Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S6 (R,S) (FT/WP/S4PT) Examinations April 2026 (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	Explain different classifications of shunt faults in power systems.	(3)
2	Explain why the neutral grounding impedance Z_n appears as $3Z_n$ in the zero-sequence equivalent circuit.	(3)
3	What are the objectives of load flow studies in power systems?	(3)
4	Why Generator bus is chosen as slack bus in load flow studies.	(3)
5	Differentiate between steady state and transient stability of power systems.	(3)
6	A 50 Hz four pole turbo alternator rated 20 MVA, 13.2 kV has an inertia constant of H=9.0 KW-sec/KVA. Determine the Kinetic energy stored in the rotor at synchronous speed.	(3)
7	Explain P-f and Q-V control loops of a power system.	(3)
8	Differentiate between Area Control Error (ACE) in a single-area power system and a two-area power system.	(3)
9	What are the thermal unit constraints in unit commitment problem.	(3)
10	Derive the condition for economic load dispatch when transmission losses are neglected.	(3)

PART B

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

Module I

11	a)	A 30 MVA, 13.8 KV, 3-phase generator has a sub transient reactance of 15%. The generator supplies 2 motors through a step-up transformer - transmission line – step- down transformer arrangement. The motors have rated inputs of 20 MVA and 10 MVA at 12.8 KV with 20% sub transient reactance each. The 3-phase transformers are rated at 35 MVA, 13.2 KV-Δ /115 KV-Y with 10 % leakage reactance. The line reactance is 80 ohms.	(8)

Draw the equivalent per unit reactance diagram by selecting the generator ratings as base values in the generator circuit.

b) What is the significance of current limiting reactors in power system? Where are they located? (6)

OR

12 a) Derive the expression for fault current and draw the interconnection of sequence for the line-to-ground fault on the terminals of an unloaded generator. (7)

b) Determine the fault current at the fault when a line-to-ground fault occurs at the terminals of a 50MVA, 13.8 KV alternator. The alternator has solidly grounded neutral and has a sub-transient reactance of 0.20 p.u., negative sequence reactance of 0.20 p.u. and zero sequence reactance of 0.05 p.u. (7)

Determine:

(i) The per-unit fault current

(ii) The actual fault current in amperes

(iii) The fault MVA

Module II

13 a) Explain the step-by-step procedure of Gauss- Siedel method of load flow analysis of power system. (9)

b) A 3-bus power system has the following data: (5)

Line	Impedance Zij (pu)
1–2	0.02 + j0.06
1–3	0.08 + j0.24
2–3	0.06 + j0.18

Compute the Y bus matrix of the system.

OR

14 a) Draw and explain the flowchart and algorithm of Fast Decoupled Load Flow analysis. (7)

b) A 3-bus power system has the following data: (7)

Bus	P (pu)	Q (pu)	|V| (pu)	δ (°)
1	-	-	1.06	0°
2	-0.5	-0.2		
3	-0.6	-0.25		

Line admittance (pu):

From	To	Y_{ij} (pu)
1	2	- j5.0
1	3	−j4.0
2	3	−j3.333

Perform one iteration of the Fast Decoupled Load Flow (FDLF) method and compute values of δ_2, δ_3, $|V_2|$, and $|V_3|$.

Module III

15 a) Derive Swing equation of a synchronous machine. (8)

b) A 50 HZ synchronous generator having an internal voltage 1.2 p.u, H=5.2 MJ/MVA and a reactance of 0.5 p.u. is connected to an infinite bus through a double circuit line, each line of reactance 0.37 p.u. The generator is delivering 0.85 pu power and the infinite bus voltage is 1.0 p.u. (6)

Determine: (i) Maximum power transfer (ii) Steady state operating angle.

OR

16 a) Explain the equal area criterion to determine the stability of a power system. (7)

b) A generator with constant excitation supplies 30 MW through a step up transformer and a high voltage line to an infinite bus bar. If the steady state stability limit of the system is 60MW, determine the maximum permissible sudden increase of generator output (resulting from sudden increase prime mover output) if the stability is to be maintained. Assuming resistance of generator, lines and transformers are neglected. (7)

Module IV

17 a) Derive from fundamentals, the complete block diagram of load frequency control of an isolated power system. (9)

b) Two generators rated 250 MW and 400 MW are operating in parallel. The droop characteristics of their governors are 4% and 5%, respectively from no load to full load. Assuming that the generators are operating at 50 Hz at no load, how would a load of 500 MW be shared between them? What will be the system frequency at this load? Assume free governor operation. (5)

OR

18 a) With help of a diagram explain the Automatic Voltage Regulator (AVR) of power system. (8)

b) A two-area system connected by a tie-line has following parameters on 1000 MVA base: (6)

R1 = 4%; D1 = 0.6; H1 = 4;

R2 = 5%; D2 = 0.8; H2 = 5;

The units are running in parallel at a frequency of 50 Hz. The synchronizing power coefficient is 1.8 pu at the initial operating angle. A load change of 120 MW occurs in area 1. Determine the new steady state frequency.

Module V

19 a) Derive the condition for economic dispatch when transmission losses are considered using optimal load flow method. (6)

b) A two-bus system is shown in Fig. (1). If a load of 125 MW is transmitted from plant 1 to the load, and the loss incurred is given by $P_L = 0.001P_1^2$. Determine the generation schedule and the load demand if the cost of received power is Rs. 24/MWhr p.u., using Penalty factor method . (8)

The incremental production costs of the plants are

$dF_1/dP_1 = 0.025\ P_1 + 15$ and $dF_2/dP_2 = 0.05\ P_2 + 20$

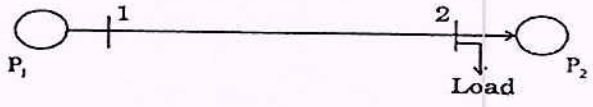

Fig. (1)

OR

20 a) Enlist the constraints on unit commitment. (6)

b) Assume that the fuel input in Btu per hour for two units, units 1 and 2 are given by (8)

$F_1 = (8P_1 + 0.024\ P_{12} + 80)10^6$

$F_2 = (6P_2 + 0.04\ P_{22} + 120)10^6$

The maximum and minimum loads on the units are 100 MW and 10 MW respectively. Determine the minimum cost of generation per day, when the following load (Fig.2) is supplied. The cost of fuel is Rs. 2 per million Btu.

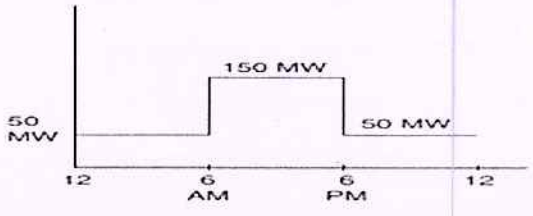

Fig. (2)

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