

M.E. ELECTRICAL ENGINEERING FIRST YEAR SECOND SEMESTER
EXAMINATION 2019

POWER ELECTRONICS APPLICATION IN EHV TRANSMISSION

Time: Three hours

Part-I

Full Marks: 50

Answer any two questions.

Figures in the margin indicate full marks

- 1.(a) Explain the following terms and their importance in the context EHV power transmission system. (i) load angle control (ii) series compensation. (5+5)
- (b) Derive the expressions for active and reactive power both at sending end and receiving end of a lossless transmission line in terms of midpoint voltage and load angle. Discuss how power transferred through transmission line can be controlled by midpoint voltage compensation. (6+4)
- (c) What do you understand by the terms 'transient stability' and 'dynamic stability'? (5)
- 2.(a) What is SVS? How a SVS can be configured as a SSSC? What is IPFC? (9)
- (b) Derive the expressions for real and reactive power injected by the series converter of the UPFC connected between two buses of a power system. (12)
- (c) Distinguish between SVC and STATCOM. (4)
- 3.(a) What do you understand by the terms 'FACTS' and 'FACTS controller'? Mention the importance of FACTS devices in power system operation and control. (5)
- (b) With a schematic diagram describe the principle of operation of SVC. Explain why there is a firing angle limit in SVC operation. (8)
- (c) Draw an equivalent circuit of a STATCOM and justify it. Derive the expressions for real and reactive power injected by a STATCOM connected to a power system bus. (12)
- 4.(a) Discuss the operating principle of a mechanically operated conventional phase shifter. (6)
- (b) 'A HVDC link connected between bus i and j of a N-bus EHV AC power transmission system where the rectifier is on CIA control and the inverter is on CC control mode of operation'. – Explain the statement mentioning prevailing operating condition of the HVDC link. (3+10)
Write an algorithm along with relevant equations to perform load flow analysis of this power system. State the assumptions made.
- (c) Discuss about TCSC and its application in power system. (6)

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EXAMINATION, 2019**

POWER ELECTRONICS APPLICATIONS IN EHV TRANSMISSION

Time: Three hours

Full marks: 100

(50 marks for each part)
Use a separate answer script for each part

PART - II

Group A

Answer any one question from this group:

1. a) Explain with suitable diagram the ideal steady state $V-I$ characteristic of an HVDC transmission link. Also draw the equivalent circuit and write the necessary equations. 10
- b) Explain with relevant diagrams how the mode of operation of rectifier and inverter are reversed when rectifier voltage is reduced due to a nearby fault. 10
2. a) Derive necessary equations to show the relationship between ac and dc voltages and currents in a converter. 12
- b) Explain the changes in the relations between ac and dc quantities in converter with N number of bridges in series and transformer ratio T . 8

Group B

Answer any three questions from this group:

3. The harmonic components of primary and secondary currents expressed as a percentage of the fundamental current is given below:

h	5	7	11	13	17	19	23	25
I_h	15	13	9	7	5	4	2	1

Discuss how the transformer can be operated in this harmonic environment.

10

4. Discuss with necessary equations the effect of harmonics on the core loss of a rotating machine. 10

5. a) Explain how the relay operation gets affected by the presence of harmonics. 5

b) Discuss the effect of harmonics on the reactive power in a pure inductance and capacitance. 5

6. Determine the Fourier series coefficients of the following waveform and calculate the rms value and total harmonic distortion of the waveform. 10

