

# 2002 SCHEME

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**Eighth Semester B.E. Degree Examination, June-July 2009**  
**HVDC Transmission**

Time: 3 hrs.

Max. Marks:100

Note:1. Answer any FIVE full questions.  
2. Assume missing data, if any.

- 1 a. Compare AC and DC transmission systems of equal voltage ratings. Discuss in terms of economics, technical performance and reliability of the system. (10 Marks)  
b. Explain the different kinds of DC links with relevant schematic diagrams and state the features of each type. (06 Marks)  
c. Mention the applications and limitations of DC transmission. (04 Marks)
- 2 a. Derive the expression for the terminal voltage of 3-phase, 6-pulse converter bridge circuit (meant for rectifier operation) with finite ignition delay and commutation overlap. Draw the relevant circuit diagrams and waveforms. Explain the effect of commutation overlap on the average DC voltage. (08 Marks)  
b. A bridge connected rectifier operates with  $\alpha = 30^\circ$  and  $u = 15^\circ$ . Determine the necessary secondary voltage of the rectifier transformer which is normally rated at 220 kV/110 kV, if it is required to obtain a DC voltage of 100 kV. Also determine the tap ratio required. (08 Marks)  
c. Explain the general forms of equations for average DC current and average DC voltage in terms of ignition advance angle  $\beta$  and extinction advance angle  $\gamma$  leading to equivalent circuit representations for the inverter. (04 Marks)
- 3 a. Draw the electrical equivalent circuit of a HVDC link and explain the basic principles of controlling the voltage at any point on the line and the current. Mention the considerations influencing the selection of control characteristics. (10 Marks)  
b. Discuss the 'actual characteristics' of converter control. In this context, explain the significance of 'current margin' and its range. (10 Marks)
- 4 a. What is "Mode ambiguity"? Explain the modification of V-I characteristic for mode stabilization. (06 Marks)  
b. Mention the purposes served by DC reactors. (06 Marks)  
c. Mention the causes producing overcurrents and overvoltages in a converter station. Explain briefly the role of valve group protection, pole protection and overcurrent protection circuits. (08 Marks)
- 5 a. Explain the various types of converter faults like Arc back, Arc through, Misfire and Quenching or current extinction. (10 Marks)  
b. Discuss the following limits that are to be recognized in establishing the current order:
  - i) Maximum current limit.
  - ii) Minimum current limit.
  - iii) VDCOL.
  - iv) Minimum firing angle limit.
  - v) Power order.(10 Marks)

- 6 a. Consider an electrical equivalent circuit involving damper across the DC reactor and explain the need for controlling the onset of electrical oscillations in DC link. With relevant assumptions, derive the expression for the optimum damping resistance to be used for avoiding the instability. (12 Marks)
- b. Explain the operation scheme of any one type of multi-terminal DC transmission (MTDC) system. (08 Marks)
- 7 a. Discuss the construction, principle of working and the V-I characteristic of a metal oxide surge arrester. (08 Marks)
- b. Explain the basic concepts of DC circuit interruption and indicate the arrangement of a DC breaker. (06 Marks)
- c. What are the problems associated with injection of harmonics? Discuss the characteristic and non-characteristic harmonics. (06 Marks)
- 8 Write explanatory notes on:
- a. Layout diagram and components of a typical converter station.
- b. Normal starting and stopping of DC link.
- c. Performance indices of telephone interference.
- d. EMTP representations of a DC network. (20 Marks)