Duration: 3hrs **[Max Marks: 80]**

N.B. : (1) Question No 1 is Compulsory.
(2) Attempt any three questions out of the remaining five.
(3) All questions carry equal marks.
(4) Assume suitable data, if required and state it clearly.

Q1. Answer the following **20**

a Draw input-output curve, heat rate curve and incremental fuel cost curve and explain their importance in economic load dispatch.

b Derive characteristic equation and state the condition for steady state stability in power system.

c Write the static load flow equations and explain the classification of buses in power system.

d For an isolated single area, consider the data given below.
Load decreases by 1% for a decrease in frequency by 1%. Find the gain and time constant of the power system represented by a first order transfer function.
Total Area Capacity=1000 MW, Normal Operating Load = 500 MW, H = 5 sec, R= 2.5 Hz / pu MW, Operating Frequency =50 Hz.

e Draw the diagram to indicate interconnection between different operating states of power system and explain each operating state.

Q 2. A Derive the equation for optimum generation scheduling considering transmission losses (Exact coordinate equation) **10**

Q 2. B A synchronous generator is generating 20% of the maximum power it is capable of generating. If the mechanical input to the generator is increases by 250% of the previous value, calculate the maximum value of torque angle during the swing of rotor round the new equilibrium point. **10**

Q3. A Compare GS, NR and Fast decoupled load flow methods for solution of Static Load Flow Equations of a power system. **10**

Q3. B A constant load of 300 MW is supplied by two 200 MW generators, 1 and 2, for which the respective incremental fuel costs are **10**

$IC_1 = 0.1P_1 + 20$ Rs/MWh

$IC_2 = 0.12P_2 + 15$ Rs/MWh

with powers in MW and costs C in Rs/hr. Determine (a) the most economical division of load between the generators, and (b) the saving in Rs/day thereby obtained compared to equal load sharing between machines.

Q4. A Derive Swing equation for a synchronous machine that describes rotor dynamics. **10**

Q 4. B Find the steady state power limit of a system consisting of a generator equivalent reactance 0.50 pu connected to an infinite bus through a series reactance of 1.0 pu. The terminal voltage of the generator is held at 1.20 pu and the voltage of the infinite bus is 1.0 pu. **10**

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Q 5 A Draw complete block diagram and explain dynamic response of Load frequency controller for an isolated power system with and without PI controller. **10**

Q 5.B For the following system generators are connected to all the four buses and loads are connected at buses 2 and 3. All buses other than slack bus are PQ buses. Assuming flat voltage start, determine the bus voltages at the end of first Gauss Seidel iteration. **10**

Line Bus to bus	Y(pu)
1-2	2-j6
1-3	1-j3
2-3	0.6667-j2
2-4	1-j3
3-4	2-j6

Bus	P(pu)	Q(pu)	V(pu)	Remarks
1	-	-	$1.04\angle 0^o$	Slack
2	0.5	-0.2	-	PQ
3	-0.1	0.5	-	PQ
4	0.3	-0.1	-	PQ

Q 6. A What is power pool? Explain the different types of energy transactions and interchanges in power system. **10**

Q 6. B Two generators rated 250 MW and 350 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 600 MW be shared between them? What will be the system frequency at this load? Assume free governor operation. **10**

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