Reg. No.:

# Question Paper Code: 71759

### B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2017.

#### Eighth Semester

Electrical and Electronics Engineering

# EE 6010 — HIGH VOLTAGE DIRECT CURRENT TRANSMISSION

(Regulations 2013)

Time: Three hours

Maximum: 100 marks

#### Answer ALL questions.

### PART A — $(10 \times 2 = 20 \text{ marks})$

- 1. State why DC power grid is not anticipated to replace AC power grid.
- 2. What are the problems associated with DC circuit interruption?
- 3. Define 'Valve utilization factor' of a converter.
- 4. Write the three main categories of HVDC-VSC topologies.
- 5. Give the hierarchical control structure for a DC link.
- 6. What is the need for subsynchronous damping controller in HVDC systems?
- 7. What are the demerits of synchronous condensers?
- 8. What are the advantages of Thyristor Switched Capacitor instead of fixed capacitor?
- 9. What is the significance of power flow analysis in AC / DC systems?
- Write the per unit voltage equation for a HVDC converter.

#### PART B — $(5 \times 16 = 80 \text{ marks})$

- 11. (a) (i) Give the comparison of AC and DC transmission based on economics of transmission and reliability. (10)
  - (ii) Explain how the technological developments in the areas of power semiconductor devices and adaptive control have increased the rate of application of HVDC transmission.

		MTDC systems. (8)
12.	(a)	What are the three modes of six-pulse Graetz converter? Explain the complete analysis of model operation of the converter for overlap angle (u) less than 60°. (16)
		Or
	(b)	Describe the six-pulse converter bridge characteristics as rectifier, and explain the different modes of operation of a 12-pulse converter for rectification. $(6+10)$
13.	(a)	(i) Draw the complete steady-state equivalent circuit of a two terminal DC link and obtain the expression for the steady-state current in it.  (8)
		(ii) With a neat schematic diagram, explain the direct control scheme of HVDC-VSC system. (8)
		Or
	(b)	(i) Explain the necessity of constant extinction angle control of inverters and describe how such control can be accomplished. (8)
		(ii) Write down the start-up procedure of DC link with
		(1) long-pulse firing, and
		(2) short-pulse firing. (8)
14.	(a)	Explain the reactive power requirements of the HVDC converter in steady state and how they are affected by the converter control methods. $(6+10)$
		Or
	(b)	(i) Describe the effects of firing angle errors on the non-characteristic harmonics. (6)
		(ii) Explain the design of minimum cost tuned AC filter. (10)
15.	(a)	Derive the mathematical modelling of HVDC links for power flow analysis. (16)
		Or
	(b)	With a neat flow chart, explain the solution methodologies for AC-DC power flow. (16)

What are the types of HVDC Links, with neat diagrams, explain?(8)

(b) (i)