



M.E. DEGREE EXAMINATIONS: JUNE 2018

(Regulation 2015)

Second Semester

POWER ELECTRONICS AND DRIVES

P15PETE09: Flexible AC Transmission Systems

COURSE OUTCOMES

CO1: Understand the operation of shunt and series compensators

CO2: Suggest suitable FACTS controllers for power system stability improvement

CO3: Identify and overcome SSR problems using FACTS devices

Time: Three Hours

Maximum Marks: 100

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

- Main objective of FACTS is: CO1 [K₂]
 Assertion (A): The power transfer capability of transmission system is to be increased.
 Reason (B): The power flow is to be kept over designated routes.
 a) Both A and R are Individually true and R is the correct explanation of A b) Both A and R are Individually true but R is not the correct explanation of A
 c) A is true but R is false d) A is false but R is true
- The reactive power is essential in power transmitting system because it aides in CO1 [K₂]
 a) Operation of Electromagnetic Energy devices b) For transmitting HVDC
 c) For transmitting HVAC d) For all the above.
- In series Compensator FACTS device K is degree of compensation lies in the range of CO1 [K₂]
 a) 40-70% b) 20-40%
 c) 30-70% d) <100%

- Match List I with List II CO1 [K₂]

List I	List II
A. Shunt capacitor	i. reduces I^2X loss
B. Series capacitor	ii. are used as current limiting device
C. Shunt Reactors	iii. compensate for I^2X losses
D. Series reactors	iv. limit voltage rise on open circuit or light load

- | | A | B | C | D |
|----|-----|----|-----|----|
| a) | ii | i | iii | iv |
| b) | iii | i | iv | ii |
| c) | ii | iv | iii | i |
| d) | iii | i | ii | Iv |

- Reactive power flow has the following effects: CO1 [K₃]
 Assertion (A): Increase losses in transmission system.
 Reason (R): Major influence on system voltage deviation
 a) Both A and R are Individually true and R is the correct explanation of A b) Both A and R are Individually true but R is not the correct explanation of A
 c) A is true but R is false d) A is false but R is true

6. Controller interactions can occur in the following combinations: CO1 [K₂]
 a) Multiple FACTS controllers of a similar kind b) Multiple FACTS controllers and HVDC converter controllers
 c) Multiple FACTS controllers of a dissimilar kind d) All the above
7. Sub-synchronous oscillations, usually in the frequency range of 10–50/ 60 Hz , which can have potential damage to generator shafts may be caused by CO1 [K₂]
 (I) the interaction between the generator torsion system and the series-compensated-transmission lines
 (II) the HVDC converter controls,
 (III) the generator excitation controls
 (IV) even the SVCs.
 a) I, II, III b) I, II and IV
 c) I and II d) All the above four.
8. UPFC was completed at the Inez Substations owned by American Electrical Power (AEP). It represents the first controller capable of providing complete control of CO3 [K₃]
 a) Voltage & Line impedance b) Line impedance & Phase Angle
 c) Voltage & Phase Angle d) Voltage , Line impedance & Phase Angle
9. The IPFC proposed in acts as a current source with the following characteristics: CO3 [K₃]
 a) As no power electronic controllers are required, harmonics are not generated. b) Major contingencies on one side of the IPFC have negligible impact on the voltages of the other side.
 c) Both a and b d) Is all the above
10. Principal of working of NGH SSR damping Scheme CO3 [K₃]
 1) The measurement of half cycle period restarts from a new voltage zero.
 2) Identification of the half cycles which are longer than the nominal half cycle period.
 3) To dissipate capacitor charges which is done by inserting a resistor across the capacitor through thyristor switches
 4) The thyristor stops conducting whenever the capacitor voltage (and the thyristor current) reaches zero. The correct sequence is
 a) 2-3-4-1 b) 1-3-2-4
 c) 3-4-2-1 d) 4-1-3-2

PART B (10 x 2 = 20 Marks)

11. State Surge Impedance loading Limit. CO1 [K₁]
 12. What are the devices of passive compensations? Why? CO1 [K₂]
 13. What is the objective of series compensation in FACTS controller? CO1 [K₂]
 14. What types of connections are used for capacitor banks and why? CO1 [K₂]
 15. What is side effect of saturated Reactors? CO2 [K₂]
 16. Why reactors are connected in parallel to capacitor in TCR? CO2 [K₂]
 17. Acronym of FACTS and justify the explanation. CO3 [K₂]
 18. Acronym of IPFC and justify the explanation. CO3 [K₂]
 19. State the importance of sub-synchronous resonance in FACTS controller. CO3 [K₁]
 20. State the importance of TCBR installation in FACTS controller installed transmission line. CO3 [K₁]

PART C (10 x 5 = 50 Marks)

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| 21. Why shunt compensation as FACTS devices are used in power transmission? | CO1 | [K ₂] |
| 22. State the Constrains of Maximimum line loading. | CO1 | [K ₂] |
| 23. What is the effect of Line charging capacitance for a long transmission line? | CO1 | [K ₂] |
| 24. Write the difference between TCSC and SSSC. | CO1 | [K ₂] |
| 25. Explain with neat diagram the operation of TSC as FACTS devices for shunt compensation | CO1 | [K ₂] |
| 26. Differentiate between Saturated Reactor and TCR. | CO1 | [K ₂] |
| 27. State the conventional transmission control capabilities in FACTS controller. | CO1 | [K ₂] |
| 28. Explain the control structure of Interline Power flow controller | CO1 | [K ₂] |
| 29. With neat diagram explain the working of TCBR Schemes. | CO1 | [K ₂] |
| 30. Why there is need of Thyristor controlled Voltage Limiter in a transmission system when FACTS devices are installed? | CO1 | [K ₂] |

**Answer any TWO Questions
PART D (2 x 10 = 20 Marks)**

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|--|-----|-------------------|
| 31. With neat diagram explain how the flow of power in transmission line is improved using series compensation. | CO1 | [K ₁] |
| 32. State the objective of Shunt compensation in transmission system. Describe the different methods of controllable VAR generation with the operation and effects on transmission system. | CO2 | [K ₁] |
| 33. With neat sketches explain the basic operation of UPFC when installed in the receiving end of the transmission system. | CO3 | [K ₃] |
