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Question Paper Code: AEE524



# INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

## MODEL QUESTION PAPER -II

B.Tech VIII Semester End Examinations (Regular), April – 2020

Regulation: IARE–R16

### FLEXIBLE ALTERNATING CURRENT TRANSMISSION SYSTEM

(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 the effect of shunt and series Compensation on power transmission capacity of a short symmetrical transmission line [7M]
- b) Name and explain different types of stability issues that limit transmission capability? [7M]
- 2 a) Explain how shunt compensation can be achieved with ideal mid point reactive compensators. What is the effect of multi point segmentation on line performance? [7M]
- b) A 400 kV, 50 Hz, 600 km long symmetrical line is operated at the rated voltage. [7M]  
(a) A series capacitor is connected at the midpoint of the line to double the power transmitted. What is its reactance?  
(b) A shunt capacitor of value 450 ohms is connected at the midpoint of the line. If the midpoint voltage is 0.97, compute the power flow in the line corresponding to this operating point.

#### UNIT – II

- 3 a) Using a general schematic diagram, explain the three basic modes of SVC control in detail [7M]
- b) Describe the construction and operating characteristics of synchronous condensers. [7M]
- 4 a) Deduce the VI characteristic of SVC with FC and TCR in detail. Draw the Schematic and explain the basic operation of SVC? With neat schematic diagrams. [7M]
- b) Consider a SMIB system in which the synchronous machine is generating 0.9 p.u MW and 0.3 p.u MVAR. The voltage of infinite bus is  $0.995+j0.0$  p.u. The machine transient reactance is 0.3 p.u and the transmission line reactance is 0.650 p.u [7M]
  - i) Calculate what should be the net susceptance of SVC to maintain  $V_m$  at 1 p.u
  - ii) Given  $B$  = susceptance offered by transformer = 0.025 p.u on 100MVA, 400kv base find  $B_{TCR}$  and  $B_{TSC}$ . Given rating of one capacitor bank is 50MVA.

### UNIT – III

- 5 a) Explain the different modes of operation of TCSC and its characteristics. [7M]  
b) What is Bang-Bang Control and Explain the Auxiliary signal and its types in detail [7M]
- 6 a) Explain the modelling of TCSC for constant current and constant angle control [7M]  
b) The analysis of TCSC operation in the Vernier-Control Mode [7M]

### UNIT – IV

- 7 a) Discuss in detail about the modeling of SSSC in load flow and transient stability studies? [7M]  
b) Explain the principle of operation and VI characteristics of STATCOM with neat sketch? [7M]
- 8 a) With the help of phasor diagrams, explain how UPFC provides voltage regulation, line impedance compensation and phase shifting? [7M]  
b) What is the advantage of regulation slope control? Draw and explain the control scheme for STATCOM with regulation slope control. [7M]

### UNIT – V

- 9 a) Explain the FACTS Controller interactions? [7M]  
b) Describe the Quantitative treatment of control coordination? [7M]
- 10 a) Discuss the different classification of Controller Interaction? [7M]  
b) Describe the genetic algorithm based control co-ordination [7M]



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## COURSE OBJECTIVES:

The course should enable the students to:

I	Describe the effect of series and shunt compensation using various FACTS controllers
II	Static VAR compensator for voltage regulation and transient stability enhancement of system
III	Analyse voltage source converter based FACTS controllers and their coordination.

## COURSE OUTCOMES (COs):

CO 1:	Understand the fundamentals of FACTS controllers and their role in improving power system performance
CO 2:	Understand SVC for various functions viz. Transient stability Enhancement, voltage instability prevention and power oscillation damping
CO 3:	Analyse the use of control schemes of TCSC, TSSC, GSC in improving the power quality.
CO 4:	Analyse the applications of Voltage Source Converter based FACTS Controllers.
CO 5:	Explain the FACTS Controllers and their co-ordination

## COURSE LEARNING OUTCOMES (CLOs):

AEE524.01	Discuss about the introduction of FACTS technology in Power Systems and power flow in transmission lines
AEE524.02	Discuss about the Reactive Power Compensation in Transmission line and also the types of Compensation methods
AEE524.03	Explain the need of FACTS and types of FACTS Controllers.
AEE524.04	Discuss about the Static VAR Compensator, its configuration and Voltage Regulation
AEE524.05	Study the modelling of SVC for Stability and for Load flow analysis
AEE524.06	Designing of SVC to regulate transient stability enhancement and power oscillation damping
AEE524.07	Understanding the concepts Controlled Series Capacitors.
AEE524.08	Explain the operation, analysis and gate turn off characteristics of Thyristor Controlled Series Capacitor
AEE524.09	Modeling of TCSC and GCSC for Stability and for Load flow analysis.
AEE524.10	Operation of Static Synchronous Compensator(STATCOM) and Synchronous Series Compensator(SSSC)
AEE524.11	Modeling of Static Synchronous Compensator (STATCOM) and Synchronous Series Compensator(SSSC) Transient Stability and for Power Flow analysis.
AEE524.12	Modeling of UPFC and IPFC for Transient Stability and for Power Flow analysis

AEE524.13	Discuss about FACTS controller interactions
AEE524.14	Explain SVC interaction, co- ordination of multiple controllers using linear control techniques
AEE524.15	Explain the quantitative treatment of control co ordination
AEE524.16	Explore the knowledge and skills of employability to succeed in national and international

### MAPPING OF SEMESTER END EXAMINATION - COURSE OUTCOMES

SEE Question No		Course Learning Outcomes	Course Outcomes	Blooms Taxonomy Level	
1	A	AEE524.02	Discuss about the Reactive Power Compensation in Transmission line and also the types of Compensation methods	CO 1	Understand
	b	AEE524.01	Discuss about the introduction of FACTS technology in Power Systems and power flow in transmission lines	CO 1	Understand
2	a	AEE524.02	Discuss about the Reactive Power Compensation in Transmission line and also the types of Compensation methods	CO 1	Remember
	b	AEE524.03	Explain the need of FACTS and types of FACTS Controllers.	CO 1	Understand
3	a	AEE524.04	Discuss about the Static VAR Compensator, its configuration and Voltage Regulation	CO 2	Understand
	b	AEE524.05	Study the modelling of SVC for Stability and for Load flow analysis	CO 2	Understand
4	a	AEE524.04	Discuss about the Static VAR Compensator, its configuration and Voltage Regulation	CO 2	Understand
	b	AEE524.06	Designing of SVC to regulate transient stability enhancement and power oscillation damping	CO 2	Understand
5	a	AEE524.08	Explain the operation, analysis and gate turn off characteristics of Thyristor Controlled Series	CO 3	Understand
	b	AEE524.07	Understanding the concepts Controlled Series Capacitors	CO 3	Understand
6	a	AEE524.09	Modeling of TCSC and GCSC for Stability and for Load flow analysis	CO 3	Understand
	b	AEE524.08	Explain the operation, analysis and gate turn off characteristics of Thyristor Controlled Series Capacitor	CO 3	Understand
7	a	AEE524.11	Modeling of Static Synchronous Compensator (STATCOM) and Synchronous Series Compensator(SSSC) Transient Stability and for Power Flow analysis.	CO 4	Remember
	b	AEE524.10	Operation of Static Synchronous Compensator(STATCOM) and Synchronous Series Compensator(SSSC)	CO 4	Understand

8	a	AEE524.12	Modeling of UPFC and IPFC for Transient Stability and for Power Flow analysis	CO 4	Understand
	b	AEE524.11	Modeling of Static Synchronous Compensator (STATCOM) and Synchronous Series Compensator(SSSC) Transient Stability and for Power Flow analysis.	CO 4	Understand
9	a	AEE524.13	Discuss about FACTS controller interactions	CO 5	Understand
	b	AEE524.15	Explain the quantitative treatment of control coordination	CO 5	Understand
10	a	AEE524.13	Discuss about FACTS controller interactions	CO 5	Understand
	b	AEE524.15	Explain the quantitative treatment of control coordination	CO 5	Understand

**Signature of Course Coordinator**

K.Harshini

**HOD, EEE**