P 7198

M.E. DEGREE EXAMINATION, MAY/JUNE 2006.

Elective

Power Electronics and Drives

HV 032 — HIGH VOLTAGE DIRECT CURRENT TRANSMISSION

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Name the existing HVDC systems in operation in India with their power rating.

2. Mention three important criteria to go for HVDC transmission.

3. A Bipolar two terminal HVDC link is delivering 1000 MW at ±500 kV at the receiving end. Total losses in DC circuit are 60 MW. Calculate the sending end voltage and total resistance of the DC circuit.

4. What is meant by 'compounding'? What type of compounding adopted for converters and inverters?

5. Explain the necessity for HVDC circuit breakers.

6. Explain the significance of voltage dependent current limit in control characteristics of a DC link.

7. State the harmful effects of DC harmonics.

8. List the various types of filters used in AC and DC side.

9. What is the need for simulation of HVDC systems?

10. State the difference in application of digital computer and HVDC simulator in system studies.

PART B — (5 × 16 = 80 marks)

11. (i) For a 6–pulse bridge converter, sketch the time variations of input voltage, output voltage and the voltage across one thyristor for one complete cycle for a firing angle delay of 0° and 30°. (6)

(ii) A 6–pulse bridge converter feeds power to a resistive load of 20 ohms. For a firing angle delay of 45°, the load takes 4 kW. Find the magnitude of per phase input supply voltage. (6)

(iii) Repeat part (ii) in case a large reactor in series with load renders the load current ripple free. (4)

12. (a) (i) State the merits and demerits of HVDC as compared to AC for long distance overhead transmission system and interconnection. (8)

(ii) Compare the insulation level of a Bipolar HVDC system and a 3–phase AC system for the same power transmitted and same percentage losses. (8)

Or

(b) (i) State the prospects of HVDC transmission system in India. Why Back-to-back HVDC coupling stations are preferred to AC interconnections. (8)

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

13. (a) (i) Explain by means of a schematic and equations, how power flow through an HVDC link is controlled. (10)

(ii) Write short note on higher level controllers of HVDC system. (6)

Or

(b) (i) Explain the constant current and constant extinction angle control with necessary sketches. (10)

(ii) Draw and explain the hierarchical control structure of HVDC system. (6)

14. (a) Define characteristic and non–characteristic harmonics. Obtain the order of characteristic harmonics on AC network side with 6–pulse and 12–pulse converter operation. Assume firing angle, $\alpha = 0°$. (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 to be used on the AC side in a HVDC line. (10)

15. (a) (i) Give the analog computer and parity simulator representation of any one of the element. Compare the merits and demerits of analog computer and parity simulator. (8)

(ii) Draw the physical model of a HVDC simulator and highlight the problems that can be studied using it. (8)

Or

(b) (i) Write a short note on digital dynamic simulation. Compare the advantages and disadvantages with other tools. (8)

(ii) Give the detailed modelling of a converter bridge for digital dynamic simulation. (8)
