CLASS TEST

S.No. : 01 SK_ABCD_250422

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ELECTRICAL ENGINEERING

Power Systems-2

Duration : 1:00 hr. **Maximum Marks : 50**

Read the following instructions carefully

1. This question paper contains **30** objective questions. **Q.1-10** carry one mark each and **Q.11-30** carry two marks each.
2. Answer all the questions.
3. Questions must be answered on Objective Response Sheet (**ORS**) by darkening the appropriate bubble (marked **A**, **B**, **C**, **D**) using HB pencil against the question number. Each question has only one correct answer. In case you wish to change an answer, erase the old answer completely using a good soft eraser.
4. There will be **NEGATIVE** marking. For each wrong answer **1/3rd** of the full marks of the question will be deducted. More than one answer marked against a question will be deemed as an incorrect response and will be negatively marked.
5. Write your name & Roll No. at the specified locations on the right half of the **ORS**.
6. No charts or tables will be provided in the examination hall.
7. Choose the **Closest** numerical answer among the choices given.
8. If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to that questions.
9. If a question is left blank, i.e., no answer is given by the candidate, there will be **no penalty** for that question.

DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE ASKED TO DO SO

Q.No. 1 to Q.No. 10 carry 1 mark each

Q.1 For a power system:
Line to line fault current = $-j$ 2.5 p.u.
3-ϕ fault current = $-j$ 5 p.u.
The positive and negative sequence reactances are

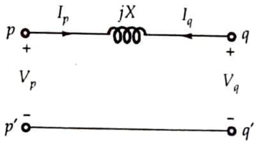
(a) X_1 = 0.3 p.u., X_2 = 0.1 p.u.
(b) X_1 = j0.2 p.u., X_2 = j 0.49 p.u.
(c) X_1 = 0.1 p.u., X_2 = 0.3 p.u.
(d) X_1 = 0.25 p.u., X_2 = 0.15 p.u.

Q.2 A synchronous generator neutral is grounded through a reactance X_n. The generator has balanced emfs and sequence reactances X_1, X_2 and X_0. The value of neutral grounding reactance for which the LG fault current is less than the three phase fault current is

(a) $X_n < \frac{1}{3}(X_1 - X_0)$ (b) $X_n > (X_1 + X_0)$

(c) $X_n > \frac{1}{3}(X_1 - X_0)$ (d) $X_n > X_1 + 2X_0$

Q.3 Given the model of the transformer shown in figure, obtain the Y_{bus} representation of the transformer.



(a) $Y_{bus} = \begin{bmatrix} \frac{1}{jX} & \frac{1}{jX} \\ \frac{1}{jX} & \frac{1}{jX} \end{bmatrix}$

(b) $Y_{bus} = \begin{bmatrix} \frac{1}{jX} & \frac{-1}{jX} \\ \frac{-1}{jX} & \frac{1}{jX} \end{bmatrix}$

(c) $Y_{bus} = \begin{bmatrix} jX & -jX \\ -jX & jX \end{bmatrix}$

(d) $Y_{bus} = \begin{bmatrix} jX & jX \\ jX & jX \end{bmatrix}$

Q.4 The following sequence current were recorded in a power system under a fault condition.

$$I_{positive} = j\,1.653 \text{ pu},$$
$$I_{negative} = -j\,0.5 \text{ pu},$$
$$I_{zero} = -j\,1.153 \text{ pu}$$

The fault is

(a) line to ground
(b) three phase
(c) line to line to ground
(d) line to line

Q.5 The power angle characteristic of single machine-infinite bus system is $P_e = 2 \sin \delta$ pu. It is operating at $\delta = 30°$. Which one of the following is the synchronizing power coefficient at the operating point?

(a) 1.0
(b) $\sqrt{3}$
(c) 2.0
(d) $\frac{1}{\sqrt{3}}$

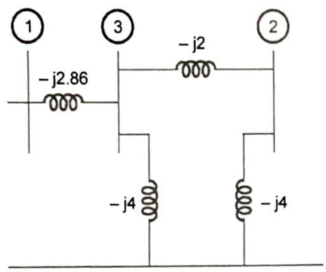
Q.6 A three phase Y-connected alternator rated as 10 MVA, 13.8 kV has following sequence reactances: X_1 = 0.3 pu, X_2 = 0.4 pu, X_0 = 0.05 pu. A reactance X_n is to be added in the generator neutral such that the fault current for a line to ground fault of zero fault impedance will not exceed the rated line current. The per unit value of X_n is

(a) 0.083 pu (b) 0.25 pu
(c) 0.75 pu (d) 2.25 pu

Q.7 A synchronous generator having an inertia constant of 6.0 MJ/MVA in delivering power of 1.0 pu to an infinite bus through a purely reactive network. Suddenly a fault occurs reducing the generator output power to zero. The maximum power that could be delivered is 2 pu. The critical cleaning angle (δ_{cr}) is-

(a) 89.27° (b) 59.33°
(c) 79.55° (d) 86.20°

Q.8 In the system shown below,



the Y_{Bus} matrix is,

(a) $j\begin{bmatrix} 2.86 & 4 & 2 \\ 2 & -4 & 2.2 \\ 4 & 2.2 & 8.86 \end{bmatrix}$

(b) $j\begin{bmatrix} -2.86 & 0 & 2.2 \\ 0 & -4 & 4 \\ 2.2 & 4 & -8.86 \end{bmatrix}$

(c) $j\begin{bmatrix} -2.86 & 0 & 2.86 \\ 0 & -6 & 2 \\ 2.86 & 2 & -8.86 \end{bmatrix}$

(d) $j\begin{bmatrix} 2.86 & -4 & 2 \\ -4 & 2 & 0 \\ 4 & 0 & 8.66 \end{bmatrix}$

Q.9 A 400 MVA synchronous machine has H_1 = 4 MJ/MVA and a 1600 MVA machine has H_2 = 2 MJ/MVA. The two machines operate in parallel in a power station. The equivalent H constant for the two on the base of 200 MVA is

(a) 24 MJ/MVA (b) 12 MJ/MVA
(c) 48 MJ/MVA (d) 6 MJ/MVA

Q.10 A 112-bus power system has 91 *PQ* buses and 20 PV buses. In the general case, to obtain the load flow solution using Newton-Raphson method in polar co-ordinates, the minimum number of simultaneous equations to be solved are

(a) 224 (b) 204
(c) 202 (d) 206

Q. No. 11 to Q. No. 30 carry 2 marks each

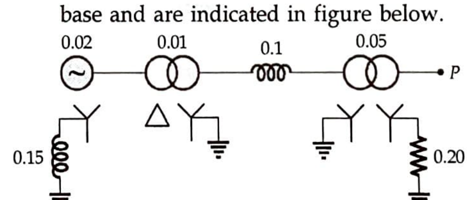
Q.11 A three phase transformer has rating of 10 MVA, 220 kV (star)/33 kV (delta) with leakage reactance of 10%. The transformer reactance (in ohms) reffered to each phase of the L.V. delta connected side is

(a) 21.1 Ω (b) 32.6 Ω
(c) 9.26 Ω (d) 19.6 Ω

Q.12 A generator operating at 50 Hz delivers 1 pu power to an infinite bus through a transmission circuit in which resistance is ignored. A fault takes place reducing the maximum power transferable to 0.5 pu. Where as before the fault, this power was 2.0 pu and after the clearance of the fault, it is 1.5 pu. The critical clearing angle is

(a) 55.5° (b) 70.3°
(c) 60.6° (d) 80.2°

Q.13 A generator is connected to a transformer which feeds another transformer through a short feeder. The zero sequence impedance values are expressed in p.u. on a common base and are indicated in figure below.



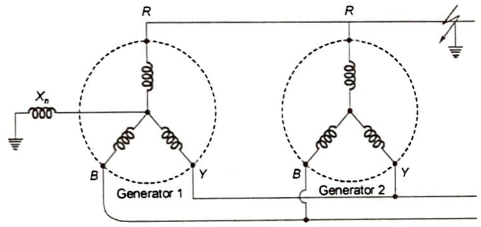
The Thevenin's equivalent of zero sequence impedance at P is

(a) $(1.5 + j\,0.25)$ p.u.
(b) $(0.6 + j\,0.16)$ p.u.
(c) $(0.8 + j\,0.6)$ p.u.
(d) $(0.75 + j\,0.22)$ p.u.

Q.14 For a two machine system with losses, with the transfer impedance being resistive, the maximum value of the sending end power $P_{1\,max}$ and the maximum receiving end power $P_{2\,max}$ will occur at power angles (δ) in such a manner that

(a) Both $P_{1\,max}$ and $P_{2\,max}$ occur at $\delta < 90°$
(b) Both $P_{1\,max}$ and $P_{2\,max}$ occur at $\delta > 90°$
(c) $P_{1\,max}$ occur at $\delta > 90°$ and $P_{2\,max}$ at $\delta < 90°$
(d) $P_{1\,max}$ occur at $\delta < 90°$ and $P_{2\,max}$ at $\delta > 90°$

Q.15 A 20 MVA, 11 KV, 3-phase, 50 Hz generator has its neutral earthed through a 5% reactor. It is in parallel with another identical generator having isolated neutral. Each generator has a positive sequence reactance of 20%, negative sequence reactance of 10% and zero sequence reactance of 15%. If a line to ground short circuit occurs in the common bus bar, then the magnitude of fault current is



(a) 6998 A (b) 7899 A
(c) 8258 A (d) 8691 A

Q.16 Two generators G_1 and G_2 rated 10 MVA, 11 kV and 5 MVA, 11 kV respectively are connected to a 15 MVA, 11/66kV transformer (Δ/Y) with 10% reactance. If both the generators have a substransient reactance of 20%, the substransient current in generator-1 when a three phase fault occurs on h.v. side of the transformer assuming that there is no circulating current in the machines is

(a) j 5.221 p.u. (b) $-j$ 1.111 p.u.
(c) j 3.212 p.u. (d) $-j$ 3.333 p.u.

Q.17 A 3-phase generator rated at 100 MVA, 11 kV is connected through circuit breakers to a transformer. The generator reactances are:

$$X_d'' = 22\%$$
$$X_d' = 30\%$$
$$X_d = 120\%$$

The generator is operating at no load and rated voltage when a three phase short circuit fault occurs between the breakers and the transformer. The magnitude of initial symmetrical rms current is

(a) 23.82 kA (b) 24.9 kA
(c) 20.16 kA (d) 26.2 kA

Q.18 The base impedance matrix of a 4-bus power system is given by

$$Z_{Bus} = \begin{bmatrix} j0.34 & j0.28 & j0.27 & j0.22 \\ j0.28 & j0.34 & j0.25 & j0.24 \\ j0.27 & j0.25 & j0.28 & j0.22 \\ j0.22 & j0.24 & j0.22 & j0.27 \end{bmatrix}$$

If a branch having an impedance of j 0.1Ω is connected between bus-2 and the reference bus, then the values of $Z_{22,new}$ and $Z_{23,new}$ of the bus impedance matrix of the modified network are respectively

(a) 0.0568, 0.0772 (b) 0.0568, 0.0172
(c) 0.0772, 0.0772 (d) 0.0772, 0.0568

Q.19 A 50 MVA, 11 kV, three phase synchronous generator was subjected to different types of faults. The fault current are as follows

LG fault = 4200 A,
LL fault = 2600 A,
3- ϕ fault = 2000 A

The generator neutral is solidly grounded. The value of the zero sequence reactances of the generator is

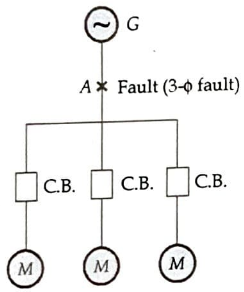
(a) 0.305 Ω (b) 0.701 Ω
(c) 1.105 Ω (d) 2.111 Ω

Q.20 A synchronous generator is rated 25 MVA, 11 kV. It is star connected with neutral point solidly grounded. The generator is operating at no-load rated voltage. Positive, negative and zero sequence reactances are 0.2 p.u., 0.2 p.u. and 0.08 p.u. respectively. A line to line fault occurs on b and c phases of generator. Then the magnitude of fault current will be

(a) 1.312 kA (b) 5.68 kA
(c) 4.33 kA (d) 3.28 kA

Q.21 A 500 kVA, 2.5 kV generator with transient reactance of 8% is connected to a bus through a circuit breaker as shown in below figure. The synchronous motors each rated 250 kVA, 2.5 kV. The sub transient reactance of each of the motors being 20%. If a 3-ϕ short circuit fault occurs at point A. Then

the current contribution of each motor in fault current (in p.u.) is
(Assume prefault voltage is rated voltage)

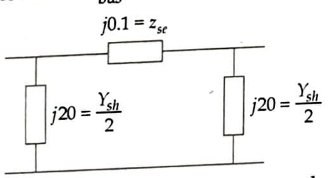


(a) $-j7.5$ (b) $-j2.5$
(c) $-j12.5$ (d) $-j20$

Q.22 For the 4-bus system, containing transmission lines and transformers. The admittance matrix is

$$Y_{bus} = \begin{bmatrix} -j20 & j20 & 0 & 0 \\ j20 & -j60 & j40 & 0 \\ 0 & j40 & -j60 & j20 \\ 0 & 0 & j20 & -j25 \end{bmatrix}$$

If a transmission line having π-equivalent circuit as shown below is connected between 2nd and 4th buses. Then the modified Y_{bus} matrix will be



Where, Z_{se} = series impedance of transmission line.
Y_{sh} = shunt admittance of transmission line.

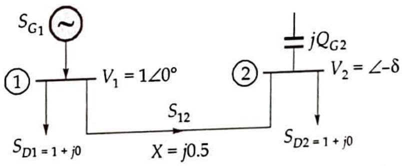
(a) $\begin{bmatrix} -j20 & j20 & 0 & 0 \\ j20 & -j50 & j40 & 0 \\ 0 & j40 & -j60 & j20 \\ 0 & 0 & j20 & -j15 \end{bmatrix}$

(b) $\begin{bmatrix} -j20 & j20 & 0 & 0 \\ j20 & -j40 & j40 & 0 \\ 0 & j40 & -j60 & j20 \\ 0 & -j20 & j20 & -j15 \end{bmatrix}$

(c) $\begin{bmatrix} -j20 & j20 & 0 & 0 \\ j20 & -j50 & j40 & -j20 \\ 0 & j40 & -j60 & j20 \\ 0 & -j20 & j20 & -j15 \end{bmatrix}$

(d) $\begin{bmatrix} -j20 & j20 & 0 & 0 \\ j20 & -j40 & j40 & -j20 \\ 0 & j40 & -j60 & j20 \\ 0 & -j20 & j20 & -j5 \end{bmatrix}$

Q.23 For the system shown in figure below, all quantities are per phase values and are in per unit.



If reactive power supplied by capacitor to bus-1 is zero. Then the voltage at bus-2 is

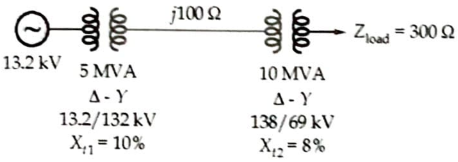
(a) $\frac{1}{\sqrt{2}}\angle 45°$ (b) $1\angle 0°$
(c) $\frac{1}{\sqrt{2}}\angle -45°$ (d) $\sqrt{2}\angle -45°$

Q.24 A 50 Hz synchronous generator is connected to an infinite bus through a line. The p.u. reactance of the generator and the line are $j0.25$ and $j0.15$ p.u. on system base respectively. The generator no load voltage is 1.2 p.u. and that of the infinite bus is 1 p.u. The inertia constant of the generator is 4 MW-sec/MVA. If the generator is loaded to 80% of its maximum power transfer capability and a small perturbation is given, then the natural frequency of oscillations will be (in Hz)

(a) 50 Hz (b) 2.68 Hz
(c) 3.64 Hz (d) 1.34 Hz

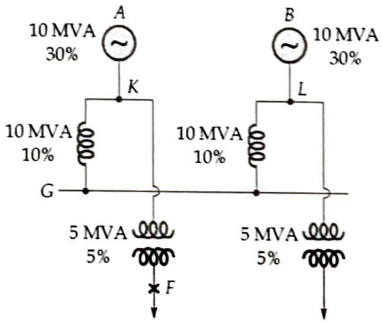
Q.25 Consider a system with the one-line diagram shown in below figure. The three phase transformer name plate ratings are listed. The transformer reactances are given in percent, (10% = 0.1 p.u.). The transmission line and load impedances are in actual ohms.

The generator terminal voltage (magnitude) is 13.2 kV (line-line) then the load voltage is



(a) 58.93 kV
(b) 78.20 kV
(c) 69.02 kV
(d) 13.20 kV

Q.26 A generating station is laid out as shown in figure below. If a 3-φ fault occurs at F, then the short circuit MVA fed to the fault is

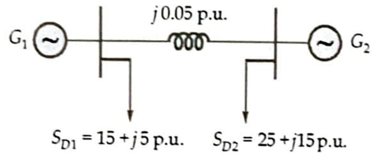


(a) 10 MVA
(b) 34.78 MVA
(c) 30 MVA
(d) 17.62 MVA

Q.27 A 100 MVA, 50 Hz synchronous generator having inertia constant H = 5 kW-s/KVA on full load at unity power factor. The load is suddenly reduced to 60 MW. Due to time lag in governor system, the steam valve begins to close after 0.5 second. The change in frequency that occurs in this time is

(a) 5 Hz
(b) 3.6 Hz
(c) 1 Hz
(d) 2.4 Hz

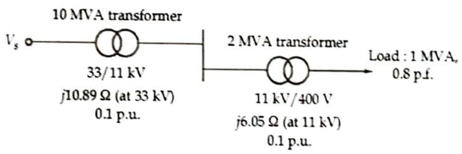
Q.28 In the system shown below,



If the station loads are equalized by the flow of power in the cable and generator G_1 can generate a maximum of 20 p.u. real power, then the power factor at station 2 is (Desired voltage profile is flat i.e. $|V_1| = |V_2|$ = 1 p.u.)

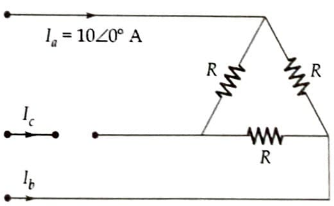
(a) 0.92 lag
(b) 0.75 lag
(c) 0.78 lag
(d) 0.95 lag

Q.29 In the circuit shown below, if a load of 1 MVA, 0.8 p.f. is supplied at 400 V then the value of V_s is



(a) 34.22 kV
(b) 33 kV
(c) 38.62 kV
(d) 36 kV

Q.30 In the circuit shown below,



The magnitude of positive sequence current of 'a' phase is

(a) 17.31 A
(b) 5.77 A
(c) 3.33 A
(d) 21.60 A

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