Time : 3 Hours **Total marks : 80**

N. B.
(1) Question No. **1** is **compulsory**.
(2) **Attempt** any **three** questions out of remaining questions.
(3) **Figures** to the **right** indicate **full** marks.
(4) **Assume** suitable **data** if **necessary**.

1. Solve any **four** :- 20
a) Show location of different components of HVDC links
b) Show the hierarchy in the control of HVDC
c) Compare IPC and EPC scheme of firing of HVDC converter bridge
d) What is a self-clearing fault in HVDCT
e) Synthesize the harmonics produced in HVDC converters and name different filters used

2. a) For a bridge converter with grid control and overlap less than 60^0. Prove that 10

$$cos\emptyset \cong cos \propto - \frac{R_C . I_d}{V_{do}}$$

a) Investigate that single commutation with neat waveforms and diagrams. 10

3. a) Calculate the secondary line voltage of the transformer for a three phase bridge rectifier to provide dc voltage of 120KV. Assume $\alpha=30^0$ and $\mu=15^0$. What is the effective reactance? When the rectifier gives 800A of dc current. 10
a) Develop the complete control characteristic of HVDC control from the basic characteristic. 10

4. a) Show the conduction of different valves in HVDC converter for overlap angle $\mu<60^0$, $\mu=60^0$, $\mu>60^0$. Also show the number of valves conducting, state which conduction is normal, rare and abnormal. 10
a) Investigate what happens if current margin is not given and when it is very narrow 10

5. a) Discuss problems related to 'Ground return' 10
b) Describe 'Power reversal in HVDC' 10

6. a) Evaluate different faults and protections in HVDCT 10
b) Derive equations of fundamental current and rms current drawn by 6-pulse converter and the equation to decide converter transformer rating 10