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B.E / B.Tech (Full Time) DEGREE END SEMESTER EXAMINATIONS, APRIL / MAY 2013

ELECTRICAL & ELECTRONICS ENGINEERING BRANCH

FIFTH SEMESTER

EE9045 – HIGH VOLTAGE DIRECT CURRENT TRANSMISSION

(REGULATIONS 2008)

Time: 3 Hours Answer ALL Questions Max. Marks 100

PART-A (10 x 2 = 20 Marks)

1. What is the need for back to back HVDC link?
2. Name any four existing HVDC systems in India with their power rating.
3. The voltage at the middle of a bipolar HVDC line is 1030 kV, pole to pole. The line current in each pole is 1000 A and total line resistance of two poles is 50 ohms. Calculate the DC voltage at rectifier end and total line losses.
4. Draw the hierarchical control structure for a HVDC link.
5. What is the necessity of higher-level controller for HVDC link?
6. The following lower order harmonics were present in the AC side with 12-pulse converter operation: 11,13,17,19. Identify the non-characteristics harmonics.
7. List any two criteria to decide the effectiveness of the DC filter.
8. Define Telephone Influence Factor.
9. What is the need for simulation of HVDC systems?
10. What are the requirements of good simulation tool?

Part – B (5 x 16 = 80 marks)

11(a). A 3-phase, 12-pulse rectifier is fed from a transformer with nominal voltage ratings of 220 kV/110 kV.

i) If the primary voltage is 230 kV and the effective turns ratio T is 0.5, determine the dc output voltage when the ignition delay angle α is 25° and the commutation angle μ is 15°. (6)

ii) If the direct current delivered by the rectifier is 2,000 A, calculate the effective commutating reactance Xc, RMS fundamental component of alternating current, power factor and reactive power at the primary side of the transformer. (6)

iii) Compute the rms values of the 11-th and 15-the order harmonic current in the primary side of the transformer feeding the rectifier. (4)

12(a). Compare the insulation level, power losses, transmitted power and conductor material requirement of HVDC transmission system with HVAC Transmission system. (16)

OR

(b)(i). Discuss the modern trends in HVDC system. (8)

(ii). Draw a typical HVDC layout and explain their basic components. (8)

13(a)(i). Describe the steps involved in deenergization of a converter bridge in a HVDC link. (10)

(ii). Draw the converter characteristics of a HVDC link and explain the different modes of operation. (6)

OR

(b). Explain the inverse cosine control and pulse frequency control schemes for firing angle control of HVDC link with neat circuit diagram and waveforms. (16)

14(a). Define characteristic and non-characteristic harmonics. Derive the expressions for characteristic harmonics on AC network side with 6-pulse converter operation. (16)

OR

(b)(i). Explain the effect of firing angle errors and unbalanced voltages on the generation of harmonics. (6)

(ii). With the aid of an equivalent circuit, outline the design procedure of a single tuned filter used in the AC side of a HVDC link. (10)

15(a). Compare and contrast the different types of tools available for HVDC simulation. (16)

OR

(b)(i). What is simulation? Explain the recent trends in the simulation of HVDC systems. (6)

(ii). Describe the modelling of HVDC systems for digital dynamic simulation. (10)