Code No: M0225 /R07

Set No. 1

IV B.Tech. I Semester Supplementary Examinations, February/March - 2011

EHV AC TRANSMISSION

(Electrical & Electronics Engineering)

Time: 3 Hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks
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1. a) Discuss the advantages and problems with EHV AC transmission.
   b) The configurations of some e.h.v. lines for 400 kV to 1200 kV are given. Calculate r_{eq} for each.
      i) 400 kV : $N = 2$, $d = 2r = 3.18$ cm, $B = 45$ cm
      ii) 750 kV : $N = 4$, $d = 3.46$ cm, $B = 45$ cm
      iii) 1000 kV : $N = 6$, $d = 4.6$ cm, $B = 12\,d$
      iv) 1200 kV : $N = 8$, d=4.6 cm, $R = 0.6$ m. [8+8]

2. a) Calculate the capacitance matrix of a 3-phase 400 kV horizontal line with the following dimensions: Height above the ground=H=15 m, Phase separation S=11 m, conductor 2x 3.18 cm diameter, and B=45.72 cm.
   b) Show that the velocity of wave propagation in the line to ground mode is $\frac{1}{\sqrt{(L_s + 2L_m + 3L_g)(C_s + 2C_m)}}$. [8+8]

3. An isolated sphere in air has a potential V and radius R. Calculate the charge to be placed at its centre to make the surface of the sphere an equipotential. [16]

4. a) Explain the generation and measurement of audio noise due to corona in EHV lines.
   b) A single smooth conductor 1 cm in radius is strung 5 metres above ground; using Peek's formula for corona-inception gradient, find
      i) the corona-inception voltage,
      ii) the equivalent radius of conductor to the outside of the corona envelope at 20% overvoltage. Take $\delta = 1$. [8+8]

5. Discuss in detail about the modes of propagation of radio interference waves in 3 phase transmission line. [16]

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6. Explain the procedure to calculate the electrostatic filed of a double circuit 3-phase AC line is computed. [16]

7. Explain the behavior of a traveling wave when it is reflected from the terminal inductance. [16]

8. a) List the dangers resulting from series capacitor compensation on long lines, and the remedies taken to counteract them.
   b) Explain the sub-synchronous problem in EHV lines and discuss the counter measures to minimize it. [8+8]

Code No: M0225 /R07 **Set No. 2**

IV B.Tech. I Semester Supplementary Examinations, February/March - 2011

EHV AC TRANSMISSION

(Electrical & Electronics Engineering)

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1. a) A Moose conductor has the following details: Outer diameter = 31.8 mm. Area of Aluminium = 515.7 mm^2. Calculate the resistance of 1 km of a double-Moose bundled conductor at 50°C given that $\rho_a = 2.7 \times 10^{-8}$ ohm-m at 20°C and temperature resistance coefficient of Aluminium, $\alpha = 4.46 \times 10^{-3}$/°C. (Increase length by 5% for stranding.)
   b) Write brief descriptions of (*a*) aeolian vibration, and (*b*) wake-induced oscillations. Describe the measures taken to minimize the damage due to them. [8+8]

2. a) Discuss the convenience offered by using modes of propagation and possible uses of shows all b) Figure (2) below shows all major dimensions of a 400-kV line. Calculate the matrices of ground-return resistance and inductance per km at f = 1 kHz for c_s = earth conductivity = 10^{-2}mho/m. [8+8]

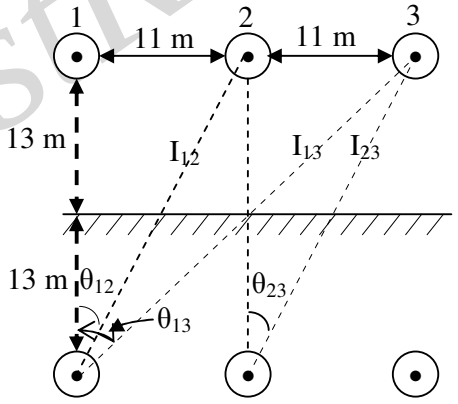

Figure (2)

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3. A sphere gap consists of two spheres with R = 0.25 m each. The gap between their surfaces is 0.5 m. Calculate charges and their locations to make the potentials 1 and 0. [16]

4. a) Show that the energy loss in EHV conductor in the presence of corona is $P_C = \frac{1}{2} KC(V_m^2 - V_0^2)$. (Use charge-voltage diagram).
   b) Describe the difference between a line spectrum and band spectrum for noise. What is the difference between a pure tone and broad-band spectrum? [9+7]

5. a) Explain properties of pulse trains and its filter response.
   b) Write a short notes on radio interference excitation function due to corona. [8+8]

6. Explain the procedure to calculate the electrostatic filed of a single circuit 3-phase AC line is computed. [16]

7. A 132 kV transmission line having a surge impedance of 450 ohms terminates at a 7.5 MVA, 132/33 kV transformer which may represented by a lumped inductor of 15 H and lumped capacitance of 0.03 μF in parallel. A rectangular surge of 1500 kV travels along the line towards the transformer. Calculate the refracted voltage into the transformer when the incident wave reaches the transformer terminals. [16]

8. a) Explain various static var compensators for reactive power control in EHV systems.
   b) What is the reason for the existence of sub-synchronous resonance in the steady state and transient conditions in series-capacitor compensated lines? [8+8]

Code No: M0225 /R07 **Set No. 3**

IV B.Tech. I Semester Supplementary Examinations, February/March - 2011

EHV AC TRANSMISSION

(Electrical & Electronics Engineering)

Time: 3 Hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. a) A power of 12,000 MW is required to be transmitted over a distance of 1000 kM. Determine the current and total line losses if the magnitude of both the sending and receiving end voltages are 750 kV, with a 30^0 phase difference in the voltages between the sending and receiving end.
   b) What is a bundled conductor? Show that equivalent radius of a bundled conductor is

$$r_{eq} = R\left[\frac{N.r}{R}\right]^{\frac{1}{N}}$$

   Where R is the radius of the bundle, r is the radius of a sub conductor and N is the number of conductors in the bundle. [8+8]

2. a) Derive the Maxwell's co-efficient matrix for inductance having a multi-conductor line.
   b) The capacitance matrix of a 750-kV horizontal configuration line is [8+8]

$$[C] = \begin{bmatrix} 10.2 & -1.45 & -0.35 \\ -1.45 & 10.45 & -1.45 \\ -0.35 & -1.45 & 10.2 \end{bmatrix} \text{nF/km.}$$

   i) Find the 3 eigen values of the matrix, ($\lambda_1, \lambda_2, \lambda_3$).
   ii) Diagonalizable the matrix by evaluating suitable transformation matrix [T] and its inverse [T]$^{-1}$.

3. a) Show that the variation of surface voltage gradient on the periphery of a sub-conductor of bundle conductor follows cosine law.
   b) A sphere gap with the spheres having radii R = 0.5 m has a gap of 0.5 m between their surfaces.
      i) Calculate the required charges and their locations to make the potentials 100 and 0.
      ii) Then calculate the voltage gradient on the surface of the high-voltage sphere.
      iii) If the partial breakdown of air occurs at 30 kV/cm peak, calculate the disruptive voltage between the spheres. [8+8]

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4. A 400 kV line supplies a load of 600 MW over a distance of 400 km. Its conductors are 2×3.18 cm diameter with a resistance of 0.03 ohm/km per phase. It carries an average load of 400 MW over the year (66.7% load factor).
   i) Calculate annual energy loss of the line.
   ii) If the average corona loss is 20 kW/km for the 3-phases for 2 months of the year, calculate the annual energy loss due to corona.
   iii) Calculate the % corona energy loss as compared to the I^2R heating loss of the line. [16]

5. a) Describe the mechanism of formation of a positive corona pulse train. [8+8]
   b) Explain the procedure for measuring radio interference and radio interference voltage.

6. Explain the procedure to calculate the electrostatic filed of a single circuit 3-phase AC line is computed. [16]

7. a) For a 400 kV line, L = 1 mH/km and C = 11.1 nF/km, and E_s = 400 kV from the source, line-line, r.m.s. Calculate the charging MVAR for line lengths varying from 100 km to 1000 km. Neglect resistance.
   b) Calculate the expected per unit value of load-end voltage for various line lengths from 100 km to 1000 km at no load. Neglect line resistance and assume source-end voltage to be held constant at 1 per unit. [8+8]

8. A 400-kV line is 800 km long. Its inductance and capacitance per km are L = 1 mH/km and C = 11.1 nF/km (Z_{00} = 300 ohms). The voltages at the two ends are to be held at 400 kV at no load. Neglect resistance. Calculate
   i) MVAR of shunt-reactors to be provided at the two ends and at an intermediate station midway with all four reactors having equal reactance.
   ii) The *A, B, C, D* constants for the entire line with the shunt reactors connected.
   iii) The voltage at the intermediate station. (Use 6°/100 km). [16]

Code No: M0225 /R07 **Set No. 4**

IV B.Tech. I Semester Supplementary Examinations, February/March - 2011

EHV AC TRANSMISSION

(Electrical & Electronics Engineering)

Time: 3 Hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. a) What are the properties of the bundled conductors? Derive an expression for Geometric Mean Radius of the bundle with N sub-conductors in the bundle.
   b) A power of 2000 MW is to be transmitted from a super thermal power station in central India over 800 km to Delhi. Use 400 kV and 750 kV alternatives. Suggest the number of circuits required with 50 % series capacitor compensation, and calculate the total power loss and loss per km. [8+8]

2. a) Derive the capacitance matrix of an '*n*' conductor system.
   b) The dimensions of a 3-phase 400-kV horizontal line are: H = 16 m, S = 12 m phase separation, conductor 2 × 3.18 cm dia, and B = 45.72 cm. Calculate.
      i) the matrix of inductances per km, for untransposed configuration, and
      ii) the same when there is complete transposition. [8+8]

3. Show that maximum voltage gradient on a N-sub conductor bundle in a 3-phase system is $E = \frac{q}{2\pi\varepsilon_0}\frac{1}{r}\left[1+\frac{(N-1)r}{R}\right]$. (r is radius of the sub conductor; R is the radius of the bundle; q is the charge on each sub conductor) [16]

4. a) Discuss the relationship between single phase and 3 phase audio noise levels.
   b) List out different corona loss formulae and explain each one. [8+8]

5. a) Discuss the frequency spectrum of the radio interference field produced in a EHV line.
   b) Discuss the limits for radio interference fields in EHV trnsmission lines. [8+8]

6. a) What are the effects of high electrostatic fields on biological organisms and human beings.
   b) Discuss the effects electrostatic induction on unenergized circuit of a double circuit 3-phase AC line. [8+8]

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Set No. 4

7. a) Derive the expression for charging current and MVAR rating of EHV lines.
   b) A transmission line is 300 km long and open at the far end. The attenuation of surge is 0.9 over one length of travel at light velocity. It is energized by (i) a step of 1000 kV, and (ii) a sine wave of 325 kV peak when the wave is passing through its peak. Calculate the open-end voltage up to 20 ms. [8+8]

8. A 50-Hz 750 kV line with L = 0.866 mH/km is 500 km long. It is provided with 50% series compensation connected in the middle of line. The power delivered at 750 kV is 2000 MW 3-phase per circuit at unity power factor. Neglect shunt capacitance and line resistance and assume the line inductance to be lumped. Calculate (*a*) the reactance and capacitance of series capacitor, (*b*) the voltage drop across it at full load, (*c*) the current flowing through it and the voltage across it during a sustained shortcircuit occurring (*i*) on the source-side terminal of the capacitor, (*ii*) on the load-side terminal of the capacitor, and (*iii*) across the load. (*d*) the same as in (*c*) without the series capacitor. [16]