

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, April/May 2018

Course: Substation Designing
Semester: VIII
Program: B. Tech. Electrical
Time: 03 hrs.

Max. Marks: 100

SECTION A

S. No.		Marks	CO
Q 1	Discuss the type of groundings practiced in Industrial, Distribution system with their voltage levels in the AC substations	4	CO1
Q2	Explain the following terms and their units of measurement: a) The chopped wave insulation level b) Insulation coordination c) Discharge current d) Impulse ratio	4	CO2,3
Q3	Deduce an expression for transmission loss in terms of load current and the voltages of the HVDC transmission system	4	CO4
Q4	Write a short note on advantages of Gas Insulated Substation	4	CO3,4
Q5	Discuss the various modes of operations of breakers and isolators in a substation.	4	CO1

SECTION B

Q6	A generating station has three generators, each of 10 MVA, 10% reactance capacity, connected to a common bus through reactors of 8% to each generator. If a fault develops on the bus bar of one generator, calculate the short circuit MVA and compare it with a with a case when there is no reactors used	10	CO4
Q7	With the help of neat diagram, explain the functioning of Pressure relieved bellow compensator for the gas insulated substation OR Discuss the sequence of control actions during a line fault on HVDC Overhead line pole.	10	CO3
Q8	Discuss the scheme suitable for the interstate transmission system operating on two different frequencies & the sending end& receiving end voltage levels are 400 kV AC & 220 kV AC respectively.	10	CO3
Q9	With the help of neat diagram, develop the logic of the switches (load break switches and D.C. Breaker) of the bipolar HVDC substation for the power transfer when one of the HVDC line is faulty.	10	CO4

SECTION-C

Q 10	A lineman, working at a 33 kV substation yard, was deputed on a sunny day to	20	CO3
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	<p>rectify a light point at the top of switchyard steel structure. The switchyard is laid with 7.5 cm thick gravel layer as a safety measure. While fixing and positioning the ladder in the switchyard manually, it went out of control, causing the ladder to fall on the 33kV Busbar. This caused an earth fault with the bus and the people on the scene heard an explosive sound. The power supply tripped instantly. The lineman fell on the ground after getting a severe shock. He sustained some burns on both hands and both feet causing bleeding. Fortunately, his life was saved. Explain what the factors that saved his life are. Assume his body resistance 1000 ohms with contact resistance of 100 ohms (Shoes). The 33kV bus fault level 750 MVA. Make any reasonable assumption if required.</p>		
<p>Q11</p>	<p>The following data of a system is made available to the engineer and he was asked to analyze it for different lightning impulse condition and his comments. Give your analysis for the system and draw a schematic diagram for the system</p> <ol style="list-style-type: none"> 1. Basic insulation level of Incoming feeder: 650kV 2. Surge arrester Normal Voltage: 120kV 3. Basic Insulation of surge arrester: 650kV 4. Discharge Voltage: 350 kV 5. Cable basic Insulation Level: 640kV 6. Transformer voltages: 132/ 66kV 7. Transformer basic insulation level: 550 kV <p style="text-align: center;">OR</p> <p>a) a) Discuss the steps in bus bar design of a 220 kV substation.</p> <p>b) Design a Busbar system for the following specifications:</p> <p>Rated Voltage: 400kv ; Rated normal current: 2000A</p> <p>Rated short circuit current: 40kA rms ; Type of Busbar: Aluminum & Rigid</p> <p>i) Phase to phase 5 M ; ii) Phase to ground 3.5 M;</p> <p>iii) Creepage value: 24mm/kV</p> <p>Take the other parameters as per the standards.</p>	<p>20</p>	<p>CO2</p>

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Name of the School <small>(Please tick, symbol is given)</small>	:	SOE	☒	SOCS		SOP	
Programme	:	B. Tech. Electrical					
Semester	:	VIII					
Name of the Course	:	Substation Designing					
Course Code	:	PSEG 302					
Name of Question Paper Setter	:	Ram Mohan Sharma					
Employee Code	:	40000868					
Mobile & Extension	:	9997636035					
Note: Please mention additional Stationery to be provided, during examination such as Table/Graph Sheet etc. else mention "NOT APPLICABLE":							
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Date of Examination	:						
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Note: - Pl. start your question paper from next page

Model Question Paper (Blank) is on next page

Name: Enrolment No:	
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SECTION A

S. No.		Marks	CO
Q 1	Deduce an expression for transmission loss in terms of load current and the voltages of the HVDC transmission system	4	CO1
Q2	Write a short note on functional requirement of substation earthing system	4	CO2,3
Q3	With the help of neat diagram, explain the functioning of parallel compensator used in bus modules of gas insulated substation	4	CO4
Q4	Write a short note on advantages of Gas Insulated Substation	4	CO3,4
Q5	Discuss the type of neutral groundings practices in Industrial, Distribution system with their voltage levels in the AC substations.	4	CO4

SECTION B

Q6	A generating station has three generators, each of 10 MVA, 10% reactance capacities, are connected to a common bus through reactors of 8% to each generator. If a fault develops on the bus bar of one generator, calculate the short circuit MVA and compare it with a case when there is no reactors used	10	CO4
Q7	State the protective zones for HVDC terminals, show them on a single line diagram of HVDC terminal & protection for HVDC substation. OR With the help of neat diagram, explain the static sealing system between the two Gas insulated Substation modules	10	CO4
Q8	With the help of neat diagram, develop the logic of the switches (load break switches and D.C. Breaker) of the bipolar HVDC substation for the power transfer when one of the Valve system of HVDC system is faulty.	10	CO4
Q9	With the help of neat diagram, show the location of the surge arresters in a HVDC substation.	10	CO4

SECTION-C

Q 10	A lineman working at a 33 kV substation yard was deputed on a sunny day to rectify a light point at the top of switchyard steel structure. The switchyard is laid with 7.5 cm thick gravel layer as a safety measure. While fixing and positioning the ladder in the switchyard manually, it went out of control, causing the ladder to fall on the	20	CO5
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	<p>33kV Busbar. This caused an earth fault with the bus and the people on the scene heard an explosive sound. The power supply tripped instantly. The lineman fell on the ground after getting a severe shock. He sustained some burns on both hands and both feet causing bleeding. Fortunately, his life was saved. Explain what the factors that saved his life are. Assume his body resistance 1000 ohms with contact resistance of 100 ohms (Shoes). The 33kV bus fault level 750 MVA. Make any reasonable assumption if required.</p>		
<p>Q11</p>	<p>A lightning arrester is having a rating of 80kA is selected for 400 kV substation. Calculate the following on the basis of 75% and 80% arrestors</p> <p>a) Voltage rating</p> <p>b) Arrester discharge voltage</p> <p>c) Minimum insulation level protected against</p> <p>i) Impulse surges</p> <p>ii) Switching surges</p> <p>Take discharge factor value 3.0</p> <p>Switching surge voltage factor = 3.88</p> <p>Impulse surge voltage insulation level (kV) = $1.15(1.10 * E_d + 40)$</p> <p style="text-align: center;">OR</p> <p>a) a) Discuss the steps in bus bar design of a 220 kV substation.</p> <p>b) Design a Busbar system for the following specifications:</p> <p>Rated Voltage: 400kV ; Rated normal current: 2000A</p> <p>Rated short circuit current: 40kA rms ; Type of Busbar: Aluminum & Rigid</p> <p>i) Phase to phase 5 M ; ii) Phase to ground 3.5 M;</p> <p>iii) Creepage value: 24mm/kV</p> <p>Take the other parameters if required, as per the standards.</p>	<p>20</p>	