Name: Enrolment No:	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, May 2019

Programme Name: B. Tech Electrical **Semester : VIII**
Course Name : Advanced Power Transmission System **Time : 03 hrs**
Course Code : EPEG 4004 **Max. Marks : 100**
Nos. of page(s) : 2
Instructions: All questions are mandatory.

SECTION A

S. No.		Marks	CO
Q 1	Compare HVDC and EHVAC transmission system with respect to stability.	4	CO1
Q 2	Explain back-to-back HVDC coupling system with neat diagram.	4	CO2
Q 3	Explain the purpose of smoothing reactor in HVDC system.	4	CO3
Q 4	Draw the steady state V-I characteristics of HVDC converter.	4	CO4
Q 5	Discuss various types of faults that can occur in converter.	4	CO5

SECTION B

Q 6	Sketch a schematic of 2T bipolar HVDC Transmission link and explain the need for Earth electrode and line electrode.	10	CO1
Q 7	A bipolar 2T HVDC Transmission system is operated in Bipolar mode with earthing of neutral points of converters at each terminal. The following voltages were measured: i. Pole 1 rectifier: 501 kV DC j. Pole 1 inverter: 499 kV DC k. Pole 2 rectifier: 495 kV DC l. Pole 2 inverter: 493 kV DC DC resistance of pole 1 and pole 2 line conductor is 5 Ohms. Neglect the Earth return resistance. Calculate the following with respect to Pole 1: a. DC Current b. Earth current c. DC power from rectifier end d. DC power received at inverter end e. Line loss (OR) Draw the schematic of cascaded three-phase rectifier and explain its operation.	10	CO2
Q 8	Explain the principle of DC link control with a neat diagram.	10	CO4
Q 9	Explain in detail about the protection scheme applied for overcurrent in a HVDC	10	CO5

<table>
<tr><td></td><td>pole.</td><td></td><td></td></tr>
<tr><td colspan="4">SECTION-C</td></tr>
<tr><td>Q 10</td><td>Give your recommendation for the type of transmission system for the following under transmission planning for year 2020-2035.
i. National Grid of India with Interconnection between Western Region, Northern Region, Southern Region, Eastern Region.
ii. Interconnection between Srilanka and India
iii. Supply to Andaman Nicobar Islands from Indian main land grid
iv. 20,000 MW Hydro-electric power pool in Himalayan Region to National grid over 3000 km.
v. 100 MW Ocean Thermal Power Plants in high sea to Tamilnadu.
Note: choice can be made from the following:
a. Three phase AC system
b. Bipolar 2T HVDC system
c. MT HVDC system
d. Flexible AC transmission system
e. HVDC Coupling Stations

(OR)

a. Explain the procedure to find the optimal configuration of HVDC converter.
b. Find the optimal 12-pulse configuration among the following:

<table><tr><td>S. No</td><td>q</td><td>r</td><td>s</td></tr><tr><td>1</td><td>6</td><td>2</td><td>1</td></tr><tr><td>2</td><td>12</td><td>1</td><td>1</td></tr><tr><td>3</td><td>6</td><td>1</td><td>2</td></tr></table></td><td>20</td><td>CO1</td></tr>
<tr><td>Q 11</td><td>Explain the operation of HVDC converter if operated in the following modes:
a. Mode 1: overlap angle $u<60°$
b. Mode 2: overlap angle $u=60°$
c. Mode 3: overlap angle $u>60°$
Also, draw the output waveforms</td><td>20</td><td>CO4</td></tr>
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SECTION A

S. No.		Marks	CO
Q 1	Compare HVDC and EHVAC transmission system with respect to Corona loss.	4	CO1
Q 2	Explain Multi-terminal HVDC system with neat diagram.	4	CO2
Q 3	Explain the purpose of reactive power control in weak AC system.	4	CO3
Q 4	Discuss the drawbacks of Individual phase control scheme.	4	CO4
Q 5	Explain the following: a. Misfire b. Current extinction	4	CO5

SECTION B

Q 6	Explain the economic breakeven of long bipolar HVDC transmission over double circuit EHV AC Transmission using necessary plot.	10	CO1
Q 7	A bipolar 2T HVDC Transmission system has 12 pulse converter per pole at each terminal. The system has the following data: i. Rated DC voltage = ±500 kV ii. Rated Bipolar power = 1500 MW iii. Line resistance per pole = 5 Ohms iv. DC voltage at rectifier end = ±500 kV Calculate the following: a. DC line current b. Inverter end DC voltage c. DC voltage of 6-pulse converter at rectifier end d. DC line losses e. DC power delivered to inverter end (OR) Explain different types of HVDC links with neat diagram and comment on its application.	10	CO2
Q 8	Explain Current and Extinction angle control with neat diagram.	10	CO4
Q 9	Explain in detail about the protection scheme applied for overvoltage in a HVDC pole.	10	CO5

SECTION-C			
Q 10	Draw the schematic of 6-pulse converter for the following configuration: a. $q=3, s=2, r=1$ b. $q=6, s=1, r=1$ Calculate the maximum DC power and transformer ratings (valve windings) if PIV rating of the valve is V and the RMS current rating is I.	**20**	**CO1**
Q 11	Explain in detail about the following control schemes applied in HVDC link a. Firing angle Control b. Power Control (OR) Explain the effect of firing angle on HVDC converters and draw the waveforms if operated at a. $\alpha=0°$ b. $\alpha=150°$ *Note: Indicate the switching sequence as applicable*	**20**	**CO4**