

**Eighth Semester B.E. Degree Examination, Dec. 07 / Jan. 08**  
**HVDC Power Transmission**

Max. Marks: 100

Time: 3 hrs.

**Note : Answer any FIVE full questions.**

- 1 a. Compare AC and DC transmission in terms of economics, technical performance and reliability. (10 Marks)
- b. Explain the applications and limitations of HVDC power transmission. (06 Marks)
- c. Explain the various kinds of DC links used for HVDC power transmission. (04 Marks)
- 2 a. Perform the analysis of 3-phase, 6 pulse, converter bridge circuit with no ignition delay. Draw the relevant waveforms and derive the expression for ideal no load direct voltage ( $V_{d0}$ ) in terms of RMS line-to-line voltage ( $E_{LL}$ ). Explain the effect of commutation overlap on the average DC voltage. (10 Marks)
- b. A DC link has a loop resistance of  $10 \Omega$  and is connected to transformers giving secondary voltage of 120 kV at each end. The bridge connected converters operate as follows :  
 Rectifier :  $\alpha = 15^\circ$  and  $X_C = 15 \Omega$   
 Inverter :  $\beta = 10^\circ$ ,  $\gamma = 15^\circ$  and  $X_C = 15 \Omega$   
 Calculate the direct current delivered if the inverter operates on constant  $\beta$  control. (06 Marks)
- c. Show that transformer utilization factor of a Graetz circuit is a function of number of valves  $q$  involved in each commutation group. (04 Marks)
- 3 a. Explain the basic principles of DC link control. (10 Marks)
- b. Discuss the complete characteristics of converter control. In this context, explain the significance of current margin and its values. How is mode stabilization achieved? (10 Marks)
- 4 a. Explain the IPC and EPC firing angle control schemes leading to the power control. Mention the merits and drawbacks of each scheme. (10 Marks)
- b. Mention the basic functions to be performed by smoothing reactors. Discuss the criterion for sizing the reactor. (10 Marks)
- 5 a. Explain the following converter faults :  
 i) Arc back ii) Arc through iii) Misfire iv) Quenching or current extinction (10 Marks)
- b. Discuss the protection against overcurrents in DC systems. (10 Marks)
- 6 a. Workout the optimal value of resistance for avoiding the instability in the control operation of DC link. (10 Marks)
- b. Explain the different types of MTDC systems and compare them. (10 Marks)
- 7 a. Explain the valve and converter models used for HVDC simulation studies. (10 Marks)
- b. Discuss the EMTP representation of a DC network. (06 Marks)
- c. Define characteristic and non-characteristic harmonics. (04 Marks)
- 8 Write explanatory notes on :  
 a. Modern trends in DC transmission  
 b. Starting and stopping of DC link  
 c. Surge arrestors  
 d. DC breaker. (20 Marks)