

M.E. ELECTRICAL ENGINEERING FIRST YEAR SECOND SEMESTER EXAM 2025**POWER ELECTRONIC CONTROLLERS AND INTERFACES IN POWER SYSTEM**

Time: Three hours

Full Marks: 100

Figures in the margin indicate full marks

Group-A**Answer any one question out of two**

- 1.a) A lossless transmission line is maintaining the voltage magnitude at both of its ends as V . Derive the expression for the midpoint voltage of the line in terms of V and load angle (δ). Also derive the expressions for active and reactive power both at sending end and receiving end of a lossless transmission line in terms V and δ . (8)
- b) Discuss the effect of midpoint compensation in power transmission in terms of active and reactive power transferred to receiving end of the line with suitable derivation. Assume that midpoint voltage magnitude is maintained as V . Is it possible to obtain flat voltage profile throughout the length of a transmission line using midpoint compensation? – Justify your answer. (10+2)
- 2.a) With a suitable diagram discuss the operating principle of a conventional mechanically operated phase shifter. (8)
- b) Discuss effect of implementation of a phase shifter in a two bus power system in terms of (i) steady state stability limit, (ii) transient stability limit, (iii) maximum power transfer capability of a transmission line. Use suitable phasor diagram and P- δ diagram whenever necessary. (12)

Group-B**Answer any two questions out of three**

- 3.a) With schematic diagram describe the operating principle of UPFC. (6)
- b) Assume the maximum power transferred by a lossless transmission line is 1p.u.. Draw the receiving end power circle diagram for the line. With help of power circle diagram explain how UPFC is able to control (i) voltage regulation (ii) phase shifting (iii) line impedance and (iv) all these three at a time, for the line. Assume the operating load angle as 30° . (14)
4. Explain the operating principle of a TSC-TCR SVC and a STATCOM with the help schematic diagrams. Which one of these two provides better control in EHV AC transmission? Justify your answer with their V-I characteristics. (7+7+6)
5. Draw basic configuration of a Dynamic Voltage Restorer and discuss about different components of it. Also discuss operating principle of DVR for voltage sag/swell mitigation. (20)

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Group-C

Answer any one question out of two

6. Write the static load flow equations in matrix form, to be solved by N-R method of load flow when a TCSC is installed to regulate power flow in a particular line of a multibus power network. Derive the expressions for new elements of Jacobian matrix that are introduced due to the installation of the TCSC. Discuss about firing angle limit of the TCSC in operation. (20)
- 7.a) State the operating conditions and write the system equations with proper explanation for a HVDC link when mode of operation is: the rectifier on CC control and inverter on CEA control. (12)
- b) Write an algorithm to solve AC and DC system equations to perform load flow analysis if a HVDC link be connected between bus-i and bus-j of a N-bus EHV AC power transmission system under normal operating condition. State the assumptions made. (8)

Group-D

Answer any one questions out of two

8. a) Discuss about different types of electrically propelled vehicles. (8)
- b) What are the limitations in using single energy storage unit in electric vehicles? (6)
- c) Discuss about the importance of power and energy management unit in electric vehicle. (6)
9. Discuss about two hybrid energy storage system topologies for electric vehicle. Mention their relative merits and demerits. (20)