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P.E.S. College of Engineering, Mandya - 571 401
(An Autonomous Institution affiliated to VTU, Belagavi)
Eighth Semester, B.E. - Electrical and Electronics Engineering
Semester End Examination; July - 2021
High Voltage DC Power Transmission

Time: 3 hrs

Max. Marks: 100

Note: Answer any FIVE full questions.

- 1 a. List the advantages and disadvantages of a HVDC transmission system. 8
- b. Compare HVDC and HVAC transmission links for;
 - i) Economics of transmission
 - ii) Stability limit 12
 - iii) Voltage limits
 - iv) Power per conductor and per circuit
- 2 a. Explain the Bipolar DC Link along with their schematic connections diagrams. 4
- b. List the Principle applications of HVDC transmission system. 6
- c. Explain the typical HVDC converter station. 10
- 3 a. With a neat circuit diagram, explain single phase full wave rectifier circuit and obtain expression for V_d . 8
- b. With a neat circuit diagram, explain three phase one way rectifier and derive an expression for V_d . 12
- 4 a. Discuss the turn on and turn off switching characteristics of Thyristor. 10
- b. With a neat circuit diagram, explain three phase two way (Three phase bridge rectifier) and derive an expression for V_d . 10
- 5 a. With the help of neat diagram and waveforms, analyse the Gratez circuit with overlap less than 60° degrees. Obtain the expression for average direct voltage in each case. Hence draw the equivalent circuit of the rectifier. 10
- b. In a monopolar HVDC link which is energized with 3 phase, 50 Hz, 400 kV source, the DC current is 1 kA and the rectifier (six pulse bridge converter) end voltage is 500 kV. For delay angle of 15° ;
 - i) Find the commutation resistance 10
 - ii) Find the commutation angle
 - iii) If the AC voltage is reduced to 200 kV, find the commutation angle μ .

Assume the DC current is constant.
- 6 a. Perform the analysis of Gratez circuit without overlap. Obtain the expression for average direct voltage. 8
- b. A Gratez bridge operates with a delay angle of 15° , the leakage reactance of the transformer is 10 ohms. The line to line AC voltage is 85 kV. Compute the overlap angle DC voltage for; 12
 - i) $I_d = 2000$ A
 - ii) $I_d = 4500$ A

- 7 a. With the help of neat equivalent of DC transmission valid for average currents and voltage in steady state, explain the basic means of control. 8
- b. Mention the designed features of control. 6
- c. What are MTDC systems? Explain the two configurations of MTDC systems. 6
- 8 a. Mention the limitations of manual control. 5
- b. Explain the Actual control characteristics in the context of combined characteristics of Rectifier and Inverter. 5
- c. Explain constant-current control and constant minimum extinction angle control. 10
- 9 a. Discuss the procedure for clearing the line faults and reengineering the line. 10
- b. Define characteristics and Non-characteristics harmonics. Explain the trouble caused by harmonics and functioning of harmonics filters. 10
- 10 a. Explain the phenomenon of 'Telephone Interference' and the factors affecting it in detail. 10
- b. Explain the basic types of faults that can occur in converters. 10

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