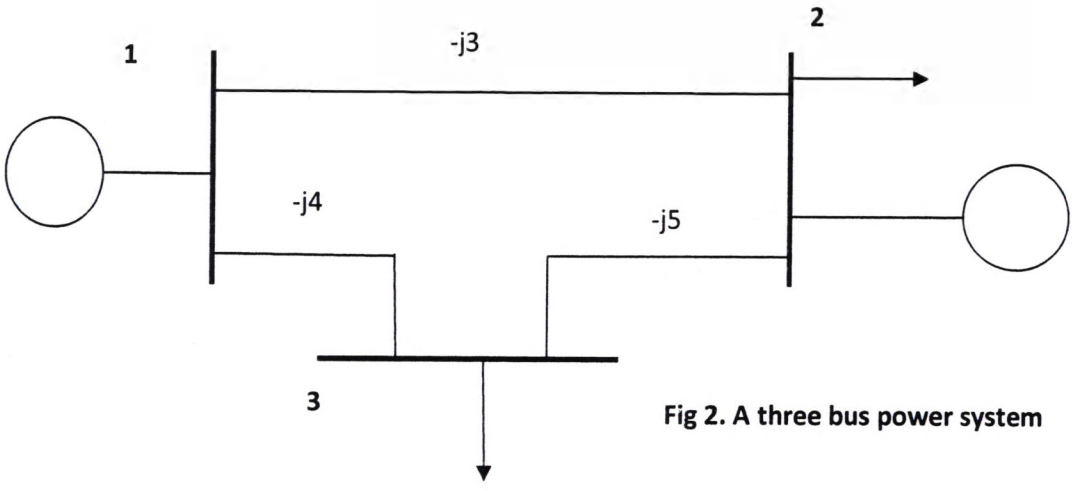

Fig 2. A three bus power system

Table 2

Bus number	Type	Generation		Load		Bus Voltage	
		P_G(MW)	Q_G(MVAr)	P_L(MW)	Q_L(MVAr)	V pu	δ deg.
1	Slack	?	?	0	0	1.02	0°
2	PQ	25	15	50	25	?	?
3	PQ	0	0	60	30	?	?

Form Ybus and determine the voltages at bus 2 and 3 after **first iteration using Gauss-Seidel** method. [7 Marks]

2.2 What is the significance of load flow analysis in a power system? Give the classification of various types of buses in power system for load flow studies. Justify the classification. [4 Marks]

Question 3 (Symmetrical Three Phase Faults)

3.1 . The one-line diagram of a simple power system is shown in Figure 3.1. Each generator is represented by an emf behind the transient reactance. All impedances are expressed in per unit on a common MVA base. All resistances and shunt capacitances are neglected. The generators are operating on no load at their rated voltage with their emfs in phase. A three-phase fault occurs at bus 1 through a fault impedance of $Zf = j0.08$ per unit.
(a) Using Thevenin's theorem obtain the impedance to the point of fault and the fault current in per unit.
(b) Determine the bus voltages and line currents during fault. [7 Marks]

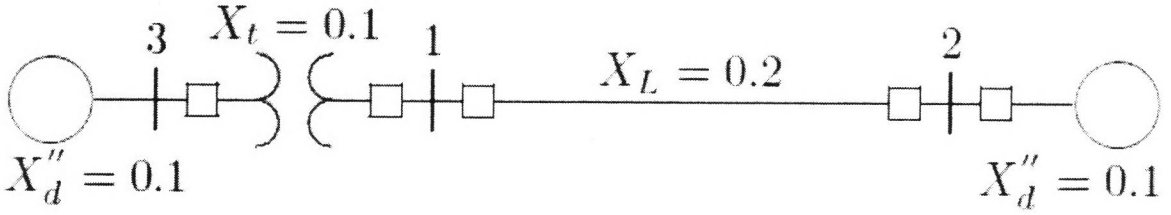

Fig 3.1

3.2 Determine Z_{bus} for the network shown in fig. 3.2 where impedances are shown in per unit.

Preserve all three nodes.

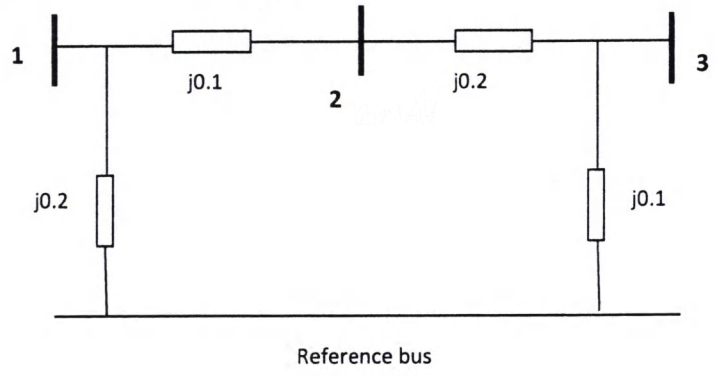

Fig 3.2

[4 Marks]

Question 4 (Symmetrical Components)

4.1 Draw the zero sequence network for the system shown in figure 4. [7 Marks]

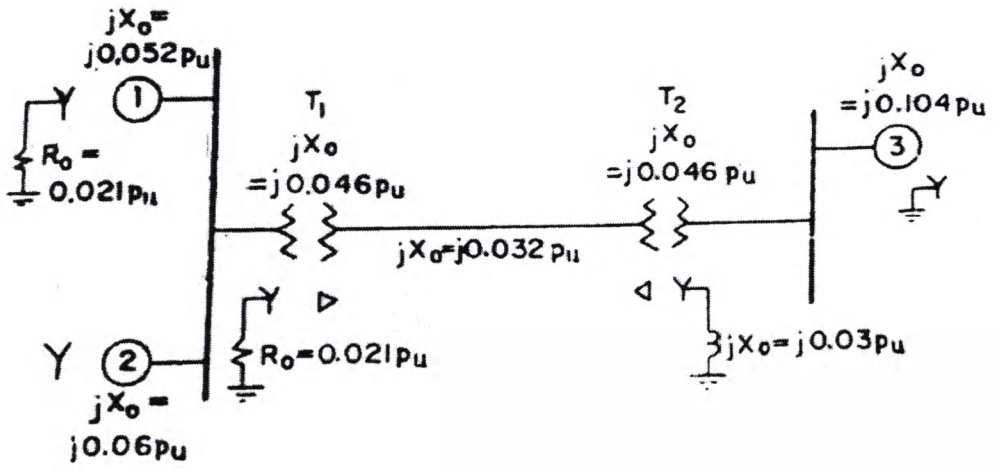

Fig 4.

4.2 One conductor of a three phase line is open. The current flowing to a Delta connected load through line '***a***' is 20A. With the current in line '***a***' as reference and assuming that line '*c*' is open; find the symmetrical components of the line currents.

$I_a = 20\angle 0^\circ$ A $I_b = 20\angle 180^\circ$ A $I_c = 0$ A [4 Marks]

Question 5(Unsymmetrical Faults)

5.1 Give the general procedure used in the analysis of various types of shunt faults. Derive the relationship to determine the fault current for a line to line fault. Draw an equivalent network showing interconnection of sequence networks to simulate L-L fault. [5 Marks]

5.2 A salient pole generator without dampers is rated 20 MVA, 13.8 kV and has a direct axis sub-transient reactance of 0.25 per unit. The negative and zero sequence reactances are 0.35 and 0.10 per unit respectively. The neutral of the generator is solidly grounded. Determine the sub-transient current in the generator and the line to line voltages for sub-transient conditions when a single line to ground fault occurs at generator terminals with the generator operating unloaded at rated voltage. Neglect resistance. [6 Marks]

Question 6 (Power system Stability and Short notes)

6.1 Explain briefly the equal area criterion and how it may be used to study the stability of two machine system. [5 Marks]

6.2 Write short notes on (any three) [3×2= 6 Marks]

1. Load Shedding effects in the context of Nepal
2. Selection of circuit breakers
3. Newton Raphson method for load flow solution
4. Steady state stability