

CS/B.Tech(EE)/EVEN/8th Sem/EE-801A/2014

**Group – C**  
(Long Answer Type Questions)  
Answer any *Three* of the questions

3x15=45

7. a) Develop the complete equivalent circuit of an HVDC link and obtain an expression for the currents in the DC link as  

$$I_d = \left[ \frac{V_{dop} \cos \alpha - V_{doi} \cos \gamma}{R_{cr} + R_L - R_{cl}} \right]$$
 symbols carry the usual meaning. 10
- b) Find the effective commutation resistance ( $R_c$ ) of a 6-pulse rectifier, which is fed from 400 kV, 3- $\phi$  a.c. voltage, when the d.c. current in HVDC link is 1.1 kA and the rectifier d.c. voltage is 500 kV at firing angle of  $30^\circ$ . 5
8. a) Derive expression for Transformer Utilization Factor of a 6-pulse Graetz circuit. 7
- b) Show that in a 6-pulse Graetz circuit power factor of the fundamental current wave ( $\cos \phi$ ) is equal to the cosine of the firing angle ( $\alpha$ ). State the assumptions to be made. 8
9. a) State the features for ideal control system for a HVDC system. 7
- b) Briefly discuss the effect of A.C. voltages in DC link current 8
10. a) What are the different types of faults that can occur in HVDC systems? Discuss their nature and occurrence. 7
- b) Discuss the protection of (i) filter units and (ii) DC line against over current. 4+4
11. Write short notes on any two : 7½+7½
  - i) Reliability of HVDC systems
  - ii) 12-pulse bridge converter
  - iii) A.C. and D.C. filters used in HVDC system
  - iv) Converter faults

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**2014**

**HVDC Transmission**

*Time Allotted : 3 Hours*

*Full Marks : 70*

*The figure in the margin indicate full marks.  
Candidates are required to give their answers in their own words as far as practicable*

**GROUP – A**  
(Multiple Choice Type Questions )

1. Choose the correct alternatives for any *ten* of the following : 10X1=10
  - i) HVDC transmission commercially began in the year –  
 (a) 1950      (b) 1954      (c) 1970      (d) 1935
  - ii) The first HVDC scheme in India is –  
 (a) Vidhyachal back-to-back system  
 (b) Chandrapur-Padghe scheme  
 (c) Delhi-Rihand 500 KV system  
 (d) Sileru-Barsoor system
  - iii) In a bipolar system –  
 (a) both conductor are positive  
 (b) both conductor are negative  
 (c) one conductor is positive and the other negative  
 (d) one conductor is positive or negative and other is at ground potential

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- iv) The initial HVDC valves were –
  - (a) Thyristors (b) IGBTs
  - (c) Mercury arc rectifiers (d) none of the above
- v) Modern HVDC systems are all –
  - (a) 3-pulse converters (b) 6-pulse converters
  - (c) 12-pulse converters (d) 24-pulse converters
- vi) HVDC systems are mainly used for –
  - (a) interconnection of two asynchronous links
  - (b) bulk power transmission over long distances by overhead lines
  - (c) underwater or submarine cable transmission
  - (d) all of the above
- vii) A 12-pulse converter consists of –
  - (a) two 6-pulse converters in series
  - (b) two 6-pulse converters in parallel
  - (c) (a) or (b)
  - (d) (a) and (b)
- viii) In 12-pulse connections, transformers are connected –
  - (a) Delta / Delta (both)
  - (b) Star/ Star (both)
  - (c) Star/Delta (both)
  - (d) One Star/Star and other Star/Delta
- ix) A thyristor valve conducts when –
  - (a) anode is positive
  - (b) anode is negative
  - (c) anode is positive with positive gate pulse
  - (d) anode is positive with negative gate pulse

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- x) If the ignition delay angle is  $5^\circ$  and the overlap angle is  $12^\circ$ , the extinction delay angle will be –
  - (a)  $17^\circ$  (b)  $7^\circ$  (c)  $6^\circ$  (d) none of the above
- xi) During commutation in a converter –
  - (a) voltage is exchanged
  - (b) current is transferred from one valve to other
  - (c) DC voltage is blocked (d) none of the above
- xii) The relation between  $V_{do}$  and peak value of phase voltage on the secondary side of AC system is,  $V_{do} =$ 
  - (a)  $\frac{3}{\pi} V_m$  (b)  $\frac{3\sqrt{3}}{\pi} V_m$  (c)  $\frac{\pi}{3} V_m$  (d)  $\frac{\pi}{3\sqrt{3}} V_m$
- xiii) The output voltage of a converter is changed by varying –
  - (a)  $\alpha$  (b)  $\mu$  (c)  $\gamma$  (d) any one of  $\alpha, \mu, \gamma$

### Group-B

(Short Type Answer Questions)

Answer any *three* of the following

3x5=15

2. State the application of HVDC transmission. 5
3. Explain the type of faults in HVDC system 5
4. A transformer secondary line voltage to a 3-phase bridge rectifier is 345 KV. Calculate the DC voltage output with  $\mu = 15^\circ$ , when  $\alpha =$  (a)  $0^\circ$ , (b)  $15^\circ$  and (c)  $30^\circ$  5
5. Describe different classes of HVDC links with their special features and necessary diagrams. 5
6. Write the purpose of smoothing reactors in HVDC system. 5