

CS/B.TECH/PWE/SEM-8/PWE-804B/2013

2013

HVDC TRANSMISSION

Time Allotted : 3 Hours

Full Marks : 70

The figures 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 the following :

10x1 = 10

i) Which system is not defined in an HVDC system ?

- a) Monopolar
- b) Bipolar
- c) Unipolar
- d) Homopolar.

ii) The longest existing HVDC link in the world is at

- a) UK b) USA
- c) Sweden d) China.

iii) HVDC transmission system is economical beyond

- a) 200 km b) 300 km
- c) 400 km d) 500 km.

iv) Overcurrent protection in HVDC system is accomplished by

- a) overhead shield wire
- b) control valves
- c) protective gaps
- d) lightning arrester.

v) The longest existing HVDC link in India is

- a) Rihand — Dadri

- b) Talcher — Kolar
 - c) Chandpur — Phadge
 - d) Jaipur — Vishakhapatnam.
- vi) Upcoming HVDC link in India is
- a) Ballia — Bhiwandi
 - b) Bishwanath — Agra
 - c) Badodara — Delhi
 - d) both (a) and (b).
- vii) If the firing angle of the Converter bridge is less than 90°
- a) the bridge acts as a rectifier operation
 - b) the bridge acts as an inverter operation
 - c) the bridge does not operate
 - d) none of these.
- viii) Which of the following is true regarding HVDC transmission ?
- a) Charging is absent
 - b) Power transmission capability of bipolar line is not almost same as 3-phase single circuit line
 - c) HVDC link cannot operate between two a.c. systems whose frequencies are different
 - d) No distance limitation for HVDC underground cable.
- ix) In mode-1 of HVDC controls
- a) Rectifier on CC and Inverter on CC
 - b) Rectifier on CC and Inverter on CEA
 - c) Rectifier on CEA and Inverter on CEA
 - d) Rectifier on CEA and Inverter on CC.
- x) Which of the following statements is true ?
- a) RoW of HVDC is smaller than HVAC for same voltage level

- b) RoW of HVDC is greater than HVAC for same voltage level
- c) RoW of HVDC is equal to the RoW of HVAC for same voltage level
- d) RoW of HVDC and HVAC cannot be compared for same voltage level.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

- 2. Draw and describe briefly the typical arrangement of Back to Back HVDC system.
- 3. Find out the expression for average direct voltage of a 3-phase full wave bridge converter with no ignition angle delay.
- 4. Discuss about the basic concept of d.c. circuit interruption used in HVDC transmission system.
- 5. Discuss the function of smoothing Reactor used in HVDC system with neat diagram.
- 6. Find the inductance of the d.c. reactor required to prevent consequent commutation failure in the inverter described below :
No. of Bridges — 2, Rated Voltage per bridge — 200 kV,
Rated Current — $I_{dn} = 1.8$ kA, Rated L-L short circuit current $I_{s2} = 10$ kA, Frequency — 60 Hz, $n = 16$ deg.,
 $\alpha_{min} = 8$ deg.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

- 7. a) What are the advantages and disadvantages of HVDC system over A.C. transmission system ? 5
- b) Discuss about different types of HVDC links with neat

diagram. 10

8. a) Find out the expression for the reduction in voltage during commutation of 3-phase full wave bridge converter. 8

b) Prove that for same power transmitted, Insulation Level of D.C. transmission system is less than A.C. transmission system. 7

9. a) Compare transmission cost of HVDC and HVAC by plotting a suitable graph. 5

b) How Reactive power can be controlled in a HVDC system with current control at rectifier end and minimum extinction angle at the inverter end during steady state operation. 10

10. a) Briefly discuss about characteristics of D.C. circuit breaker. 7

b) Find the smallest fraction of normal value to which the balanced alternating voltage at the inverter can fall suddenly without causing commutation failure. Assume that the fall of voltage occurs immediately after the beginning of commutation at $n = 1$ deg. Also assume No. of Bridges-2, Rated Voltage per bridge — 200 kV, Rated Current — $I_{dn} = 1.8$ kA, Rated L-L short circuit current $I_{s2} = 10$ kA, Frequency — 60 Hz, Commutation failure occurs if $m < 1$ deg. 8

11. Write short notes on any *three* of the following : 3 5

a) Methods of suppression of harmonics in HVDC system

b) Multi-terminal HVDC system

c) Sources of Reactive power in HVDC system

d) Impact of HVDC Technology on Environment

e) Major Components of HVDC sub-station.

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