Code No: 157BY **R18**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech IV Year I Semester Examinations, January/February - 2023
HVDC TRANSMISSION
(Electrical and Electronics Engineering)

Time: 3 Hours **Max.Marks:75**

Note: i) Question paper consists of Part A, Part B.
ii) Part A is compulsory, which carries 25 marks. In Part A, Answer all questions.
iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

PART – A
(25 Marks)

1.a)	What are the types of HVDC links?	[2]
b)	State the merits of HVDC transmission over EHVAC transmission.	[3]
c)	List out the sources of reactive power in HVDC system.	[2]
d)	Distinguish between delay in firing angle (α) and extinction angle (γ) of an HVDC converter.	[3]
e)	What is the need of solution of DC load flow?	[2]
f)	What are the merits of per unit quantities?	[3]
g)	List out the converter faults in HVDC system.	[2]
h)	Discuss the radio interference in HVDC system.	[3]
i)	What are the sources of generation of harmonics?	[2]
j)	How is a filter designed? What are the different types of Ac Filters?	[3]

PART – B
(50 Marks)

2.a) What are the limitations of a DC line? How have these limitations been surmounted in modern lines.
b) Explain in details the superiority of technical performance of HVDC lines to that of EHV lines. [5+5]

OR

3.a) Explain the choice of converter configuration with necessary expressions.
b) Calculate the secondary line voltage of the transformer for 3-phase bridge rectifier to provide a DC voltage of 120 kV. Assume $\alpha = 30^0$, $\mu = 15^0$. What is the effective reactance X_L, if the rectifier gives 800A of DC output current? [6+4]

4.a) Explain the converters control characteristics
b) The DC voltage and current at the sending end of a rectifier station are 200 kV and 1000A respectively. The commutating reactance of the rectifier is 10 ohm and the resistance of the line is 10 ohm. Calculate the extinction angle γ, if the DC voltage is 190 kV at the terminal of the inverter. Assume the no load voltage of the inverter as 200 kV at $\gamma=0$. [6+4]

OR

5.a) Explain the reactive power requirements in steady state of HVDC system.
b) Describe the static VAR compensators with neat diagram. [5+5]

6. Obtain the mathematical models of a DC network and DC converter including converter controller. [10]

OR

7.a) Classify the solution methodology of AC-DC load flows.

b) Describe the sequential method AC/DC load flow method. [4+6]

8.a) Explain briefly the faults on the AC side of HVDC systems.

b) Describe the over voltage in converter station. [5+5]

OR

9.a) Discuss the nature and type of faults on the DC side of converter stations. How are the faults sensed and cleared?

b) Give the principle of different types of DC circuit breaker schemes. Why is a surge diverter needed across the Dc circuit breaker? [5+5]

10.a) Describe the effect of Pulse number on harmonics.

b) What are the factors responsible for generation of characteristic and non-characteristic harmonics? How each can be reduced to a minimum? [4+6]

OR

11.a) Explain the design of single tuned filters.

b) Discuss the need to employ filter circuit in HVDC systems. Derive an expression for minimum cost of tuned AC filter used in HVDC systems. [5+5]

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