

A Government College of Engineering, Aurangabad
(An Autonomous Institute of Government of Maharashtra)

M. E. (EEP-EPS) F. T. Examination
End Semester Examination DEC 2016

EE 544 : HVDC Transmission Systems

Time: Three Hours

Date: 5 DEC 2016

Max. Marks: 60

N.B:-1. Solve any five questions.

2. Figures to the right indicate full marks

3. Assume suitable data if necessary and state it clearly

4. Use of non-programmable calculator is allowed

- Q1 a) Compare the performance of EHVAC link with HVDC link for, [06]
Case(1) :Same power ,same % losses and same conductor size
Case (2) :Percentage line loss same and same insulation level.
Assume suitable data.
- b) An HVDC link delivers DC power with AC line voltage to the rectifier bridge 400 kV and that at the inverter being 392 kV. Taking $\alpha = 100^\circ$ & $\gamma = 150^\circ$ and the DC line resistance is as 20Ω ; Calculate (a) the DC voltage at both the ends, (b) the current in the DC link, (c) the power delivered and loss in the link. [06]
- Q2 a) Distinguish between delay of firing angle α and extinction angle γ of an HVDC converter. Explain the operation of converter when working as inverter and State the necessary condition required for inverter operation. [08]
Also develop the equivalent circuit for it.
- b) Give schematic diagram of 12 pulse converter. Derive expressions for average voltage and average current for 12 pulse converter. Write your comment. [04]
- Q3 a) What is meant by characteristic and non-characteristic harmonic in HVDC system? How the non-characteristic harmonic are generated ,explain it short . [06]
- b) What is necessity of compounding of inverter characteristic? Explain constant Current regulation from inverter side. [06]
- Q4 a) Explain in short following type of faults in rectifier side in HVDC system, [06]
(a) Backfire

- (b) Arc through
- (c) Misfire
- (d) Quenching.

b) Explain the working of band pass and high pass filter used in HVDC system. [06]
Explain term detuning and state its importance in the design of filter in HVDC systems.

Q5 a) Show that current harmonic generated for 6- pulse operation is given by [08]
expression $6K \pm 1$. Write your comments.

b) What are insulation co-ordination in DC system? Explain the choice at different [04]
insulation level.

Q6 a) Give the principle of different types of DC circuit breaker schemes. Why is a surge [06]
diverter needed across the DC circuit breaker?

b) Explain the need to employ filter circuit in HVDC system. Derive an expression [06]
for minimum cost of tuned AC filter used in HVDC system.

Q7 a) Write a short notes(any Two) [08]

- (1) Reactive power co-ordination in HVDC.
- (2) Detail about any one HVDC station in India.
- (3) Equidistant firing control (EPC) in HVDC.
- (4) Important of simulation studies for modern DC system and links.
- (5) Methods to control over voltage in HVDC.

b) [04]
Discuss fault on AC side of inverter in HVDC system.