BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: BE **SEMESTER : VII/ADD**
BRANCH: EEE **SESSION : MO/18**

SUBJECT: EE8217 - EHV POWER TRANSMISSION

TIME: 3 HOURS **FULL MARKS: 60**

INSTRUCTIONS:
1. The question paper contains 7 questions each of 12 marks and total 84 marks.
2. Candidates may attempt any 5 questions maximum of 60 marks.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

Q.1(a) Explain about the factors affecting the power handling capacity of a EHV lines. Mention different levels of transmission voltages that are used in the world. [2]

Q.1(b) Explain the term 'Sequence Inductance and Capacitance'. Evaluate the zero, positive and negative sequence inductances & capacitances for a fully transposed 3-phase ac line. [4]

Q.1(c) Consider a matrix [A] given below: [6]

$$[A] = \begin{pmatrix} 4 & 1 & -2 \\ 1 & 0 & 2 \\ 1 & -1 & 3 \end{pmatrix}$$

Calculate the (1) Eigen values of matrix [A] **(2)** Model Matrix [M], Where M is the Eigen vectors of matrix [A]. & **(3)** Diagonalize the matrix [A].

Q.2(a) A Charge of 20 μC is placed at a distance of 4 meters from the centre of a sphere of radius **1** metre (2-metre diameter sphere). Calculate the magnitude, polarity, and location of a point charge Q_2 which will make the sphere at zero potential. [2]

Q.2(b) Derive Markt-Mengele formulae for the outer phases and for the centre phases in case of 3-phase ac line with horizontal configuration of phase. [4]

Q.2(c) Explain about Surface Voltage gradient and its effects on conductors. Discuss about Gradient factor and their use. [6]

Q.3(a) For the 1000 KV transmission lines L=500 Km, λ =6000 Km., at 50 Hz. and, Z_0 =260 ohms. Assuming $|Es|=.|E_R|$ =1000 KV. Calculate the reactance and 3 Phase MVAR required at load end in the shunt compensating reactor. Neglect line resistance. [2]

Q.3(b) In case of Transmission line with series capacitor compensation at line centre for voltage control, Prove that the generalized constants for the entire system is- [4]

$$\begin{pmatrix} A_T & B_T \\ C_T & D_T \end{pmatrix} = \begin{pmatrix} A + (\frac{X_C}{2Z_0})sin\beta l & B - jX_C cos^2(\frac{\beta l}{2}) \\ C + j\frac{X_C}{{Z_0}^2} sin^2(\frac{\beta l}{2}) & D + (\frac{X_C}{2Z_0})sin\beta l \end{pmatrix}$$

where X_C is reactance of capacitor and all remaining term have own standard meanings. Assume low loss condition of transmission line.

Q.3(c) Discuss about power frequency over-voltage control. Discuss the different types of static VAR compensators with its improvements obtained by the use of static VAR compensators (SVC). [6]

Q.4(a) Highlights the difference between 12 pulses & 6 pulses converters. [2]

Q.4(b) Compare between the natural commutation and forced commutation in voltage source converters. [4]

Q.4(c) Describe the working principle of 12 pulse converters with neat diagram, waveforms and output voltage equations. [6]

Q.5(a) Explain about switching & lightning overvoltage in case of EHV lines. [2]

Q.5(b) A series L-R-C circuit has an L=800 mH, R=24.8 Ω and C=4μF.It is excited by an equivalent step voltage of magnitude E=420√ (2/3) =343 KV.Calculate (1) the attenuation factor (2) Natural frequency of oscillation ω_0 and f_0. [4]

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Q.5(c) A single-phase overhead AC line has inductance/km as 2mH and a capacitance of 0.125×10^{-7} F/km. Estimate the surge impedance loading of the line when the system voltage is 400 KV. Also explain the terms with suitable figures, where necessary- (1) Line commutation (2) RRRV [6]

Q.6(a) Draw the schematic diagram of HVDC converter station and mention its various components. [2]

Q.6(b) Compare between HVDC transmission & EHVAC mode of transmission. [4]

Q.6(c) Discuss about types & rating of filter components used in HVDC line. [6]

Q.7 Write short technical notes on **any three** of the following— [4+4+4]

(a) Neutral grounding.
(b) Reactive power requirements of the converters
(c) Bundled conductors
(d) Comparison between current source inverter **(CSI)** & voltage source inverter **(VSI)**

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