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B.E/B.Tech(Fulltime) DEGREE END SEMESTER EXAMINATIONS,APRIL/ MAY2014

ELECTRICAL & ELECTRONICS ENGG BRANCH

VI SEMESTER

EE9045-HIGH VOLATGE DIRECT CURRENT TRANSMISSION

(REGULATIONS 2008)

DURATION : 3.00 HRS MaximumMarks -100

Answer ALL Questions

PART A (10 * 2 =20)

1. What are the disadvantages of AC transmission over long distances?
2. What is meant by short circuit ratio?
3. How do we select the voltage rating of the HVDC link?
4. State the reasons of core saturation of the converter transformer employed in HVDC transmission?
5. What are the causes of dc side harmonics?
6. Differentiate characteristics and uncharacteristics harmonics.
7. How is the power flow revered in HVDC link
8. Compare VSC based transmission system and LCC based transmission system.
9. What are the different approaches evolved in load flow analysis of HVDC transmission system.
10. Give the EMTP representation of a capacitor.

PART B (5*16=80)

11. A bipolar dc link of $\pm$ 250 kV is rated 1000 MW. The line resistance is 10 Ω/line. Each converter has a 12 pulse bridge with R_c=12 Ω(6 Ω for each of the 6 pulse bridges).The rectifier ignition delay angle minimum limit is 5^0. The effect of converter losses and forward voltage drop is to be neglected. The dc link is initially operating with the rectifier on the CC control and inverter on CEA control with $\alpha_o=18^\circ$ and $\gamma_o=18^\circ$.The current margin is set as 15 % and the transformer turns ratio is 0.5. At the inverter, the dc voltage is 250 kV (for bipolar link). For the above operating condition find

i) Power factor and the reactive power at the inverter HT bus. (2)

ii) Overlap angle μ. (2)

iii) RMS value of the line to line alternating voltage, fundamental component of the line current and the reactive power at rectifier HT bus. (6)

iv) If the reactive power at rectifier HT side drops by 20 % compute the DC voltage at the rectifier and inverter terminals , α,γ and μ. (6)

12 a) Derive the expression for equivalent commutation resistance, relationship between the r m s fundamental frequency line current in ac side and the dc link current, and deduce the equivalent circuit of the dc link. Discuss the factors governing commutation overlap angle μ . (16)

(OR)

12 b) i) What are the different modes of operation of HVDC link. Illustrate the operating points for both rectifier and inverter operation with reference to VI characteristics. Explain the mode shift logic. Illustrate the mode ambiguity and methods of avoiding the mode ambiguity. (16)

13 a) i) Explain the basic control scheme of HVDC link operation and the hierarchy of different levels of HVDC system controllers with control coordination. (10)

ii) Illustrate voltage dependent current order controller. (6)

(OR)

13 b) What are the different firing angle control schemes employed for controlling HVDC link. Explain the IPC schemes and compare the advantages and disadvantages (16)

14 a) i)Compare the performance and control coordination of parallel MTDC system and series MTDC system. (12)

ii) Illustrate Automatic current reference balancing method of control of HVDC link . (4)

(OR)

14 b) Explain the design procedure for passive AC filters for mitigating AC side harmonics in HVDC Link . (16)

15 a) Derive the basic mismatch equations for a bipolar DC link. State the assumptions made. Explain the formation of Jacobian matrix for unified solution of ac dc equations. (16)

(OR)

15 b) i) Illustrate the concept of power modulation control using a HVDC transmission link. (6)

ii) Compare online and offline simulators available for digital dynamic simulation of HVDC links. (10)