Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS/M.TECH (EE)/SEM-2/PSM-204(A)/2011

2011
HIGH VOLTAGE DC 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.

Answer any *five* questions. $5 \times 14 = 70$

1. A three phase, 12 pulse rectifier is fed from a transformer with nominal voltage ratings of 220KV/110KV.

    a) If the primary voltage is 230 KV and the effective turns ratio T is $0 \cdot 48$, determine the dc output voltage when the ignition delay angle α is $20°$ and the commutation angle μ is $18°$.

    b) If the direct current delivered by the rectifier is 2000A, calculate the effective commutating reactance X_c, RMS fundamental component of alternating current, power factor $\cos \phi$, and reactive power at the primary side of the transformer. Draw the HVDC system.

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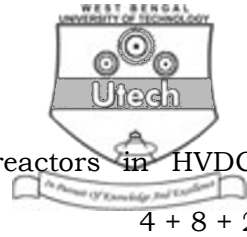
c) Write the purpose of smoothing reactors in HVDC system. 4 + 8 + 2

2. a) Discuss the causes and consequences of commutation failure in inverters with proper diagrams.

b) Explain the requirements and sources of reactive power in converters. 10 + 4

3. For a 3ϕ, 6 pulse, full wave, full controlled converter bridge explain the operation of the converter. Hence with necessary circuit diagram and graphs deduce the following.

a) Average no-load direct voltage with & without ignition delay 'α'.

b) RMS value of the fundamental frequency component of the alternating line current.

c) Currents of an outgoing and an incoming valve respectively during commutation. 4 + 4 + 2 + 4

4. a) In a 6 pulse full wave bridge converter with ignition angle α and overlap angle μ, find the voltage drop due to overlap. Hence derive the expression of equivalent commutating resistance. Draw necessary wave forms.

b) Calculate the necessary secondary line voltage of the transformer for a 3ϕ bridge rectifier to provide a voltage of 110 KV. Assume $\alpha = 25°$, $\mu = 12°$. Calculate the effective reactance X_c if the rectifier is delivering a current I_d = 750 A. $\qquad$ 4 + 2 + 2 + 6

5. a) Discuss the basic principles of DC link control.

b) Describe in details the different control characteristics. Draw the basic control scheme. $\qquad$ 3 + 8 + 3

6. a) State the advantage and disadvantage of 12 pulse converter over 6 pulse.

b) Deduce the total harmonic analysis of a 12 pulse converter. $\qquad$ 4 + 10

7. Discuss Mode 1, Mode 2, Mode 3 operations of a 2 terminal HVDC system with necessary equations and diagram. $\qquad$ 14