MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

Paper Code : EE-602

POWER SYSTEM-II

Time Allotted : 3 Hours   *Full Marks* : 70

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. Choose the correct alternatives for any *ten* of the following :   10 × 1 = 10

    i) Two buses are connected by an impedance of (0 + J5) ohms. The bus 1 voltage is 100 < 30° and bus 2 voltage is 100 < 0°. The real and reactive power supplied by the bus 1 respectively, are

      a) 1000 W, 268 VAR

      b) – 1000 W, – 134 VAR

      c) 276·9 W, – 56·7 VAR

      d) – 276·9 W, 56·7 VAR.

    ii) The arc voltage in a circuit breaker is

      a) in phase with arc current by 90°

      b) lagging the arc current by 90°

      c) leading the arc current by 90°

      d) lagging the arc current by 180°.

    iii) Bus admittance matrix is a

      a) full matrix

      b) sparse matrix

      c) diagonal matrix

      d) rectangular matrix.

    iv) An acceleration factor is used in load flow study by

      a) Newton-Raphson method

      b) Gauss-Seidel method

      c) Decoupled method

      d) Fast Decoupled method.

    v) Transient stability of the power system can be effectively improved by

      a) excitation control

      b) phase shifting transformer

      c) single pole switching of circuit breakers

      d) increasing the turbine valve opening.

vi) The rate of rise of restricking 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 inductance & capacitance of the system.

vii) By the term 'burden' of the relay, we generally mean

    a) volt-ampere rating of relay

    b) current rating of relay

    c) voltage rating of relay

    d) watt rating of relay.

viii) Zero sequence currents can flow from a line into transformer bank if the windings are

    a) grounded star-delta

    b) delta-star

    c) star-grounded star

    d) delta-delta.

ix) If X_0, X_1 and X_2 are zero, positive and negative sequence reactances 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) $X_1 < X_2 < X_0$.

x) A MhO relay is a

    a) voltage restrained directional relay

    b) voltage controlled overcurrent relay

    c) directional restrained overcurrent relay

    d) directional restrained overvoltage relay.

xi) Oven fluxing protection is recommended for

    a) generator transformer of the power plant

    b) auto transformer of the power plant

    c) station transformer of the power plant

    d) distribution transformer.

xii) The relay used for the feeder protection is

    a) undervoltage relay

    b) translay relay

    c) impedance relay

    d) differential relay.

GROUP – B
(Short Answer Type Questions)
Answer any *three* of the following. $3 \times 5 = 15$

2. A d.c. two wire distributor AB, 300 m long is fed from both ends & supplies a uniformly distributed load of 0·15 A per metre, together with the following concentrated loads : 50 A at C, and 60 A at B & 40 A at E. The supply voltage at A & B are 206 volt & 200 volt respectively and the resistance of each conductor is 0·00015 Ω per metre. If AC = 75 metre, CD = 100 metre and DE = 50 metre, calculate the current supplied at each end.
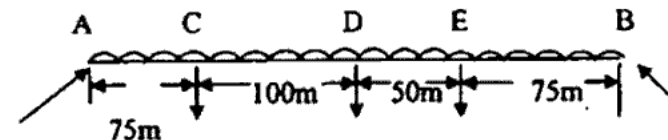
3. Draw a neat layout of a 132/33 kV substation having two 132 kV incoming lines & four 33 kV outgoing lines.

4. Find the expression of positive sequence component of current of phase A is a 3-phase unloaded alternator if a single line to ground fault occurs on phase A.

5. A 200 MVA, 2 pole, 50 Hz alternator has a moment of inertia of 50×10^3 kg-m^2.

   a) What is the energy stored in the rotor at the rated speed ?

   b) What are the values of H and angular momentum ?

6. Two generating stations have short-circuit capacities of 1500 MVA and 1000 MVA respectively. Assume base MVA to be 100 MVA and the generating stations operating at 11 kV, are linked by an interconnecting cable having a reactance of 0.6 Ω/phase. Determine the short-circuit capacity of each station.

GROUP – C
(Long Answer Type Questions)
Answer any *three* of the following. $3 \times 15 = 45$

7. a) What is meant by 'directional feature' of a directional overcurrent relay ? Describe the construction, principle of operation and application of a directional overcurrent relay.

   b) A 66 kV, 50 Hz, 3-phase alternator has an earthed neutral. The induction and capacitance per phase of the system are 7 mH and 0.01 μF respectively. The short-circuit test gave the following results : Power factor of the fault 0.25, fault current symmetrical recovery voltage is 90% of full line voltage. Assuming that the fault is isolated from the ground, calculate the RRRV. $8 + 7$

8. a) The following is the system data for a load flow solution :

   The line admittances :

Bus Code	Admittance
1 - 2	2 - j8
1 - 3	1 - j4
2 - 3	0.666 - j2.664
2 - 4	1 - j4
3 - 4	2 - j8

   The scheduled of active and reactive powers :

Bus Code	P	Q	V	Remarks
1	—	—	1.06	Slack
2	0.5	0.2	1 + j0.0	PQ
3	0.4	0.3	1 + j0.0	PQ
4	0.3	0.1	1 + j0.0	PQ

   Determine the voltage at the end of first iteration using Gauss-Seidel method. Take $\alpha = 1.6$

   b) Distinguish between voltage control bus and swing bus. What do you mean by Jacobian Matrix ? Discuss the NR method of solving SLFE and develop the corresponding flow chart. $5 + 10$

9. a) Explain the various methods of arc extinction in a circuit breaker.

   b) Describe with a neat sketch, the principle of operation of a minimum oil circuit breaker. Why is it called so ? $7 + (6 + 2)$

10. a) A three phase, 6 MVA, 6·6 kV generator has a reactance of 0·1 p.u. It is connected through a 6 MVA, 6·6/33 kV, 0·09 p.u. reactance transformer to a transmission line having a resistance of 0·09 Ω and reactance of 0·36 Ω per km. A three-phase short circuit occurs at a distance of 10 km from the transformer. The generator voltage at the time of fault is 7·2 kV. Find the fault current in the generator.

b) Derive the expression for fault current in line-to-line fault on an unloaded generator in terms of symmetrical components.   7 + 8

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

   a) Equal area criteria of stability

   b) Current chopping phenomenon

   c) Effects of negative sequence current on alternator & transformers

   d) Protection scheme for induction motor.

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