Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech(EE-OLD)/SEM-7/EE-703A/2009-10

2009

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 any *ten* of the following : 10 × 1 = 10

i) Reactive power to HVDC sytem may be supplied from

a) AC filters

b) shunt capacitors

c) SVS

d) all of these.

ii) Two AC systems can be connected through a zero length DC link. Such a connection is called

a) front to fornt connection

b) back to back connection

c) front to back connection

d) back to fornt connection.

iii) Normal value of break-even distance in DC transmission is around

a) 70 km

b) 700 km

c) 7000 km

d) any distance.

iv) In case of parallel wires, the visual corona begins

a) at disruptive critical voltage

b) at visual critical voltage which is higher than disruptive critical voltage

c) at lower voltage than disruptive critical voltage

d) none of these.

v) EHV *dc* transmission over large distances

a) is cheaper than EHV *ac* transmission

b) is costlier than EHV *ac* transmission

c) no comparison exists

d) none of these.

vi) As the transmission voltage increases the volume of the conductor

a) increases

b) decreases

c) will not change

d) will increase proportionately.

vii) AC system has which one of the following disadvantages over DC system ?

a) skin effect exists

b) line regulation is more

c) changing current exists

d) none of these.

viii) In a DC transmission line

a) it is necessary for the sending end and receiving end to be operated in synchronism

b) the effect of inductive and capacitive reactances are greater than in an AC transmission line of the same rating

c) there are no effects due to inductive and capacitive reactances

d) power transfer capability is limited by stability considerations.

ix) In a single-phase full converter bridge, the average output voltage is given by (for continuous conduction and firing angle α)

a) $\frac{1}{\pi}\int_{\alpha}^{\pi+\alpha} V_m \cos\theta \, d\theta$

b) $\frac{1}{\pi}\int_{0}^{\alpha+\pi} V_m \cos\theta \, d\theta$

c) $\frac{1}{\pi}\int_{\alpha-(\pi/2)}^{\alpha+(\pi]2)} V_m \cos\theta \, d\theta$

d) $\frac{1}{\pi}\int_{(\pi/2)-1}^{(\pi/2)+\alpha} V_m \cos\theta \, d\theta$.

x) In a 3-phase semiconverter, for firing angle less than or equal to 60°, each SCR & a diode conduct respectively for

a) 60°, 60° b) 90°, 30°

c) 120°, 120° d) 180°, 180°.

xi) Which one of the following signals can be used as control signals for dynamic stability analysis of DC transmission system ?

a) Alternator rotor frequency

b) Frequency at the converter bus

c) Current in the adjacent AC tie

d) DC link voltage.

GROUP – B
(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. Discuss the advantages and disadvantages of HVDC transmission system.

3. Derive an expression for output voltage and current for a six pulse converter for firing angle α and commutation angle μ.

4. Draw and explain the over-current protection scheme in HVDC transmission systems.

5. What is radio-interference ? Suggest methods for suppression of radio-interference.

6. Draw and explain a simple HVDC system.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) Write the functions of a smoothing reactor.

   b) Design a suitable reactor required to prevent consequent commutation failure in an inverter described below :

   No. of bridges per pole = 2

   Rated voltage per bridge = 200 kV

   Rated current = 1·80 kA

   Frequency = 60 Hz

   Peak value of *ac* side current = 10 kA

   Normal excitation angle = 16°

   Minimum excitation angle = 8°

   Assume no ignition error because of error in CEA. 5 + 10

8. Explain in brief, how different types of modelling can be done for simulation of *dc* transmission systems with the problems of representation of each equipment from its operational point of view. 15

9. a) With the help of relevant circuit diagram and waveforms, explain the operation of a 12 pulse converter used in HVDC transmission system. 8

   b) What are the different methods of firing angle control ? Discuss one of them. 2 + 5

10. a) Explain, with relevant circuit diagram, the method of reactive power control in HVDC transmission systems. 6

    b) Discuss the effects of corona in HVDC transmission system. 5

    c) How is insulation coordination done in HVDC systems ? 4

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

    a) Multiterminal DC links

    b) Modern trends of thyristors

    c) Commutation failure

    d) Stability of AC/DC interconnected systems

    e) HVDC converter station.