WEST BENGAL UNIVERSITY OF TECHNOLOGY

EE-602

POWER SYSTEM-II

Time Allotted: 3 Hours   Full Marks: 70

The questions are of equal value
The figures in the margin indicate full marks
Candidates are required to give their answers in their own words as far as practicable.

GROUP A
(Multiple Choice Type Questions)

1.   Answer any *ten* questions. $10 \times 1 = 10$

(i) Bus admittance matrix is a

(A) full matrix   (B) diagonal matrix

(C) sparse matrix   (D) rectangular matrix

(ii) The rate of rise of restriking voltage depends on

(A) the type of circuit breaker

(B) the inductance of the system only

(C) the capacitance of the system only

(D) both impedance & capacitance of the system

(iii) Zero sequence current can flow from a line into a transformer bank if the windings are in

(A) grounded star/delta   (B) star/grounded star

(C) delta/star   (D) delta/delta

(iv) Ring main distribution system is preferred to a radial system, because

(A) it is less expensive   (B) voltage drop in the feeder is less

(C) supply is more reliable   (D) power factor is higher

(v) An acceleration factor is used in load flow study by

(A) Newton- Raphson method   (B) Gauss-Seidal method

(C) Decoupled method   (D) Fast decoupled method

(vi) The arc voltage in a circuit breaker is

(A) in phase with the arc current

(B) lagging the arc current by 90°

(C) leading the arc current by 90°

(D) in phase opposition to the arc current

(vii) Which of the following quantities can never have a zero sequence component?

(A) Phase voltages

(B) Line voltages

(C) Line current of three phase form wire distribution system

(D) Line current in case of line to ground faults

(viii) Which of the following relays has the best reflectivity?

(A) over current relay   (B) differential relay

(C) impedance relay   (D) mho realy

(ix) If X_0, X_1 & X_2 are the zero, positive & negative sequence reactance's of synchronous generator, then

(A) $X_0 = X_1 = X_2$ (B) $X_0 > X_1 > X_2$

(C) $X_1 > X_2 > X_0$ (D) $X_1 < X_2 < X_0$

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(x) A 3 phase 4 wire system is commonly used for

(A) primary distribution   (B) secondary distribution

(C) primary transmission   (D) secondary transmission

(xi) The zero sequence current of a generator for L-G fault is 2.4 P.U. Then the current through the neutral during the fault is

(A) 2.4 P.U.   (B) 0.8 P.U.

(C) 7.2 P.U.   (D) 0.24 P.U.

(xii) Solution of static load flow equation of swing bus yields

(A) magnitude of V_i & δ_i (B) Q_{Gi} & δ_i

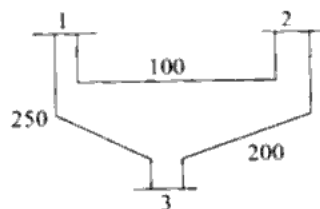(C) P_{Gi} & Q_{Gi} (D) magnitude of V_i & Q_{Gi}

GROUP B
(Short Answer Type Questions)

Answer any *three* questions.   3×5 = 15

2. The single line diagram of a network is shown in the figure below. The line series reactance is 0.001 p.u per km and shunt susceptance is 0.0016 p.u.per km. Assemble the bus admittance matrix (Y_{Bus}) of the network.   5

3. What is a substation? Discuss the function and location of instrument transformers in a substation.   2+3

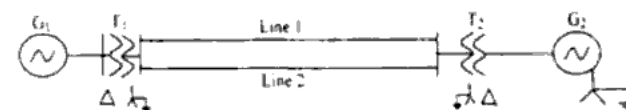CS/B.Tech/EE/Even/Sem-6th/EE-602/2015

4. Explain the principle of operation of a Buchholz relay.   5

5. A three phase 11 kV, 20mVA generator with positive, negative & zero sequence reactances as 0.4 P.U., 0.4 P.U. & 0.1 P.U. respectively is grounded through a reactance of 0.6 ohm. Calculate the fault current for a single line to ground fault.   5

6. What is meant by current chopping in circuit breaker? Discuss methods to reduce it.   5

7. Derive relation between the sequence current in case of a single line to ground fault at the terminal of an initially unloaded synchronous generator & draw the corresponding sequence diagram.   3+2

GROUP C
(Long Answer Type Questions)

Answer any *three* questions.   3×15 = 45

8. (a) The single line diagram of a power system is shown in figure. Draw positive, negative and zero sequence networks with indication of per unit reactance and per unit voltages.   10

The system data is as under:

Equipment	MVA rating	KV rating	X_1	X_2	X_0
G_1	100	11	0.25	0.25	0.05
G_2	100	11	0.2	0.2	0.05
T_1	100	11/220	0.06	0.06	0.06
T_2	100	11/220	0.07	0.07	0.07
Line 1	100	220	0.1	0.1	0.3
Line 2	100	220	0.1	0.1	0.3

(b) What is meant by fault in power system? Explain unsymmetrical faults in power system.　　2+3

9. (a) Derive the swing equation of a synchronous machine swinging against an infinite bus. Clearly state the assumption in deducing the swing equation.　　5

(b) A synchronous generator is delivering 0.5 P.U. power to infinite bus, the steady state stability limit of the generator being 1.0 P.U. The input power of the generator is suddenly increased to 0.85 P.U. Determine , whether the generator can maintain transient stability or not.　　6

(c) A 2-pole 50 Hz, 11kV turbo alternator has a ratio of 100 MW, power factor 0.85 lagging. The rotor has a moment of inertia of 10,000 kg.m². Calculate H and M.　　4

10.(a) Explain clearly the basic principle of operation of a differential relay. What is meant by percent bias? How is this achieved in practice in differential relay? Under what circumstances is a percentage differential relay preferred over differential relay?　　9

(b) Describe different types of protection of oil filled star/delta transformer.　　6

11.(a) Derive the power flow equation in polar form.　　5

(b) Write the advantages and disadvantages of Gauss-Seidel method and Newton-Raphson method.　　5

(c) The parameters of a 4-bus system are as under:　　5

Bus code	Line impedance (pu)	Charging admittance(pu)
1-2	0.2 + j 0.8	j 0.02
2-3	0.3 + j 0.9	j 0.03
2-4	0.25 + j 1.0	j 0.04
3-4	0.2 + j 0.8	j 0.02
1-3	0.1 + j 0.4	j 0.01

Draw the network and find bus admittance matrix.

12.(a) Explain the following terms in connection with circuit breaker　　5

(i) Restriking voltage

(ii) Recovery voltage

(iii)RRRV

(b) Explain different methods of arc extinction in circuit breaker.　　5

(c) A 3 phase transformer of 220/11000 volts is connected in star/delta. The protective transformers on 220V side have a current ratio of 600/5. What should be the CT ratio on 11000 V side?　　5

13. Write short notes on any three of the following:　　3×5

(a) Sub station equipments

(b) Steady state stability & transient stability

(c) Phase & amplitude comparator

(d) Alternator protection scheme

(e) Protective zones.