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

CLASS: BE **SEMESTER : VII**
BRANCH: EEE **SESSION : MO/19**

SUBJECT: EE8217 EHV POWER TRANSMISSION

TIME:3:00 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) Prove that - $GMR = (r.R^9.10)^{10/100}$, Where GMR is the Geometrical Mean radius for bundle of 10 sub-conductors having bundle radius R and bundle spacing B. Mention different levels of transmission voltages. [2]

Q.1(b) Calculate the (1) Eigen values matrix [E] and (2) Eigen vectors Matrix [V] of matrix [A] given below: [4]

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

Q.1(c) Elucidate the term 'Maxwell coefficient' & 'Sequence Inductance and Capacitance'. [6]

Q.2(a) Explain about effects of conductor resistance of e.h.v lines. [2]

Q.2(b) A point charge Q= 4×10^{-6} Coulomb is kept on the surface of a conducting sphere of radius r=1.5 cm, which can be considered as a point charge located at the centre of the sphere. Calculate the field strength and potential at a distance of 0.5 cm from the surface of the sphere. Also find the capacitance of the Sphere. Take Ɛr =2. [4]

Q.2(c) Mention the significance of Mangoldt formulae and deduce the expression of surface voltage gradient for the centre phases in case of 3-phase ac line with horizontal configuration of phase. [6]

Q.3(a) For the 900 KV transmission lines L=500 Km, λ =6000 Km, at 50 Hz and Z_0 =520 ohms. Assuming |Es|=.|E_R| =1940 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 shunt reactor compensation for voltage control at no load condition, prove that- [4]

$$\left|\frac{E_s(withoutShuntCompensation)}{E_s(withCompensation)}\right| = \frac{1}{\sqrt{1+(\frac{Z_0 \tan \beta l}{Z_{sh}})^2}}$$, where E_S , Z_{Sh} , β , Z_0 represents sending end voltage, shunt reactor impedance ,phase shift factor& characteristics impedance respectively.

Q.3(c) A 400-kV line is 800 km long. Its inductance and capacitance per km are l=1mH/km & c=11.1nF/km (Z_{00}=300 ohms). The voltages at the two ends are to be held at 400 kV at no load. Neglect resistance. (Use 6^0/100 km.). Calculate- (1) MVAR of shunt reactors to be provided at the two ends and at an intermediate station midway with all four reactors having equal reactance. (2) The A, B, C, D constants for the entire line with the shunt reactors connected. [6]

Q.4(a) Explain about load commutated inverters. [2]

Q.4(b) Highlights the advantages & disadvantages of higher pulse number in converters configuration. [4]

Q.4(c) What is an inverter? Discuss the industrial applications of inverters and also the requirements of good inverter. [6]

Q.5(a) Explain clearly the various methods to reduce overvoltage magnitude EHV systems. [2]

Q.5(b) Discuss in detail about origin and their types of severe over voltages in EHV systems. [4]

Q.5(c) 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. [6]

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Q.6(a) A bridge connected rectifier is fed from 220 kV/110 kV transformer with primary connected to 220 kV. Determine the D.C. output voltage when the commutation angle is 15° and the delay angle is(1) 30 °and (2) 45 ° [2]

Q.6(b) Discuss the technical advantages of STATCOM over SVC with respect to HVDC converter stations. [4]

Q.6(c) Explain about active and passive filters in HVDC system. Also Discuss about problems associated with injection of harmonics in HVDC converters. [6]

Q.7(a) Write short technical notes on <u>any three</u> of the following—

(a) The factors affecting the corona loss.

(b) Effects of high electrostatic fields on human beings, animal & plants. [4]

(c) Capacitor Commutated Converter [4]

(d) Comparison between voltage source inverter (VSI) & current source inverter (CSI). [4]

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