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

**Course:  Substation Designing**                                          **Semester: VI**
**Program: B. Tech. PSE + Electrical**
**Time: 03 hrs.**                                                          **Max. Marks: 100**

### SECTION A

| S. No. | | Marks | CO |
|---|---|---|---|
| Q 1 | Discuss the zones of protection of HVDC system | **4** | **CO4** |
| Q2 | Explain the following terms and their units of measurement: <br><br> a) The Earth Electrode in reference to HVDC substation Anode in relation to HVDC substation <br><br> b) Discharge current of surge arrester <br><br> d) Impulse ratio | **4** | **CO2** |
| 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** |
| Q5 | Discuss the SF6 gas supervision system of the Gas insulated substation. | **4** | **CO3** |

### 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** | **CO1** |
|---|---|---|---|
| Q7 | With the help of neat diagram, explain the functioning of Pressure relieved bellow compensator for the gas insulated substation <br><center>OR</center> <br>Discuss the sequence of control actions during a line fault on HVDC Overhead line pole. | **10** | **CO3,4** |
| Q8 | Discuss the scheme suitable for two neighboring independently controlled AC system when the voltage levels are 400 kV AC & 220 kV AC respectively. | **10** | **CO4** |
| Q9 | State the major activities for the planning of substation project and prepare a typical L2 bar chart for typical electrical erection activities | **10** | **CO5** |

### SECTION-C

| Q 10 | The following data available for the substation. <br><br> Fault current: 3.1 kA for 3 sec. & Duration of fault current: 0.15 sec. | **20** | **CO3** |
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|---|---|---|---|
| | Temperature Constant "S" = 160; Soil resistivity: $30 \times 10^3$ ohm-cm <br><br> Soil resistivity of surface material: $30 \times 10^5$ ohm-cm <br><br> Thickness of the gravel on the substation: 100 cm. <br><br> Length of 100m and a width of 50m with 6 parallel rows and 8 parallel columns <br><br> Grid conductors will be buried at a depth of 600mm <br><br> Earthing rods on the corners and perimeter of the grid; 25 no's; <br><br> Length of earthing rod: 3m <br><br> Calculate the following; <br> a) Area of grid conductors    b) Touch potential.    c) Step potential <br><br> d) Grid resistance           e) Grid potential rise | | |
| Q11 | The following data of a system received from the client to a design engineer for the analysis for different lightning impulse condition and his comments. <br><br> 1. Basic insulation level of Incoming feeder:    650kV <br> 2. Surge arrester Normal Voltage:    120kV <br> 3. Basic Insulation of surge arrester:    650kV <br> 4. Discharge Voltage:    350 kV <br> 5. Cable basic Insulation Level:    640kV <br> 6. Transformer voltages:    132/ 66kV <br> 7. Transformer basic insulation level:    550 kV <br><br> Draw a schematic diagram for the system and give your analysis for different surge conditions.        OR | **20** | **CO2** |
| a) | a) Discuss the steps in 220kV substation design. <br><br> b) Design the Busbar system for the following specifications: <br><br> **Rated Voltage**: 400kv ;  **Rated normal current:** 2000A; **Creepage** : 24mm/kV <br><br> **Rated short circuit current**: 40kA rms ;  **Type of Busbar: Aluminum & Rigid** <br><br>     **Height of insulator**: 5 meter; **Cantilever strength:** 500 kg-m <br><br> Take other parameters, if required, as per the system voltage | | |

| | Determine i) span of insulators; ii) Force on Busbar per meter | | |
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