GURU NANAK INSTITUTE OF TECHNOLOGY
An Autonomous Institute under MAKAUT
2021
POWER SYSTEM-II
EE602

TIME ALLOTTED: 3HR **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)

Answer any ***ten*** from the following, choosing the correct alternative of each question: **10×1=10**

			Marks	CO No.
1.	(i)	A 11 KV, 10 MVA alternator has impedance of 0.10 pu when referred to its ratings as bases. The new value for base as 110 KV, 20 MVA will be (a) 0.002 pu (b) 0.20 pu (c) 0.10 pu (d) 0.02 pu.	1	CO1
	(ii)	An acceleration factor is used in load flow studies by a)Gauss-Siedel Method b)NR method c)Decoupled method d)None	1	CO2
	(iii)	The negative sequence component of a voltage is equal to (a) positive sequence component in reverse direction (b) complex conjugate of positive sequence component (c) multiple of operator "b" with positive sequence component (d) none of these.	1	CO2
	(iv)	In a load flow study Y_{bus} matrix is (a)null matrix (b)sparse matrix (c)full matrix (d)unity matrix	1	CO2
	(v)	The zero sequence current will not flow in the (a) L.G fault (b) L.L.G fault (c) L.L fault (d) L.L.L.G fault	1	CO2
	(vi)	A 50 Hz, 4 pole alternator rated at 20 MVA, 13.2 KV has an inertia constant H = 4 KW.sec/KVA. The K.E. stored in the rotor at synchronous speed is (a) 80 KJ (b) 80 MJ (c) 40 MJ	1	CO1

	(d) 20 MJ.		
(vii)	Load flow study is carried out for (a) fault calculations (b) stability studies (c) system planning (d) state estimation.	1	CO1
(viii)	Plug setting of a relay can be altered by varying- (a)Number of ampere turns (b)Air gap of magnetic path (c)Adjustable back up stop (d) None.	1	CO2
(ix)	The pick up current of a relay is 6.25 A and the fault current in system is 4000A.When the relay is connected through a 400/5 current transformer, the PSM of the relay is: (a) 4 (b)8 (c)615 (d) None	1	CO2
(x)	FDLF method is suitable for (a) high voltage transmission system (b) medium voltage transmission system (c) distribution system (d) none of these.	1	CO2
(xi)	A Distance Relay measures (a) Difference in voltage (b) Difference in impedance (c) Difference in current (d)Difference in phase	1	CO2
(xii)	The unit of inertia constant is (a) MJs/MVA (b) MJ/MVA (c) KV/MVA (d) rad/MVA	1	CO2

GROUP – B
(Short Answer Type Questions)

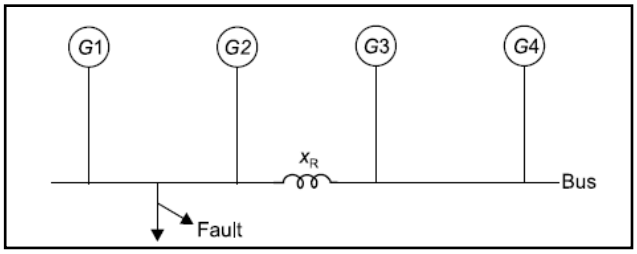
(Answer any *three* of the following) **3 x 5 = 15**

		Marks	CO No.
2.	Obtain the per unit impedance (reactance) diagram of power system shown in Figure below. Use a base of 50MVA 230 kV in 30 Ω line	5	CO1

Generator :20 MVA, 20 KV, X=20%
T1: 25 MVA, 18/230 kV (Y/Y), X=10%

T2: 45 MVA, 230/13.8 kV (Y/Δ), X=15%
Motor: 35 MVA, 13.2 kV, X=25%

3.	A fault current of 2000A is passing on the primary side of a 400/5 CT on the secondary side of the CT, an inverse time over current relay is connected whose plug setting is set as 50%. What is the plug setting multiplier?	5	CO2
4.	Fig. shows a system having four synchronous generators each rated 11.2 KV, 60 MVA and each having a subtransient reactance of 16%. Find (a) fault level for a fault on one of the feeders (near the bus with x = 0). (b) the reactance of the current limiting reactor X_R to limit the fault level to 860 MVA for a fault on one of the feeders near the bus.	5	CO2



5.	Why development of Jacobian matrix is important for load flow studies using Newton- Raphson method.	5	CO2
6.	A 400 MVA synchronous machine has H1 = 4.6 MJ/MVA and a 1200 MVA machine has H2 = 3.0 MJ/MVA. The two machines operate in parallel in a power plant. Find out Heq, relative to a 100 MVA base.	5	CO2

GROUP – C
(Long Answer Type Questions)

(Answer any *three* of the following) **3 x 15 = 45**

		Marks	**CO No.**
7. a)	For the sample system shown in figure below, the generators are connected at all the four buses, while loads are connected at buses 2 and 3. Values of real and reactive powers are listed in below table. All buses other than the slack are PQ type. Assume a flat voltage start; find the voltages and bus angles at the three buses at the end of first Gauss – Seidel iteration.	9	CO2

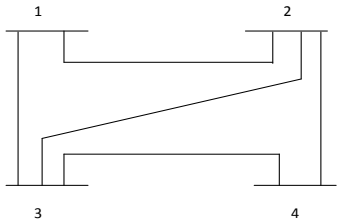


Figure: Single line Diagram

Line, bus to bus	R, pu	X, pu

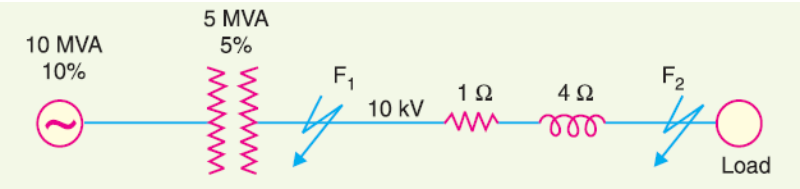
1-2	0.05	0.15
1-3	0.10	0.30
2-3	0.15	0.45
2-4	0.10	0.30
3-4	0.05	0.15

Table: Line Data

Bus	P_i pu	Q_i pu	V_i pu	Remarks
1	-	-	$1.04\angle 0^0$	Slack Bus
2	0.5	-0.2	-	PQ Bus
3	-1.0	0.5	-	PQ Bus
4	0.3	-0.1	-	PQ Bus

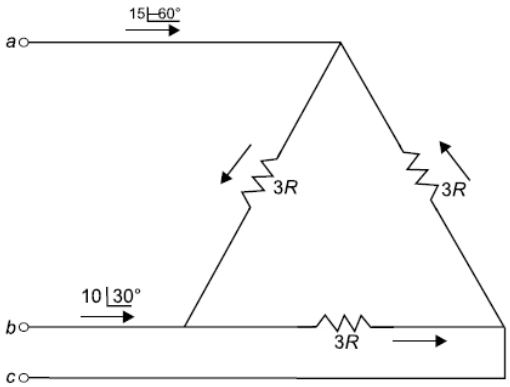
Table: Bus Data

b) A 3-phase transmission line operating at 10 kV and having a resistance of 1Ω and reactance of 4 Ω is connected to the generating station bus-bars through 5 MVA step-up transformer having a reactance of 5%. The bus-bars are supplied by a 10 MVA alternator having 10% reactance. Calculate the short-circuit KVA fed to symmetrical fault between phases if it occurs (i) at the load end of transmission line (ii)at the high voltage terminals of transformer — 6 — CO2



8.a) A 50 Hz two pole turbo alternator rated 50 MVA, 13.2 KV, has an inertia constant H=5.0 MJ / MVA. Determine the kinetic energy stored in the rotor at the synchronous speed. Determine the acceleration if the input less the rotational losses is 65000 H.P and the electrical power developed is 40 MW. If the acceleration computed for the generator is constant for a period of 10 cycles, determine the change in torque angle in that period and the r.p.m at the end of the 10 cycles. Assume the generator is synchronized with a large system and has no accelerating torque before 10 cycles period begins. — 8 — CO2

b) A delta connected resistive load is connected across an unbalanced three-phase supply as shown in Figure below. Find the symmetrical components of line currents. — 7 — CO3



9.a)	Starting from 1st principle derive the Swing equation of a synchronous machine.	7	CO2
b)	A synchronous generator capable of developing 500MW power per phase, operates at a power angle of 8º. By how much can the input shaft power be increased suddenly without loss of stability? Assume that Pmax will remain constant.	8	CO2
10.a)	Determine the time of operation of a relay of rating 5 amp, 2.2 sec IDMT and having a relay setting of 125% TSM. It is connected to a supply circuit through a C.T 400/5 ratio. The fault current is 4000 amp.	6	CO3

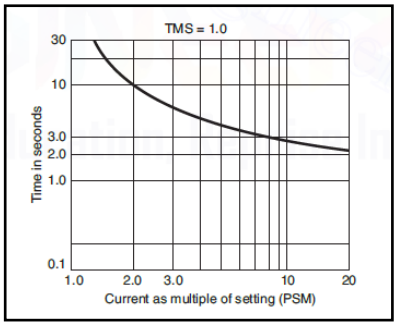


Fig. Standard 2.2 sec IDMT curve

b)	Explain clearly the basic principle of operation of a differential relay. What is meant by per cent bias? How is this achieved in practice in differential relay? Under what circumstances is a percentage differential relay preferred over differential relay?	4+1+2+2	CO1,CO2
11.	Write Short Note on (Any Three)	3x5=15	
a)	SLFE	5	CO3
b)	Feeder Protection Schemes	5	CO2
c)	Different Generator Relay protection schemes.	5	CO3
d)	Symmetrical Components for Unsymmetrical fault Calculation.	5	CO3
e)	Equal Area Criteria of Power System Stability	5	CO2