Roll No.:									

B.E./B.Tech. (Full-Time) DEGREE END SEMESTER EXAMINATIONS, APRIL/MAY 2012

ELECTRICAL AND ELECTRONICS ENGINEERING BRANCH

SIXTH SEMESTER

EE9045 - HIGH VOLTAGE DIRECT CURRENT TRANSMISSION

(REGULATIONS 2008)

Time: 3 hr Max. Marks: 100

Answer ALL Questions

PART-A (10 X 2 = 20 Marks)

1. State the reasons for using negative polarity in monopolar HVDC link.
2. A Bipolar two terminal HVDC link is delivering 800 MW at ± 400 kV at the receiving end. Total losses in DC circuit are 30 MW. Calculate the current and voltage at middle of the line.
3. Explain the term Delay angle and its significance in rectifier control.
4. What are the merits of higher pulse number?
5. Draw the converter control characteristics of HVDC link.
6. Discuss the necessity of higher-level controllers for HVDC link.
7. Define 'Telephone influence factor'.
8. What are the causes for generation of non-characteristics harmonics?
9. List the system studies necessary for HVDC system planning.
10. What is the need for simulation of HVDC systems?

PART – B (5 x 16 = 80 Marks)

11(a). A 3-phase, 12-pulse rectifier is fed from a transformer.

i) If the primary voltage is 230 kV, determine the dc output voltage when the ignition delay angle α is 15° and the commutation angle μ is 10°. (6)

ii) If the direct current delivered by the rectifier is 1.5 kA, 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). State the main reasons to go for HVDC transmission and mention the limitations of such systems. (16)

(Or)

12(b)(i). Compare the insulation level of a Bipolar HVDC system and a 3-phase AC system. (6)

(ii). Draw a typical HVDC layout and explain their basic components. (6)

(iii). List the different types of HVDC links and compare them. (4)

13(a)(i). Develop the complete equivalent circuit of a HVDC link and obtain the expression of DC current in it. (8)

(ii). What is the necessity of Voltage Dependent Current Order Limiter (VDCOL)? Draw and explain the HVDC link control characteristics with VDCOL. (4)

(iii). Draw and explain the hierarchical control structure of HVDC link. (4)

(Or)

(b). Explain the following.

(i). Inverse cosine control scheme (4)

(ii). Pulse frequency control scheme (8)

(iii). Power and auxiliary controller (4)

14(a)(i). Define characteristic and non-characteristic harmonics. Show that the characteristic harmonics generated on AC side with 6-pulse converter operation is equal to $6n\pm1$, where n=1, 2,3 ..... (10)

(ii). Draw the circuit diagram and impedance characteristic of different types of filters used in AC side of the HVDC link. (6)

(Or)

(b)(i). Explain the effect of firing angle errors and unbalanced voltages on the generation of harmonics. (8)

(ii). With the aid of an equivalent circuit, outline the design procedure of a single tuned filter to be used on the AC side in a HVDC link. (8)

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

(Or)

(b). Fig. 15b shows the one-line diagram of a simple three-bus power system with a DC link between busses 2 and 3. The line impedances are marked in per unit on a 100 MVA base.

DC link data: $a_r = a_i = 1$, $X_{cr} = X_{ci} = 0.05$ pu, $P_{d,sch} = 1$ pu, $\gamma_{min} = 8^\circ$.

Assume: $V_{dr} = V_{di} = 1$ pu; $\cos\alpha = 0.9$; $\cos\gamma = 0.95$; $\cos\varphi_r = \cos\varphi_i = 0.86$.

Write the expressions for mismatch vector and Jacobian matrix elements and obtain the values with the given data. (16)

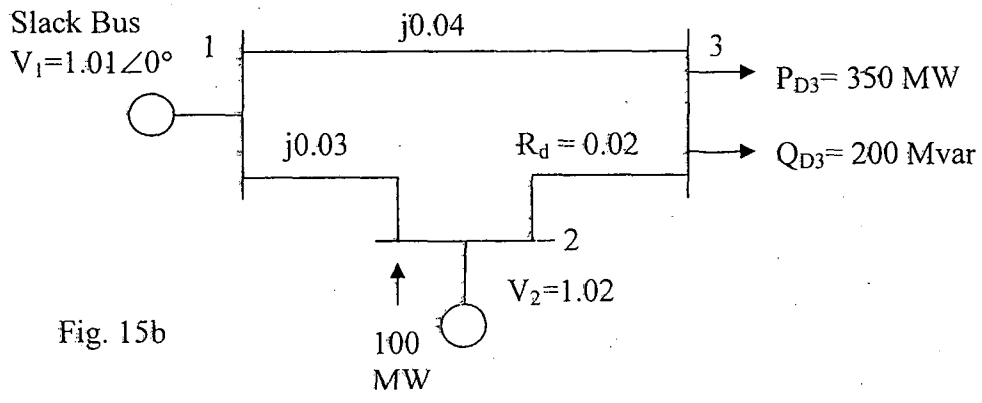

Fig. 15b