007702

December 2023

B.Tech. - VII SEMESTER (Electrical Engineering)

HVDC Transmission Systems

(ELPE–712)

Time : 3 Hours] [Max. Marks : 75

Instructions :

1. *It is compulsory to answer all the questions (1.5 marks each) of Part-A in short.*

2. *Answer any four questions from Part-B in detail.*

3. *Different sub-parts of a question are to be attempted adjacent to each other.*

PART–A

1. (a) What is the need of Smoothing Reactor? (1.5)

   (b) What are advantages and disadvantage of Equidistant Pulse Control (EPC) regarding Individual Phase Control (IPC)? (1.5)

   (c) Describe evolution phases of National Grid. What are benefits of one nation-one grid-one frequency? (1.5)

   (d) Sketch Mono polar, bipolar and homopolar Jinks. (1.5)

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7. (a) Define power system angular, voltage and frequency stability. Also explain synchronous and asynchronous links. (10)

   (b) Define multi-terminal and multi-infeed DC systems. Discuss types of MTDC systems and their comparisons. (5)

(e) Define short circuit ratio (SCR). Discuss its significance in HVDC system. (1.5)

(f) What is the purpose of Snubber circuit? (1.5)

(g) What are advantages of IGBT based voltage source converter? (1.5)

(h) Obtain expressions for peak inverse voltage (PIV) and peak-to-peak ripple voltage (PPR) in 6-pulse converter configuration with $\alpha = 0^0$. (1.5)

(i) Explain the necessity of VDCOL and CCA controls in HVDC system. (1.5)

(j) What are the advantages of STATCOM over SVC? (1.5)

PART–B

2. (a) Describe difference between HVAC and HVDC transmission systems. Discuss economics, technical performance and reliability aspects. What are the limitations and advantages of HVDC over HVAC?(10)

(b) Describe components of a HVDC system using detailed figure. (5)

3. (a) Define gate (phase) control of valves. Sketch voltage and current waveforms in a 3-phase 6-pulse bridge converter (Graetz's circuit) with $\alpha = 30°$. Derive expression for DC output voltage with phase control. (10)

(b) A transformer secondary line voltage to a 3-phase bridge rectifier in 365 kV. Calculate the DC voltage output with $\mu = 15°$, when $\alpha = $ (a) $0°$, (b) $15°$, (c) $30°$, and (d) $45°$. (5)

4. (a) In a DC line, define: Corona and Corona loss, Radio interference, Audible noise, Space charge field, and Transient over-voltages. (10)

(b) The AC line voltage of a 3-phase bridge rectifier is 150 kV when delivering a DC power of 400 MW. Assume a delay angle of $30°$ and commutating reactance of 10 ohms, find the value of the DC current in the circuit and the DC voltage on load. (5)

5. (a) What is the necessity of control in case of a DC link? Define inverter control. Explain constant β control and constant γ control with waveforms and figures. (10)

(b) Define PWM methods with wave forms. Why it is used in HVDC transmission? Compare CSC and VSC methods in HVDC system. (5)

6. Derive and explain the complete Equivalent Circuit of a HVDC Link. (15)