MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

VII SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)
END SEMESTER ON-LINE PROCTORED EXAMINATIONS

DECEMBER 2021

HVDC & FACTS [ELE 4083]

REVISED CREDIT SYSTEM

Time: 75 Minutes + 10 Minutes **Date: 17 December 2021** **Max. Marks: 20**

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.
- Time: 75 minutes for writing + 10 minutes for uploading.

1A. Draw and explain the HVDC control characteristics of both rectifier and inverter with (i) CC control (ii) CEA control (iii) CIA control and (iv) VDCOL ***(04)***

1B. A 3-phase, 48-pulse bridge converter with commutating resistance = 24 Ω is used in a Monopolar HVDC system with dc current = 1.8 kA at 500 kV and resistance of line = 8 Ω. The transformer turns ratio at each converter is 0.45. The rectifier is initially operating in CC mode with α=18° and the inverter in CEA mode with γ=18° maintains dc voltage at 500 kV. For the above condition compute the following

i) Real and reactive power at rectifier HT bus.

ii) If the rectifier HT bus voltage by 12%, compute the dc voltages and active and reactive power at rectifier and inverter HT bus. Assume no change in tap position, inverter ac voltage is constant and alpha minimum=5°. Take current margin as 17%. ***(04)***

1C. Distinguish between misfire and commutation failure in a HVDC converter. ***(02)***

2A. A 500kV, 50Hz, 600km long symmetrical line is operated at the rated voltage. Inductance of the line= 1 mH/km and capacitance=11 nF/km, angular difference δ=69°.

i) Compute the rating of a shunt capacitor to be connected at midpoint of the line to improve the voltage to 490 kV.

ii) Compute the reactive current to be given by STATCOM in order to increase the midpoint voltage to 487.5 kV and the maximum power carried by the line corresponding to this condition. ***(04)***

2B. Compute the approximate value of X_{TCSC} when the capacitive reactance is 12 Ω, firing angle is 60° and minimum inductive reactance of TCR is 3 Ω. Also calculate the firing angle which results in resonance. ***(03)***

2C. With relevant diagrams, analyze the performances of SVC & STATCOM with respect to transient stability, voltage stability and power oscillation damping. ***(03)***