USN ☐☐☐☐☐☐☐☐☐☐

Seventh Semester B.E. Degree Examination, Dec.2018/Jan.2019
HVDC Transmission

Time: 3 hrs.

Max. Marks:100

Note: *Answer any FIVE full questions, selecting*
at least TWO full questions from each part.

PART – A

1 a. List out the HVDC transmission systems in India and first HVDC transmission system in the world. **(04 Marks)**
   b. Mention the important applications of HVDC power transmission. **(06 Marks)**
   c. Explain: i) Current limit ii) Voltage limits   iii) Reactive power and voltage regulation and iv) Power per conductor and per circuit of EHV AC and DC transmission. **(10 Marks)**

2 a. With suitable schematics, explain the constitution of EHV AC and DC lines. **(08 Marks)**
   b. Compare HVAC and HVDC transmission for economics of operation and stability limits. **(12 Marks)**

3 a. Describe the single phase full wave (with center tapped transformer) rectifier with circuit diagram and wave forms and also obtain the volt-ampere rating of valve, transformer primary and secondary winding. **(12 Marks)**
   b. What is the criteria for the choice of best circuit for HVDC converter? **(08 Marks)**

4 a. Draw the circuit diagram and the wave shapes and find the peak, rms and average voltages and currents of 3-phase semi bridge rectifier. **(12 Marks)**
   b. Explain the following with neat circuit diagram:
      i)   Parallel connections with interphase transformer.
      ii) Six phase diametrical connection. **(08 Marks)**

PART – B

5 a. Analyze the Graetz circuit without overlap and prove that $Cos\phi = Cos\ \alpha$, where $Cos\ \phi$ is the input supply power factor and α is the firing angle, with assumptions made. **(12 Marks)**
   b. A bridge converter is supplied by an input transformer and the details are as follows:

Output voltage per phase of transformer	= 200 kV (rms)
Reactance per phase of transformer	= 5%
Transformer power rating	= 100 MVA
Firing angle α	= 30°
Overlap angle u	= 15°

   Calculate the load current and terminal voltage on DC side. **(08 Marks)**

6 a. Draw the electrical equivalent circuit of a HVDC link and explain the basic principle of controlling the voltage at any point on the line and the current and also explain the reversal of power. **(10 Marks)**
   b. Discuss the actual characteristics of converter control. In this context, explain the significance of 'current margin' and its range. **(10 Marks)**

7 a. Explain the stability control of DC lines by considering damping circuit. **(10 Marks)**
    b. What are the desired features of CC control? **(05 Marks)**
    c. Discuss the constant current and constant voltage control of power in a HVDC system.
                                                                                    (05 Marks)

8 a. Enumerate the functions of smoothing reactor in case of HVDC transmission system.
                                                                                    (06 Marks)
    b. What are the causes of oscillations on DC line and explain how these oscillations are minimized. **(08 Marks)**
    c. Find the inductance of the DC reactor required to prevent consequent commutation failure in the inverter described below:
        Number of bridges per pole = 2
        Rated voltage per bridge   = 200 kV
        Rated current   = 1.80 kA
        I_{s2} = 10.0 kA
        Frequency   = 60 Hz

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