Khulna University of Engineering & Technology
B. Sc. Engineering Special Backlog Examination 2018
Department of Electrical and Electronic Engineering
EE 4223
High Voltage DC and Flexible AC Transmission

Time: 3 hours Full Marks: 210

N.B.: (i) Answer **ANY THREE** questions from each section in separate scripts.

(ii) Figures in the right margin indicate full marks.

Section A

Q1. (a) Compare AC and DC HV transmission system. What is break-even distance for HVDC transmission? (08)

(b) Describe the applications of HVDC transmission. (07)

(c) Show the different types of HVDC links with relevant circuit diagrams. Discuss the advantages and disadvantages of each. (12)

(d) Explain the three HVDC link interconnection systems. (08)

Q2. (a) Explain the construction and operation of a line commutated for HVDC. Deduce the equation for dc output voltage for 6-pulse converter. (12)

(b) Draw the circuit arrangement of a six-pulse current source converter with no overlap. Deduce the equation for dc output voltage. Establish the relationship between dc and ac currents. (13)

(c) Describe the operation of a line commutated converter for inverter operation. (10)

Q3. (a) Describe the principle of operation of a shunt-active filter with net sketch of block diagram and proper waveforms. (15)

(b) Draw the schematic diagram of half-bridge and full-bridge MMC cell. What is the significance of multi-level converter? (08)

(c) A six-pulse HVDC converter is connected to 330 kV AC grid using a 330kV/220kV, 800MVA, Xt = 12% transformer. Determine the commutation overlap angle if the converter is operating at 20^0 firing angle and 1800A DC current. (12)

Q4. (a) Mention the operating mode of VSC. How does a VSC act as an inverter and reactive power controller? Explain with proper vector diagrams. (10)

(b) Sketch the circuit diagram of H-bridge type three level converter and explain the operation briefly. (10)

(c) A single-phase VSC inverter has pure inductive load with L = 21.5 mH. The inverter operates in a square wave fashion with an AC frequency of 50 Hz and DC voltage of 200V. (15)

(i) Express the instantaneous converter voltage and load current using the Fourier series.
(ii) Calculate peak and RMS load current, and
(iii) Calculate the power absorbed by load.

Section B

Q5. (a) Explain the operating characteristic of a simple SVC circuit using TCR. (15)

(b) Draw the pulse ratio modulated power measurement system. Draw and explain the operation of the IEEE Basic Model 2 for the SVC control system. (10)

(c) Define ESCR and write down its equation. Explain operation of a SVC system with coupling capacitor. (10)

Q6. (a) Describe the application of SVC in steady state and transient stability improvement. (12)

(b) Explain the modes of TCSC operation. What are the requirements and advantages of TCSC? (11)

(c) Describe the constant current and constant angle controls of TCSC based systems. Draw the block diagram and explain operation of constant current controlled TCSC system. (12)

Q7. (a) Draw the schematic diagram of a STATCOM and explain its power circuit. Describe the real and reactive power control actions of a STATCOM. (13)

(b) Deduce the steady state model of SATCOM using dc power in consideration. (12)

(c) Explain the SSR mitigation technique using STATCOM. (10)

Q8. (a) Explain the construction and operation of an SSSC. Show the power flow control of a SSSC. (12)

(b) Draw the schematic diagram of a UPFC. Explain real and reactive power control aspects of the UPFC. (13)

(c) Describe the application of UPFC in power flow control. (10)