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Question Paper Code : 60940

M.E. DEGREE EXAMINATION, MAY/JUNE 2017.

Elective

Power Systems Engineering

PS 7005 — HIGH VOLTAGE DIRECT CURRENT TRANSMISSION

(Common to M.E. Power Electronics and Drives)

(Regulations 2013)

Time : Three hours   Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1.   What are the advantages of monopolar HVDC link?

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

3.   A Bipolar two terminal HVDC link is delivering 1000 MW at ± 500 kV at the receiving end. Total losses in DC circuit are 50MW. Calculate the voltage at middle of the line.

4.   What are the causes for generation of non-characteristics harmonics?

5.   State the harmful effects of harmonics.

6.   What is current margin in HVDC system?

7.   List any two applications of MTDC systems.

8.   Define per unit system.

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

10. Differentiate off line and on line simulation.

PART B — (5 × 13 = 65 marks)

11. (a) Compare HVDC transmission and HVAC transmission with respect to technical and reliability aspects.

Or

(b) With the help of a neat schematic diagram of a typical HVDC converter station explain the functions of various components.

12. (a) Develop the equivalent circuit of a converter working as rectifier with an overlap angle p and delay angle μ.

Or

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

13. (a) (i) Explain the principle of operation of DC breaker. (7)

(ii) Explain the principle of operation of VSC based HVDC. (6)

Or

(b) Discuss about any two methods of MTDC system control in detail.

14. (a) Derive the basic mismatch equations for a bipolar DC link, Explain the formation of Jacobian matrix for unified solution of AC-DC equations.

Or

(b) Explain the algorithmic steps involved in the substitution of power injection method for solving AC-Dc load flow problem.

15. (a) Discuss the dynamic interactions between AC and DC systems.

Or

(b) Explain the modelling of the converters and the dc link for dynamic simulations.

PART C — (1 × 15 = 15 marks)

16. A 3-phase 12-pulse rectifier is fed from a transformer with nominal voltage ratings of 220 KV/110 KV.

(a) If the primary voltage is 220 kV and the effective turns ratio T is 0.5, determine the dc output voltage when the ignition delay angle α is 15° and the commutation angle μ is 10°. (6)

(b) 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. (5)

(c) 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)

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