Registration No : | | | | | | | | | | |

Total Number of Pages : 03 **B.Tech.**
PEE6J003

6th Semester Regular Examination 2017-18
HVDC TRANSMISSION
BRANCH : ELECTRICAL
Time : 3 Hours
Max Marks : 100
Q.CODE : C352

Answer Part-A which is compulsory and any four from Part-B.
The figures in the right hand margin indicate marks.

Part – A (Answer all the questions)

Q1. **Answer the following questions: *multiple type or dash fill up type :*** **(2 x 10)**

a) The converters used in HVDC converter stations
- i) Does not Consume reactive power
- ii) Consume as much as reactive power as real power
- iii) Consumes 60% of the real power
- iv) None of the above

b) The break even distance can vary from
- i) 100-200km
- ii) ii) 300-400km
- iii) 1500-1600km
- iv) iv) 500-800km

c) Full form of MTTF is _____ and MTTR is _____.

d) Important parameter based on which valve rating of converter is selected
- i) Forward Voltage
- ii) PIV
- iii) Max Forward Current
- iv) Power loss.

e) The arc back is the failure of the valve in _____ type of converter.

f) Smoothing reactor is generally connected
- i) AC side
- ii) After DC filter
- iii) before DC filter
- iv) Shunted to converter.

g) 12 pulse converter is preferred over 6 pulse converter for HVDC due to
- i) Better control
- ii) Less harmonics
- iii) Less cost
- iv) None

h) HVDC converters introduce both AC and DC harmonics, AC current harmonic order is _____ and harmonic order in DC voltage is _____, if p=pulse number, h=harmonic order.

i) Pole to ground faults in bipolar DC lines can result in
   i) Transient over voltages
   ii) Transient under voltages
   iii) Zero voltage
   iv) No change

j) Reactive power requirements of a converter can be reduced to zero or even reversed by
   i) Line Commutation
   ii) Forced Commutation
   iii) DC Breaker
   iv) Using smoothing reactor

Q2. Answer the following questions: *Short answer type :* **(2 x 10)**

a) Mention two FACTs controllers.
b) Mention the type of faults occur in HVDC converters.
c) Explain in brief about p, q, r and s in HVDC converters.
d) Mention the type of DC links.
e) Explain, why voltage drop along DC line is small as compared to the AC line?
f) What is the minimum firing angle 'α' maintained during operation of converters in HVDC. Justify your answer.
g) Mention two applications of DC breakers.
h) Why, it is required to install SVC at converter stations?
i) Give the plot between power transfer capability with distance in DC and AC transmission and Explain.
j) Explain the term commutation voltage and pulse number.

Part – B (Answer any four questions)

Q3. a) A Graetz bridge operates with a delay angle of 20^0. The leakage reactance of the transformer is 15 ohms. The line to line AC voltage is 85kV. Compute the overlap angle and DC voltage for Id=1500A and Id=2500A. **(10)**

b) For converter operation, prove that $\cos\alpha=\cos\theta$ if α is the firing angle and $\cos\theta$ is the power factor. **(5)**

Q4. a) Mention the requirements for converter selection of HVDC transmission and derive the expression for commutation voltage of all the valves and out put dc voltage for a 6 pulse Graetz converter. **(10)**

b) Explain in brief with neat sketch about 'Individual phase control'. **(5)**

Q5. a) For a 12 pulse converter with q=4, s=3, r=1, calculate the maximum DC power and transformer ratings (valve side winding), if PIV rating of the valve is V and the rms current rating is I. Rework the problem if q=2, s=6, r=1. **(10)**

b) Briefly explain with neat sketch Thyristor controlled reactor. **(5)**

Q6. a) Why Reactive power control is required for HVDC stations? Discuss about conventional control strategies for Reactive power control in HVDC link. **(10)**

b) Enumerate the relative merits and demerits of constant current control and constant voltage control of HVDC link. **(5)**

Q7. **a)** It is required to eliminate harmonics of order 10 and below 10 other than fundamental in a 12 pulse converter. Suggest a suitable transformer configuration and derive an equation for primary current of transformer. **(10)**

b) With the help of a neat schematic diagram of a typical HVDC converter station explain the functions of various components available. **(5)**

Q8. **a)** Explain the necessity of “VDCOL" control in a HVDC link with the help of VI characteristics.. **(10)**

b) Explain for what reasons as a system planner, you consider the applications of HVDC in India? **(5)**

Q9. **a)** Mention different types of converter faults, briefly explain with waveforms about commutation failure. **(10)**

b) Explain the protection scheme for over currents in converters. **(5)**