Code No: V3110 **R07** **Set No: 1**

III B.Tech. I Semester Supplementary Examinations, November/December - 2012

POWER SYSTEMS-II

(Electrical and Electronics Engineering)

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

Answer any FIVE Questions

All Questions carry equal marks

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1. (a) Explain the term geometrical mean distance (GMD) and self GMD in the inductance calculation of single phase transmission line with composite conductors.
(b) Calculate the capacitance of a three-phase, three-wire system with triangular configuration with sides D_{12} = 3.2m, D_{23} = 4.1 m and D_{31} = 4.8 m. The diameter of the conductor is 2.2cm.

2. (a) Define regulation of a short 3-phase transmission line and develop an expression for approximate voltage regulation.
(b) A three phase transmission line is 150km long. The series impedance is Z=(0.02 + j 0.95)ohms per phase per km, and shunt admittance is Y = j 5.1 μ- mhos per phase per km. The sending end voltage is 132 kV, and the sending end current is 140 A at 0.85power factor lagging. Determine the voltage, current and power at the receiving end and the voltage regulation using medium line-T model.

3. (a) Starting from first principles deduce an expression for A, B, C, D constants of a long line in terms of its circuit parameters.
(b) A long transmission line which has resistance = 40 ohm, inductive reactance = 150 ohm and shunt admittance = 0.0025 S. Calculate (i) sending end voltage, (ii) sending end current, (iii) sending end power factor and (iv) efficiency when the line is transmitting 60MVA at 0.707 p.f lagging at 400kV.

4. (a) Draw equivalent circuit for determining the transmitted voltage and current surges on a forked or bifurcated line. Derive expressions for the transmitted voltage and currents.
(b) An under ground cable having an inductance of 0.3mH per km and a capacitance of 0.4μF per km is connected in series with an overhead line having an inductance of 2.0mH per km and a capacitance of0.014μF per km. Calculate values of reflected and transmitted wave of voltage and current at junction due to a voltage surge of 110kV travelling to a junction along the cable

5. (a) How the power loss due to corona can be calculated? Discuss how it can be minimized.
(b) Find the critical disruptive voltage and the critical voltages for local and general corona on a 3- phase overhead transmission line, consisting of 3-stranded copper conductors spaced 2.3 m apart at the corners of an equilateral triangle. Air temperature and pressure are 21^{o} C and 73.6 cm of Hg respectively. Take conductor diameter 10.4 mm, irregularity factor 0.85, local and general surface factors 0.7 and 0.8 respectively.

6. (a) What electrical and mechanical characteristics are required for a good insulator for use in HV transmission lines.
(b) (i)Determine the voltage across the each disc of suspension insulators as a percentage of line voltage to earth. The self and capacitance to the ground of each disc is C and 0.5 C respectively. The capacitance between the link pin and the guard ring is 0.2 C. if the capacitance to the line of the lower link pin were increased to 0.6C by the means of guard ring (ii) determine the redistribution of voltage. Also determine the string efficiency in each case.

7. (a) Show that an overhead line conductor stung between two level supports takes up the shape of a parabola. Obtain the expression for sag and maximum tension when the supports are at the same level.
(b) An over head transmission line at a river crossing is supported from two towers at a height of 25 m and 75 m above water level, the horizontal distance between the towers is 250 m. if the required clearance between the conductor is 45m and if both of towers are on the same side of the point of the maximum sag of the parabolic configuration. Find the stringing tension in the conductor. The weight of the conductor is 0.70kg/m. Also find the span of allowable for the same maximum sag if the supporters were level.

8. (a) What do you understand by the grading of a cable? Explain why grading is more theoretical interest than practical. What is the modern practice adopted to avoid grading.
(b) A 3-core, 3-phase metal sheathed cable has Capacitance between all conductors bunched and sheath 0.8μF and Capacitance between two conductors bunched with sheath and third conductor 0.65 μF. Determine the capacitance when the sheath is insulated for the following conditions
i) Between any two conductors
ii) Between any two bunched conductors and the third conductor.
iii) Calculate the capacitance to neutral and charging current taken by the cable when connected to 33 kV, 3-phase, 50 Hz systems.

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POWER SYSTEMS-II

(Electrical and Electronics Engineering)

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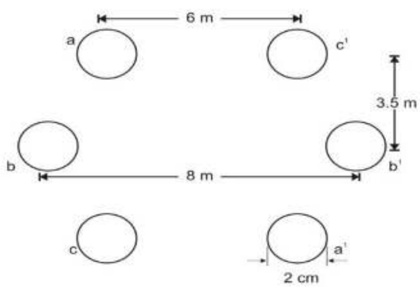
1. (a) What factors govern the capacitance of transmission line? Derive from first principles the capacitance per Km to neutral of 3-phase over head lines with unsymmetrical spacing of conductors assuming transposition.
   (b) Calculate the inductance per phase of a three-phase double circuit line as shown in below Figure. The diameter of the conductor is 2 cm. Assume that the line is completely transposed.



2. (a) What do you mean by the term regulation of transmission line? Why its knowledge is essential.
   (b) A single phase transmission line 150km long has the following constants:
   Resistance/km = 0.2 ohm
   Reactance/km = 0.6 ohm
   Susceptance/km $= 14\times10^{-6}$ mho
   Receiving end line voltage = 132k V
   Assume that the total capacitance of the line is localized at the receiving end alone; determine (i) the sending end current, (ii) the sending end voltage, (iii) regulation and (iv) supply power factor. The line is delivering 17000kW at 0.8 power factor lagging. Draw the vector diagram to illustrate your calculations.

3. (a)With reference to transmission lines give the physical interpretation of the terms, characteristic impedance and propagation constant. What is meant by surge impedance?
   (b)A 220kV,3-phase transmission line has an impedance per phase of (50+j180)ohms and an admittance of 0+j0014mho. Using the convergent series method determine (i) the sending end voltage,(ii) the sending end current and (iii) voltage regulation when the receiving end current is 200Amps at 0.9 p.f lagging

4. (a) How can bewley lattice be drawn. Discuss it with an example.
   (b) An overhead line is connected to a terminal apparatus through a length of single phase cable, the characteristic impedance being 300 and 60 ohms respectively. A travelling wave of vertical front and infinite tail of 110kV magnitude originates in the overhead line and travels towards the junction with the cable. Determine the energy transmitted into the cable during a period of 3μ Sec after the arrival of the wave at the junction. What voltage is reflected back into the line.

5. (a) Explain the skin and proximity effects on AC transmission lines.
   (b) A 132 kV, 3 Phase, 50 Hz transmission line, 200 km long consists of three 1.3 cm diameter stranded copper conductors spaced in 3.5 m delta arrangement. Temperature taken at 26^0C and barometric pressure as 74 cm. Assume surface irregularity factor m= 0.85 (Roughness factor), m_v for local corona= 0.72 and m_v for general corona=0.82. Find the following
   i) Disruptive voltage
   ii)Visual corona voltage for local corona
   iii)Visual corona voltage for general corona and
   iv)Power loss due to corona using Peek's formula under fair weather and wet conditions

6. (a) Describe briefly, with neat sketches, two types of insulators that are commonly used in overhead transmission lines.
   (b) Each line of a three phase system is suspended by a string of 3 identical insulators of self capacitance C farad. The shunt capacitance of the connecting metal work of each insulator is 0.4C to earth and 0.3C to line. Calculate the string efficiency of the system if the guard ring increases the capacitance to the line of the metal work of the lowest insulator to 0.45C.

7. (a) Obtain an expression for the sag of a transmission line supported by towers if different heights at the ends. Explain how the effect of wind and ice can be included in sag calculation of transmission lines.
   (b)An over head line is erected across a span of 250 m on level supports the conductor has a diameter of 1.42 cms and has a dead weight of 1.09 kg/m. the line is subjected to wind pressure 37.8 kg. per square meter of the projected area the radial thickness of ice is 1.25 cms. Calculate the sag
   (i)in an inclined direction
   (ii)in a vertical direction
   Assume a maximum working stress 1050kg/ square cm. one cubic cm of ice weight 913.5 kg

8. (a) Describe the general configuration of an underground cable with neat sketch.
   (b)A 3-phase, single core 33 kV cable has a conductor diameter of 3.2 cm and a sheath of inside diameter 6.1 cm. If two intersheaths are introduced in such a way that the stress varies between the same maximum and minimum in the three layers. Find (i) Positions of intersheaths, (ii) voltage on the intersheaths and (iii) Maximum and minimum stress.

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Code No: V3110 **R07** **Set No: 3**

III B.Tech. I Semester Supplementary Examinations, November/December - 2012

POWER SYSTEMS-II

(Electrical and Electronics Engineering)

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

Answer any FIVE Questions

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1. (a) Distinguish between bundled conductor 3-phase line with two conductors per bundle and a double circuit line. What is the difference in electrical characteristics do you expect between the two lines.
   (b) Two conductors of a single phase line, each of 2.2cm diameters, are arranged in a vertical plane with one conductor mounted 2m above the other. A second identical line is mounted at the same height as the first and space horizontally 0.8m apart from it. The two upper and the lower conductors are connected in parallel. Determine the inductance per km of the resulting double circuit line.

2. (a) Define regulation, efficiency, losses and power factor at each end of the line and explain how these characteristics are affected by the constants of the lines.
   (b)A 120km long, 3-phase, 50Hz overhead transmission line has the following line constants:
   Resistance/km/phase = 0.15 ohm
   Inductive reactance/km/phase = 0.6ohm
   Capacitive susceptance /km/phase $= 10\times10^{-6}$ mho.
   If the line supplies a load of 30MW at 0.9 p.f. lagging at 132kV at the receiving end, Calculate by nominal-π method (i) the sending end power factor, (ii) regulation and(iii) transmission efficiency.

3. (a) Derive an expression for voltage and current distribution over long lines. Explain the significance of characteristic impedance loading in connection with the long lines.
   (b) A 3- phase transmission line is 500km long and serves a load of 500MVA, 0.85p.f lag at 400kV. The ABCD constants of the line are $A=D=0.82\angle1.3^0$; $B=175.2\angle84.2^0$; $C=0.00193\angle90.4^0$ mhos.
   (i) Determine the sending end line to neutral voltage, the sending end current and the percent voltage drop at full load.
   (ii) Determine the receiving end line to neutral voltage at no load, the sending end current at load and the voltage regulation.

4. (a) What is a travelling wave? Explain the development of such a wave along an over head transmission line.
   (b) An overhead line having a surge impedance of 600 ohm branches into two lines having surge impedance of 35 and 45 ohms. If a travelling wave of vertical front and magnitude 110kV travels along the overhead line, calculate the magnitude of voltage and current in the overhead line and in the two branches immediately after the travelling wave has reached the fork

5. (a) What is ferranti effect? Obtain an expression for the rise in voltage at receiving end due to ferranti effect.
(b) An overhead transmission line operates at 220 kV between phases at 60 Hz. The conductors are arranged in a 4.5meter delta formation. What is the maximum diameter of the conductor that can be used for no corona loss under fair weather conditions? Assume an air density factor of 0.95 and irregularity factor of 0.85. The critical voltage is 230 kV. Find also the power loss under stormy conditions.

6. (a) Explain the methods used for improving the voltage distribution along the string of insulators in overhead lines.
(b) The potential across the 6 units of the string is equalized by using grading insulators. If the capacitance of the top insulator is 7C and that of pin to earth is C, calculate the capacitance of the other units. If instead of graded insulators, a guard ring is used to equalize the potential, calculate the capacitance of each link to conductor. Assume that the insulators used in string are similar to that of the top.

7. (a) Discuss in brief, the factors on which sag on the overhead line depends. Write the expression for sag and explain the terms with units.
(b) Find the erection sag and tension of the line use particulars as follows: nominal span = 2.75 m,
conductor data :
Size = 20 + 7/2.79 mm steel cored aluminum
Nominal copper area = 110mm^2
Weight per meter = 0.844 kg
Ultimate strength 7950 kg
Coefficient of linear expansion per degree centigrade = 18.44×10^{-6}
Modulus of elasticity kg/mm^2 = 9.32×10^3
The factor of safety based on worst loading conditions (radial ice thickness 0.95cm and wind pressure 39kg/m^2 of projected area at – $5.5°C$) is to be 2. The line is to be erected at $50°C$ in still air, weight of ice of 913 kg/m^3.

8. (a) Classify the underground cables according to insulation used, voltage rating and number of cores. Sketch the typical 3-core cable and label the important parts.
(b)A single core cable has a conductor diameter of 2.5 cm and a sheath of inside diameter 6 cm. Calculate the maximum stress. It is desired to reduce the maximum stress by using two intersheaths. Determine their best positions, the maximum stress and the voltage on each. System voltage is 66kV, 3-phase.

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Code No: V3110 **R07** **Set No: 4**

III B.Tech. I Semester Supplementary Examinations, November/December - 2012

POWER SYSTEMS-II

(Electrical and Electronics Engineering)

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

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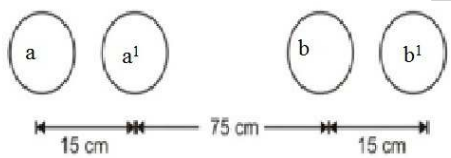
1. (a) What do you understand by transposition in overhead lines? Explain why transposition is done in such lines.
(b) In a single-phase double circuit transmission line as shown in below Figure, conductors a and a′ are parallel to each other in one conductor, while conductors b and b′ are parallel to each other in the other conductor. Each conductor radius is 2.3 cm. Determine the loop inductance of the line per km assuming that the current is equally shared by the two parallel conductors.



2. (a) Explain how transmission lines are classified into short, medium and long lines and also explain their characteristics.
(b)A balanced 3-phase load of 25MW is supplied at 132kV, 50Hz and 0.8 p.f. lagging by means of a transmission line. The series impedance of a single conductor is (20 + j50) ohms and the total phase-neutral admittance is 315×10^{-6} mho. Using nominal-T method, determine:
(i) The A, B, C and D constants of the line,
(ii) Sending end voltage,
(iii)Regulation of the line.

3. (a) Develop the long line exact equations in hyperbolic terms for sending end voltage and current.
(b). A three-phase, 50 Hz, 250 km long transmission line has three conductors each of 0.6 cm radius spaced at the corners of triangle of sides 2.8 m, 4.2m and 5.3m. The resistance of each conductor is 0.3 ohms per km and the line delivers 30 MVA at 132 kV and at a lagging p.f. of 0.85. Determine ABCD constants as (i) long line (both real and complex angle methods) and (ii) Parameters of equivalent T representations of long lines.

4. (a) Show that a travelling wave moves along an overhead line with a velocity of light and its speed is proportional to $\frac{1}{\sqrt{\varepsilon_r}}$ in case of cable with dielectric material of relative permittivity ε_r.
(b)An over head transmission line 500km having a surge impedance of 400 ohm is short circuited at one end and a steady voltage of 7kV is applied at the other end. Neglecting the resistance, draw the diagram of voltage and current waves. Calculate the sending end current of the line 0.003 sec after the voltage is applied

5. (a) What do you understand by corona? What are its effects and how corona can reduce.
(b)A conductor 2.1 cm diameter is passed centrally through a porcelain bushing (relative permittivity) $\varepsilon_r = 3$ having internal and external diameters of 2.7 cm and 7.8 cm respectively. The voltage between conductor and an earthed clamp surrounding the porcelain is 11 kV (r.m.s). Find the value of maximum potential gradient in the air space between the conductor and porcelain and also state whether Corona will be present or not?

6. (a) Explain with neat sketch, the constructional features of suspension type insulator. List out its merits.
(b) A three phase over head transmission line is suspended by a suspension type insulator which consists of three units. The potential across top unit and middle unit are 10kV and 11 kV respectively. Calculate
(i) The ratio of capacitance between pin and earth to the self capacitance of the each unit (ii) The line voltage (iii) String efficiency

7. (a) What are the various types of line supports? Discuss the suitability of each with reference to system voltage and span.
(b)A copper conductor is suspended between two points at the same height and strung to a tension of 1350 kg, the load on the conductor is 2.1 kg/ m and its cross section area 2 sq cm, the load on the conductor is increased to 2.8 kg/m, calculate the tension in the conductor and a sag under this move conditions the span is 200 m. and the modulus of the elasticity of the copper is 12.5×10^5 kg/sq cm
Use the approximate method, assuming the curve to be a parabola.

8. (a) For a single core lead sheath cable derive the expression for
(i) Maximum dielectric stress and (ii) Capacitance
(b)A single core 11 kV, 50Hz, 5 km long cable has a core diameter of 1.5 cm and diameter of under sheath 3.0 cm. The relative permittivity of the insulating material is 2.5. The power factor on open circuit is 0.04. Determine (i) the capacitance of the cable (ii) charging per conductor (iii) dielectric loss (iv)The equivalent insulation resistance.

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