Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Sixth Semester B.Tech Degree Supplementary Examination May 2023 (2019 Scheme)

Course Code: EET304

Course Name: POWER SYSTEMS II

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks.

		Marks
1	A single phase transformer is rated at 110/440V, 2.5 kVA. Leakage reactance measured from LT side of the transformer is 0.06Ω. Determine the leakage reactance in p.u.	(3)
2	Discuss the effects of faults in power system? Explain the need for fault analysis.	(3)
3	Explain how buses in a power system are classified?	(3)
4	Explain the principle of DC load flow.	(3)
5	Discuss what do you mean by equality and non equality constraints in a power system?	(3)
6	A 50Hz, 4 pole turbo generator rated 20MVA, 11kV has an inertia constant of H=9MJ/MVA. Find the kinetic energy stored in the rotor at synchronous speed. Find the acceleration if the input less the rotational losses is 26800HP and the electrical power developed is 16MW.	(3)
7	Discuss the need for maintaining constant frequency in a power system?	(3)
8	What do you mean by synchronising power coefficient? Explain its significance?	(3)
9	Define penalty factor. Explain its significance.	(3)
10	Explain what do you mean by unit commitment. Identify the constraints on unit commitment?	(3)

PART B

Answer one full question from each module, each carries 14 marks.

Module I

11	a)	An alternator and a synchronous motor each rated at 50 MVA, 13.2 kV	(10)

having sub transient reactance of 20% are connected through a transmission line of reactance 10% on the base of machine ratings. The motor acts as a load of 30 MW at 0.8 p.f. lead and terminal voltage 12.5 kV when a 3-phase fault takes place at the motor terminals. Determine the sub transient current in the alternator, the motor and the fault.

b) The line to ground voltages on the high voltage side of a transformer are 100kV, 33kV and 38kV on phase a, b and c respectively. The voltage of phase "a" leads that of "b" by 100^0 and that lags that of phase "c" by 176.5^0. Determine the symmetrical components of voltage. (4)

OR

12 a) A 11kV, 10MVA synchronous generator has a sub transient reactance of 15%. Under no load condition, a 3phase fault occurs between the transformer and circuit breaker. Calculate a) initial symmetrical short circuit current b) sustained short circuit current c) maximum dc component of current d) momentary current rating e) current interrupting capacity f) interrupting kVA of the circuit breaker. Assume the circuit breaker is a 2 cycle breaker with voltage rating of 11kV and steady state reactance is 80%. (4)

b) Derive the expression for fault current for a single line to ground fault on an unloaded generator. Draw an equivalent network showing the inter connection of networks to simulate single line to ground fault (10)

Module II

13 a) An incomplete nodal admittance matrix for a 4 bus system is given. Find the missing terms. (7)

$$\begin{bmatrix} 0.7-j3 & -0.2+j1 & -0.5+j2 & y14 \\ y21 & y22 & -0.3+j2 & -0.5+j3 \\ y31 & y32 & y33 & -1+j4 \\ y41 & y42 & y43 & y44 \end{bmatrix}$$

b) What is Jacobian matrix? How the elements of Jacobian matrix are computed? What are the advantages and disadvantages of Newton-Raphson method? (7)

OR

14 Obtain the load flow solution at the end of first iteration of the system. The solution is to be obtained for the following cases: (14)

i) All buses except bus 1 are PQ buses

ii) Bus 2 is a PV bus whose voltage magnitude is specified as 1.04.

iii) Bus 2 is a PV bus with voltage magnitude is specified as 1.04 and $0.25 \leq Q_2 \leq 0.8pu$

LINE DATA

Bus Code	R	X
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

Bus No.	P	Q	V_i
1	-	-	1.04<0
2	0.5	-0.2	-
3	-1.0	0.5	-
4	-0.3	-0.1	-

Module III

15 a) Derive the swing equation for a single machine infinite bus system. State clearly the assumptions made. (4)

b) Figure.1 shows a generator transformer unit feeding an infinite bus bar through a transmission line. At the middle of the transmission line a 3-phase inductor of reactance 0.5 p.u. per phase is connected. The generator emf behind transient reactance is 1.1 p.u. and the voltage of the infinite bus is 1p.u. Find a) transfer reactance and steady state power limit with inductor switch open b) transfer reactance and steady state power limit with inductor switch closed c) transfer reactance and steady state power limit with inductor replaces by a capacitor of same p.u value. (10)

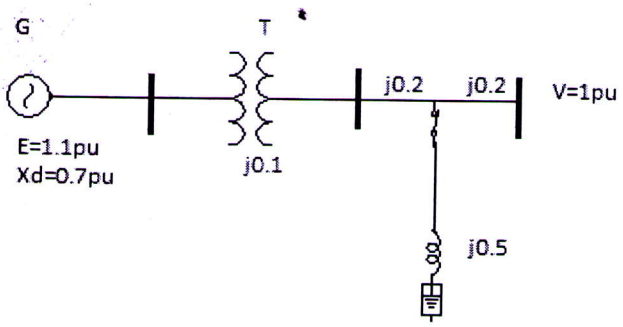

Fig.1

OR

16 a) Using equal area criterion, derive an expression for critical clearing angle for a system having a generator feeding an infinite bus through a single circuit line . (10)

b) A 50 Hz synchronous generator is connected to an infinite bus through a line. The p.u. reactances of generator and the line are j0.3 p.u. and j0.2 p.u. respectively. The generator no load voltage is 1.1 p.u. and that of infinite bus is 1.0 p.u. The inertia constant of the generator is 3 MW-sec/MVA. Determine the frequency of natural oscillations if the generator is loaded to 60% of its maximum power transfer capacity and small perturbation in power is given. (4)

Module IV

17 a) A 125 MVA turbo-alternator operator on full load operates at 50 Hz. A load of 50 MW is suddenly reduced on the machine. The steam valves to the turbine commence to close after 0.5 s due to the time lag in the governor system. Assuming the inertia to be constant, H = 6 kWs/kVA of generator capacity, calculate the change in frequency that occurs in this time. (4)

b) Derive the block diagram of a two-area system. (10)

OR

18 a) Draw a neat block diagram of a typical speed-governing system and derive its block diagram representation. (10)

b) State why P-f and Q-V loops can be treated as non-interactive. (4)

Module V

19 a) A constant load of 400 MW is supplied by two 210-MW generators 1 and 2, (10)

for which the fuel cost characteristics are given as

$C_1=0.05\ P^2_{G1} + 20\ P_{G1} + 30$ Rs/hr

$C_2=0.06\ P^2_{G2} + 15\ P_{G2} + 40$ Rs/hr

The real-power generations of units P_{G1} and P_{G2} are in MW. Determine: The most economical load sharing between the generators. 2) The saving in Rs./day thereby obtained compared to the equal load sharing between two generators.

b) Derive the condition for economic dispatch when transmission losses are neglected. (4)

OR

20 a) Derive the expression for transmission losses as a function of power generation. (4)

b) A two-bus system is shown in Fig. 2. If a load of 125 MW is transmitted from plant 1 to the load, a loss of 15.625 MW is incurred. Determine the generation schedule and the load demand if the cost of received power is Rs. 24/MWhr. Solve the problem using coordination equations and the penalty factor method approach. The incremental production costs of the plants are: (10)

$$\frac{dF_1}{dP_1} = 0.025P_1 + 15$$

$$\frac{dF_2}{dP_2} = 0.05P_2 + 20$$

Fig.2

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