

**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 - 2023****HVDC Power Transmission**

Time: 3 hrs

Max. Marks: 100

Course Outcomes*The Students will be able to:**CO1: Comparison of DC transmission with respect to AC transmission, Historical sketch, DC links, recent trends & Applications of DC transmission.**CO2: Discussion on valve characteristics, Properties and analysis of converters.**CO3: Analysis of Gratez circuit without overlap & with overlap ($<60^\circ$) (rectification & inversion).**CO4: To interpret the control strategies in reversal, manual control, Actual control characteristics, Stability & MTDC systems.**CO5: To study about the converter faults and its protection, Characteristic / Uncharacteristic harmonics, their Troubles & filters.***Note: I) PART - A is compulsory. Two marks for each question.****II) PART - B: Answer any Two sub questions (from a, b, c) for a Maximum of 18 marks from each unit.**

Q. No.	Questions	Marks	BLs	COs	POs
I : PART - A		10			
1 a.	Mention the types of DC links.	2	L2	CO1	PO1
b.	Define pulse number.	2	L1	CO2	PO2
c.	Write the expression for direct current I_d for Gratez circuit with overlap condition.	2	L1	CO3	PO2
d.	What are MTDC systems?	2	L1	CO4	PO2
e.	Mention the types of converter faults.	2	L1	CO5	PO2
II : PART - B		90			
UNIT - I		18			
2 a.	Summarize the advantages and disadvantages of HVDC transmission system.	9	L2	CO1	PO2
b.	Compare HVAC and HVDC transmission for economic of operation, stability limit and reactive power limit.	9	L2	CO1	PO2
c.	Explain briefly on modern trends in HVDC technology.	9	L3	CO1	PO2
UNIT - II		18			
3 a.	Explain the three-phase two way rectifier circuit, with relevant waveforms and obtain;				
	i) Average direct voltage	9	L3	CO2	PO2
	ii) Average direct current				
	iii) PIV				

b.	Explain the characteristics of a twelve pulse converter.	9	L3	CO2	PO2
c.	'Best converter circuit for the HVDC transmission is 3-phase bridge'. Justify the statement by explaining advantages of a 3-phase Graetz bridge configuration.	9	L3	CO2	PO2
UNIT - III		18			
4 a.	With relevant figure and waveforms, explain the operation of Graetz bridge circuit, also derive the expression for average DC output voltage of converter without overlap.	9	L2	CO3	PO2
b.	With relevant waveform, derive an expression for average DC voltage in a bridge converter with an overlap of less than 60 degrees.	9	L2	CO3	PO2,3
c.	Explain briefly about Vd-Id characteristics of converter.	9	L3	CO3	PO2
UNIT - IV		18			
5 a.	Discuss briefly about actual control characteristics, also mention it's significances of current margin and its range.	9	L3	CO4	PO2
b.	Explain briefly about two configurations of MTDC systems and mention the limitations of manual control.	9	L1	CO4	PO2
c.	Explain the stability of control as considering a damping circuit.	9	L3	CO4	PO2
UNIT - V		18			
6 a.	Explain briefly about the phenomenon of Telephone interferences and the factors affecting it.	9	L3	CO5	PO2
b.	i) Discuss the troubles caused by harmonics and functioning of harmonics filters.	5	L1	CO5	PO2
	ii) What are the characteristics and non-characteristic harmonics?	4			
c.	Explain the procedures for clearing the line faults and re-energizing the line.	9	L3	CO5	PO2

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