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) Explain in detail the terms production costs, total efficiency, incremental efficiency and incremental rates with respect to a thermal power plant. [7M]

   b) The fuel inputs per hour of plants 1 and 2 are given as [7M]
   F1 =0.2 P1
   2+40 P1+120 Rs per hr.
   F2 =0.25 P22+30 P2+150 Rs per hr.
   Determine the economic operating schedule and the corresponding cost of generation if the maximum and minimum loading on each unit is 100 MW and 25 MW, the demand is 180 MW and transmission losses are neglected. If the load is equally shared by both the units, determine the saving obtained by loading the units as per the incremental production cost.

2. a) Describe in detail, with suitable examples, the methods of optimum scheduling of generation of power from a thermal station. [7M]

   b) The following are data pertaining to three units in a plant. [7M]
   Unit 1: Min. = 150 MW; Max. = 600 MW C1 = 5610 + 79.2 P1 + 0.01562 P1 2 Rs / h
   Unit 2: Min. = 100 MW; Max. = 400 MW C 2 = 3100 + 78.5 P 2 + 0.0194 P 2 2 Rs / h
   Unit 3: Min. = 50 MW; Max. = 200 MW C 3 = 936 + 95.64 P 3 + 0.05784 P 3 2 Rs / h
   What unit or combination of units should be used to supply a load of 550 MW most economically?

UNIT – II

3. a) Derive the model of a speed governing system and represent it by a block diagram. [7M]

   b) Two turbo alternators rated for 150 MW and 250 MW have governor drop characteristics of 8% from no load to full load. They are connected in parallel to share a load of 300 MW. Determine the load shared by each machine assuming free governor action. [7M]

4. a) Describe the various blocks of IEEE Type – I excitation system and develop the [7M]

mathematical model of the system.

b) An inductive load of Z = R +jX is interconnected across a supply 'V. By how many percent will the real drop be if the voltages is reduced by 5? [7M]

UNIT – III

5. a) Define control area and Explain the concept of "control area" in the load frequency control of a power system. [7M]

b) A single area consists of two generators with the following parameters: Generator 1 = 1200 MVA; R=6 % (on machine base) Generator 2 = 1000 MVA; R=4 % (on machine base) The units are sharing 1800 MW at normal frequency 50 Hz. Unit supplies 1000 MW and unit 2 supplies 800 MW. The load now increased by 200 MW. [7M]
(a) Find steady state frequency and generation of each unit if B=0.
(b) Find steady state frequency and generation of each unit if B=1.5.

6. a) Show how the steady state error of frequency in a typical load frequency control of a power system is reduced to zero. [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) What is load compensation and write short notes on compensated and uncompensated transmission lines. [7M]

b) A 400 V 50 cycles three phase line delivers 207KW at 0.8 power factor lagging. It is desired to bring the line power factor to unity by installing shunt capacitors, calculate the capacitance if they are i. Star connected ii. Delta connected. [7M]

8. a) Discuss different types of capacitors used in distribution network to improve power factor. [7M]

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

UNIT – V

9. a) Define load and List out the various factors affecting the distribution system planning? [7M]

b) Distribution substation experiences an annual peak load of 3, 500 KW. The total annual energy supplied to the primary feeder circuits is 107 kwh. Find i)The annual average Factor ii) The annual Load Factor [7M]

10. a) Define loss factor and load factor. Obtain the relation between the load factor and loss factor? [7M]

b) Annual peak load input to a primary feeder is 2000kw at which the power loss is total copper loss at the time of peak load is $\sum I^2R$=100kw. The total annual energy supplied to the sending end of the feeder is 5.61*106 kwh. Determine. I) Annual loss factor [7M]
ii) Total annual copper loss energy and its value Rs.1.50 per kwh

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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	AEE016.03	Solve the unit Commitment problem with various constraints using conventional optimization techniques and general transmission line loss formula	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**