Code No: R1631021 **R16** SET - 1

III B. Tech I Semester Regular/Supplementary Examinations, March – 2021

POWER SYSTEMS–II

(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

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PART –A **(14 Marks)**

1. a) What are the merits of bundled conductors? [3M]
   b) How is transmission lines classified? [2M]
   c) What are the methods used for computing the hyperbolic functions in the solution of long lines? [2M]
   d) What is the effect of shunt capacitance at the terminal of a transmission line for a surge? [2M]
   e) On what factors skin effect depends? [3M]
   f) List the merits of suspension type insulators over pin type insulators. [2M]

PART –B **(56 Marks)**

2. a) Prove that the inductance of a group of parallel wires carrying current can be represented in terms of their geometric distance. Explain the meaning of the term self G.M.D and mutual G.M.D. [7M]
   b) A 3-phase, 50 Hz, 132kV overhead line has conductors placed in a horizontal plane 4 m apart. Conductor diameter is 20 mm. If the length of the line is 100 km, find the charging current per phase assuming the line is completely transposed. [7M]

3. a) What is power factor? Explain the effect of power factor on regulation and efficiency. [7M]
   b) A three- phase transmission line has the following data: Resistance of each conductor=20 ohms; Inductive reactance per Phase=40 ohms; capacitive susceptance to neutral=0.0004 mho; Load at receiving end=10 MVA at 0.8 p.f lagging; voltage at receiving end=60 kV. Find regulation and efficiency of transmission using nominal T- Method. [7M]

4. a) What is an equivalent π circuit of a long line? Obtain the expression for parameters of this circuit in terms of line parameters. [7M]
   b) A three – phase overhead transmission line has series impedance per phase of $200\angle 80^0$ ohms and a total shunt admittance of $0.0019\angle 90^0$ siemen per phase. The line delivers a load of 150 MW at 0.8 pf lagging and 220 kV between the lines. Find the sending-end voltage and current by the rigorous method. [7M]

5. a) Obtain an expression for the voltage across a capacitance C connected at the end of a line of surge impedance Z_c when a step wave V travels on the line and reaches the capacitance. [7M]
   b) Two stations are connected together by an underground cable having a surge impedance of 40 ohms joined to an overhead line with a surge impedance of 400 ohms. If a surge having a maximum value of 120 kV travels along the cable towards the junction with the overhead line, find the value of the reflected and transmitted wave of voltage and current at the junction. [7M]
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6. a) Explain the skin and proximity effects on transmission line parameters. [7M]
   b) A certain 3-phase equilaterally spaced transmission line has a total corona loss of 50 kW at 110 kV and a loss of 98 kW at 115.9 kV. What is the disruptive critical voltage between lines? What is the corona loss at 113 kV? [7M]

7. a) Explain what is meant by a string efficiency of a suspension insulators consists of number of units? What causes the string efficiency to be less than 100%? [7M]
   b) An overhead conductor having an ultimate strength of 6000 kg/cm^2 and an area of 2 cm^2 is erected between supports placed 500 m apart and having a level difference of 12 m. If the minimum ground clearance is to be 40 m, determine the tower heights. The conductor is subjected to a horizontal wind pressure of 1.5 kg/mt. The self-weight of the conductor is 1.75 kg/mt. Assume a safety factor of 4. [7M]

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Code No: R1631021 **R16** SET - 2

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(Electrical and Electronics Engineering)

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2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

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PART –A (14 Marks)

1. a) What are the types of conductors? [2M]
   b) How do you classify the transmission line is to short, medium and long lines. [2M]
   c) What is the significance of SIL in lines? [2M]
   d) A transmission line of surge impedance Z_0 is terminated through a resistance R. What is their reflection and refraction coefficient? [3M]
   e) Distinguish between AC and DC resistance of a conductor. [3M]
   f) How is the transmission line insulators classified? [2M]

PART –B (56 Marks)

2. a) What are the factors which govern the capacitance of a transmission line? [7M]
   b) Find the inductance/km/ph for a 3-phase transmission line. Give with D_{ab}=D_{bc}=4.5m and D_{ca}=6.5m. The radius of the conductor is 0.2 cm. The line is transposed. Also find Inductance of all three conductors without transposition. [7M]

3. a) What do you understand by the terms nominal T and nominal-π circuits? Derive the expressions for the ABCD constants for the nominal-T circuit of a medium transmission line. [7M]
   b) Calculate the sending end voltage and current of an 100 km 3-phase, 50Hz transmission line designed to deliver 25 MVA at 0.8 P.F lagging at 6.6 kV to a balanced load. The conductors are of copper each having a resistance of 0.105 ohm/km and an outside diameter of 1.5 cm. They are spaced equilaterally 1.5 meters apart. Use nominal-π method. [7M]

4. a) Starting from first principles deduce expressions for transmission line constants of a long line in terms of its parameters. [7M]
   b) A three-phase, 250 km long transmission line has the following constants. Resistance/ph/km=0.15 ohm, reactance/ph/km=0.25 ohm, shunt admittance/ph/km= 1.2×10^{-6} mho. Find by rigorous method, the sending-end voltage and current when the line is delivering a load of 25 MW at 0.85 p.f lagging. The receiving-end voltage is kept constant at 110 kV. [7M]

5. a) Explain the behavior of a travelling wave when it reaches the end of short circuited line. Draw diagrams to show voltage and current of the line before and after the wave reaches the end. [7M]
   b) A 440 kV surge travels on an overhead line of surge impedance 500 Ω towards its junction with a cable which has a surge impedance of 50Ω. Determine: i) transmitted voltage and current, ii) reflected voltage and current. [7M]

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6. a) Explain the effect of shunt compensation on transmission lines performance. [7M]
   b) A single phase overhead line has two conductors of diameter 1.2 cm with a spacing of 1.4 m between centers. If the dielectric strength of air is 21.21 kV/cm. Find the line voltage for which corona will commence on the line. Derive the formula used. [7M]

7. a) What do you mean by string efficiency? How can it be improved? [7M]
   b) An overhead line has the following data: span length 200 m, difference in levels of supports 7.5 m, conductor diameter 1.8 cm, weight per unit length of conductor 1.5 kg/m, wind pressure 39 kg/m^2 of projected area. Maximum tensile strength of the conductor is 4250 kg/cm^2, factor of safety is 4. Find the length of the lower support. [7M]

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Code No: R1631021 **R16** SET - 3

III B. Tech I Semester Regular/Supplementary Examinations, March – 2021

POWER SYSTEMS–II

(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

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2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

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PART –A (14 Marks)

1. a) What are the properties of conducting material? [3M]
   b) Write ABCD constants for medium transmission lines using nominal T and π methods. [2M]
   c) Define Z_c and mention its typical values. [2M]
   d) What are the expressions for the voltage and current when a line is terminated by an inductance? [3M]
   e) What is Ferranti effect? [2M]
   f) What is static shielding? [2M]

PART –B (56 Marks)

2. a) What are the factors which govern the inductance of transmission line? [7M]
   b) Three conductors of a three phase, 3 wire systems are arranged at the corners of triangles. The sides of which are 1.5 m, 1.8 m and 2.0 m. Determine the capacitance per Km of the line when the conductors are transposed. Diameter of each conductor is 1.3 cm. And also calculate the capacitance with consideration of earth effect. Assume the circuit is located 6 m above the ground level. [7M]

3. a) How is transmission lines classified? Obtain the relation between the sending end and receiving end voltages and currents of a medium line using nominal-π representation. [7M]
   b) A 3 phase overhead transmission line 80 km long, delivers 24 MVA at 66 kV, 50 Hz, 0.8 p.f lag. The line conductors have a diameter of 1.5 cm and are symmetrically spaced at a distance of 2.5 m. Determine the regulation and efficiency of the line, using the nominal π method. [7M]

4. a) Describe the surge impedance loading with necessary expressions. [7M]
   b) A three-phase transmission line is 450 km long and delivers a load of 300 MVA, 0.8p.f lag at 400 kV. The ABCD constants of the line are $A=D=0.918\angle 1.5^0$; $B=175\angle 85^0$; $C=0.0019\angle 90^0$ mhos. Find the following under full load and no load conditions: [7M]
   i) Sending-end line to neutral voltage,
   ii) The sending-end current, and
   iii) The percent voltage regulation.
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5. a) Obtain the reflection and refraction coefficient of transmission line when receiving end is open circuited. [7M]
   b) A step wave of 130 kV travels through a line having a surge impedance of 450Ω. The line is terminated by an inductance of 6000 μH. Determine the voltage across the inductance and reflected voltage wave. [7M]

6. a) Explain the Ferranti effect and derive an expression for power loss an open circuited line. [7M]
   b) An overhead transmission line operates at 210 kV between phases at 50 Hz. The conductors are arranged in a 4.2-meter delta formation. Find 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 240 kV. Find also the power loss under stormy conditions. [7M]

7. a) Explain the necessity of a stringing chart for a transmission line and show how such a chart can be constructed? [7M]
   b) A string of suspension insulators consists of three units. The capacitance between each pin and earth is 12% of the self-capacitance of the unit. If the maximum peak voltage per unit is not to exceed 36 kV, find the greatest working voltage and the string efficiency. [7M]

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Code No: R1631021 **R16** SET - 4

III B. Tech I Semester Regular/Supplementary Examinations, March – 2021

POWER SYSTEMS–II

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2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

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PART –A **(14 Marks)**

1. a) What is meant by loop inductance? [2M]
   b) What are the different types of overhead transmission lines? [3M]
   c) What is the need of rigorous solution approach for lines performance calculation? [2M]
   d) What is a traveling wave? [2M]
   e) How can reduce the corona loss? [2M]
   f) What is a stringing chart? What is its utility? [3M]

PART –B **(56 Marks)**

2. a) Derive from first principles the capacitance per km to neutral of a 3-phase over head transmission line with unsymmetrical spacing of conductors assuming transposition. [7M]
   b) A 3-ϕ, 50Hz over high tension line (HTL) has each conductor of 3.2cm diameter. The distance between 3 phases are between A and B is 5m, B and C is 6m and C and A is 3m. Find the inductance of each line. If the lines are transposed regularly, determine the inductance per km. [7M]

3. a) Explain the short transmission lines. Derive the performance characteristics. [7M]
   b) A balanced three – phase load of 30 MW is supplied at 132 kV, 50 Hz and 0.85p.f lag means of a transmission line. The series impedance of a single conductor is (20+j52) ohms and the total phase to neutral admittance is 315×10^{-6} mhos. Using nominal-π method, determine: (i) A, B, C and D constants of the line, (ii) V_s and (iii) regulation of the line. [7M]

4. a) What is meant by Nominal π method of solution for the performance of long transmission lines? Draw a phasor diagram with the receiving end voltage as reference. [7M]
   b) A three-phase, 50 Hz, 200 km long transmission line has three conductors each of 0.7 cm radius spaced at the corners of triangle of sides 2.5 m, 4m and 3.5m. 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 0.95. Determine ABCD constants as long line and Parameters of equivalent T representations of long lines. [7M]
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5. a) Derive the expression for reflected voltage and current waves, when the transmission line is terminated by the capacitive load. [7M]
   b) An overhead transmission line with surge impedance of 400 Ω is 300 km long. One end of this line is short circuited and the other end has a source of 11 KV which is suddenly switched in. Calculate the current at the source end 0.005 sec after the voltage is applied. [7M]

6. a) Describe the effect of shunt compensation on transmission lines. [7M]
   b) Determine 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 2.7 m apart at the corners of an equilateral triangle. Air temperature and pressure are 21^0C and 73.6 cm of Hg respectively. Take conductor diameter 10.2 mm, irregularity factor 0.85, local and general surface factors 0.7 and 0.8 respectively. [7M]

7. a) What is sag? Derive the equation for sag when the conductor takes the form of a parabola and supported at equal levels? [7M]
   b) A string of suspension insulator consists of four units and the capacitance to ground is 14 percent of its mutual capacitance. Find the voltage across each unit as a fraction of the operating voltage. Also find the string efficiency. [7M]

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