Hall Ticket No | | | | | | | | | | | Question Paper Code: AEE016

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

MODEL QUESTION PAPER

B.Tech VII Semester End Examinations, November - 2019

Regulations: R16

POWER SYSTEM OPERATION AND CONTROL

(Electrical and Electronics Engineering)

Time: 3 hours **Max. Marks: 70**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

UNIT – I

1. a) Define Heat rate and cost curve? Derive transmission loss formula in terms of B-coefficients [7M]

   b) A power System consists of two, 125 MW units whose input cost data are represented by the equations : [7M]
   C1 = 0.04 P12 + 22 P1 + 800 Rupees/hour
   C2 = 0.045 P22 + 15 P2 + 1000 Rupees/hour
   If the total received power PR = 200 MW. Determine the load sharing between units for most economic operation.

2. a) Derive the coordination equation for the optimal scheduling of hydrothermal interconnected power plants [7M]

   b) Two power plants are connected together by a transmission line and load at plant-2. When 100 MW is transmitted from plant-1, the transmission loss is 100 MW. The cost characteristics of two plants are [7M]
   C1 =0.05P\2G1+13PG1; C2=0.06P2G2+12PG2
   Find the optimum generation for ʎ=22,ʎ=25 and ʎ=30.

UNIT – II

3. a) Draw the schematic diagram showing the speed changer setting, governor and steam admission valve and indicate how steam input is regulated with the change in load. The transfer functions of the above system. [7M]

   b) A 100 MVA Synchronous generator operates at 50 Hz, runs at 3000 rpm under no- load. A load of 25 MW is suddenly applied to the machine. Due to the time lag in the governor system the turbine commences to open after 0.6 sec. Assuming inertia constant H= 5 MW- sec per MVA of generator capacity, calculate the frequency of the system before steam own commences to increase to meet the new load. [7M]

4. a) Explain the function of an excitation system and develop the block diagram for voltage regulator. Develop the transfer function model of each block. [7M]

b) Two generators rated 200MW and 400MW are operating in parallel. Draw the 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 600MW is shared between them? What will be the system frequency at this load, Assume free governor operation, repeat the problem if both governors have drop of 4%. [7M]

UNIT – III

5. a) Obtain the dynamic response of load frequency controller with and without integral control action. [7M]

b) Two areas of a power system network are interconnected by a tie-line, whose capacity is 250MW, operating at a power angle of 450. If each area has a capacity of 2000 MW and the equal speed regulation of 3 Hz/Pu MW, determine the frequency of oscillation of the power for step change in load. Assume that both areas have the same inertia constants of H = 4 sec. If a step load change of 100MW occurs in one of the areas determine the change in tie-line power. [7M]

6. a) Give typical block diagrams for two area system interconnected by a tie – line and explain each block. Also deduce relations to determine the frequency of oscillations of tie – line power and static frequency drop. [7M]

b) The single area control system has the following data: TP=10 sec, Tg = 0.3 sec, Tt=0.2 sec, KP =200 Hz/pu MW, R=6 Hz/pu MW, PD=0.5 pu MW, Ki=0.5. Compute the time error caused by a step disturbance of magnitude 0.5 pu (as given above). Prove, in particular, that the error is reduced by increasing the given Ki. Express the error in seconds and cycles if the system frequency is 50 Hz. [7M]

UNIT – IV

7. a) Discuss in detail about the generation and absorption of reactive power in power system components. [7M]

b) A 3phase transformer rated 7000kVA and has a over load capability of 125 % of the rating. Ifthe connected load is 1150 kVA with a 0.8 p.f(lag), determine the following: [7M]
i. The kVAR rating of shunt capacitor bank required to decrease the kVA load of the transformer to its capability level,
ii. The kVAR raring of the shunt capacitor bank required to correct the load p.f. to unity.
iii. The p.f. of the corrected level.

8. a) How do the shunt capacitors and reactors control the voltage? List the disadvantages of using a shunt capacitor for voltage control? [7M]

b) A single-phase motor takes a current of 10 amps at a p.f. of 0.707 lagging from a 230V, 50 Hz supply. What value must a shunting capacitor have to raise the p.f. to unity [7M]

UNIT – V

9. a) Draw a block diagram in flow chart form for a typical distribution system planning process and explain the techniques for distribution planning. [7M]

b) At the end of a power distribution system, a certain feeder supplies three distribution transformer, each one supplying a group of customers whose connected loads are as under, if the diversity factor among the transformers is 1.3, find the maximum load on the feeder. [7M]

Transformer	Load	Demand Factor	Diversity Factor
No.1	10kw	0.65	1.5
No 2	12kw	0.	3.5
No.3	15kw	0.7	1.5

10. a) Explain briefly the classification of loads and modeling of load in distribution networks? [7M]

b) A small city experiences an annual peak load of 3500 kw. The total annual energy supplied to the primary feeder's circuits is 10* 106 kwh. The peak demand occurs in July/August and Is due to air Conditioning load. [7M]

i) Find the annual average power demand

ii) Find the annual load factor

iii) Find the annual loss factor

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COURSE OBJECTIVES:

The course should enable the students to:

I	Demonstrate economic operation of power systems, hydrothermal scheduling.
II	Illustrate modelling of turbines, generators and automatic controllers.
III	Discuss single area and two area load frequency control.
IV	Analyze reactive power control and load modeling

COURSE OUTCOMES (COs):

CO 1	Understand the optimal operation of generators in thermal power stations and their characteristics with and without transmission loss coefficient.
CO 2	Design the mathematical models of the speed governing systems, turbine and excitation system.
CO 3	Discuss single area load frequency control and two area load frequency control.
CO 4	Discuss the need of power factor correction and voltage drop compensation and Identify the best methods for power factor improvement and voltage control.
CO 5	Understand the types of loads and their characteristics with specifications of load compensator.

COURSE LEARNING OUTCOMES (CLOs):

AEE016.01	Understand optimal operation of generators in thermal power stations and their characteristics.
AEE016.02	Design an optimal operation setup of power system which minimizes operation costs and meet desired needs.
AEE016.03	Solve the unit Commitment problem with various constraints using conventional optimization techniques and general transmission line loss formula
AEE016.04	Examine optimal scheduling of hydrothermal system characteristics and their economic operation.
AEE016.05	Design the mathematical models of the mechanical and electrical components involved in the operation of power systems.
AEE016.06	Understand the modeling of excitation systems and fundamental characteristics of an excitation system.
AEE016.07	Design the single area and two area thermal power system.
AEE016.08	Demonstrate the understanding of the open loop and closed loop control practices associated with the voltage and frequency control of single area or interconnected multi area power systems.
AEE016.09	Understand the significance of reactive power control in power systems to maintain quality of power
AEE016.10	Design appropriate control scheme to compensate reactive power
AEE016.11	Describe the different methods of control and compensation to choose the best option so that social and environmental problems are minimized.
AEE016.12	Describe the different methods of control and compensation recognize the need to continuously follow the advancements in technology and incorporate them in the present system to improve efficiency and increase the flexibility and quality of operation.

AEE016.13	Differentiate the types of loads and their characteristics.
AEE016.14	Calculate the voltage drop and power loss in a distribution system
AEE016.15	Apply the concept of power systems and operation and control to solve real time world applications.
AEE016.16	Explore the knowledge and skills of employability to succeed in national and international level competitive examinations.

MAPPING OF SEMESTER END EXAMINATION - COURSE OUTCOMES

SEE Question No		Course Learning Outcomes		Course Outcomes	Blooms Taxonomy Level
1	a	AEE016.02	Design an optimal operation setup of power system which minimizes operation costs and meet desired needs.	CO 1	Understand
	b	AEE016.01	Understand optimal operation of generators in thermal power stations and their characteristics.	CO 1	Understand
2	a	AEE016.04	Examine optimal scheduling of hydrothermal system characteristics and their economic operation.	CO 1	Understand
	b	AEE016.01	Understand optimal operation of generators in thermal power stations and their characteristics	CO 1	Understand
3	a	AEE016.05	Design the mathematical models of the mechanical and electrical components involved in the operation of power systems	CO 2	Understand
	b	AEE016.05	Design the mathematical models of the mechanical and electrical components involved in the operation of power systems	CO 2	Remember
4	a	AEE016.06	Understand the modeling of excitation systems and fundamental characteristics of an excitation system.	CO 2	Understand
	b	AEE016.06	Understand the modeling of excitation systems and fundamental characteristics of an excitation system.	CO 2	Understand
5	a	AEE016.08	Demonstrate the understanding of the open loop and closed loop control practices associated with the voltage and frequency control of single area or interconnected multi area power systems	CO 3	Understand
	b	AEE016.07	Design the single area and two area thermal power system.	CO 3	Understand
6	a	AEE016.08	Demonstrate the understanding of the open loop and closed loop control practices associated with the voltage and frequency control of single area or interconnected multi area power systems	CO 3	Understand
	b	AEE016.08	Design the single area and two area thermal power system.	CO 3	Understand
7	a	AEE016.09	Understand the significance of reactive power control in power systems to maintain quality of power	CO 4	Understand
	b	AEE016.12	Describe the different methods of control and compensation recognize the need to continuously follow the advancements in technology and incorporate them in the present system to improve efficiency and increase the flexibility and quality of operation.	CO 4	Understand
8	a	AEE016.10	Describe the different methods of control and compensation to choose the best option so that social and environmental problems are minimized.	CO 4	Understand
	b	AEE016.12	Describe the different methods of control and compensation recognize the need to continuously follow the advancements in technology and incorporate them in the present system to improve efficiency and increase the flexibility and quality of operation.	CO 4	Understand

9	a	AEE016.13	Differentiate the types of loads and their characteristics.	CO 5	Remember
	b	AEE016.14	Calculate the voltage drop and power loss in a distribution system	CO 5	Understand
10	a	AEE016.13	Differentiate the types of loads and their characteristics.	CO 5	Remember
	b	AEE016.14	Calculate the voltage drop and power loss in a distribution system	CO 5	Understand

Signature of Course Coordinator **HOD, EEE**