Code No: RT31023 **R13** SET - 1

III B. Tech I Semester Regular/Supplementary Examinations, October/November - 2017

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. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**

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PART –A

1 a) What is the effect of ground on capacitance calculations? [3M]

b) What are the various parameters of a transmission line and how they are considered for different lines? [4M]

c) Define the wave length and velocity of propagation. [4M]

d) Prove that the surges behave as travelling waves. w.r.t long transmission line. [4M]

e) What is meant by Ferranti effect? [3M]

f) What are the various factors that contribute for the variation of sag and tension in overhead electric power transmission lines? [4M]

PART -B

2 a) Explain the different types of conductors used for over head transmission lines. [6M]

b) The three conductors of a 3-phase transmission line are arranged in a horizontal plane and are 5 meters apart. The diameter of each conductor is 30mm.Determine the inductance per km of each conductor (line to neutral). Assume balanced load and R, Y, B phase sequence. Determine also the average inductance per phase for regularly transposed line. [10M]

3 a) Define regulation of a short 3-phase transmission system and develop an expression for approximate voltage regulation. [7M]

b) A balanced 3-phase load of 30MW is supplied at 132kV, 50Hz and 0.85 p.f. lagging by means of a transmission line. The series impedance of a single conductor is (20 + j52) ohms and the total phase-neutral admittance is 315×10^{-6} mho. Using nominal-T method, determine: [9M]
(i) The A, B, C and D constants of the line,
(ii) Sending end voltage,
(iii) Regulation of the line.

4 a) Explain the evaluation of transmission line constants [6M]

b) A three – phase overhead transmission line has series impedance per phase of $250\angle80^0$ ohms and a total shunt admittance of $0.0019\angle90^0$ siemen per phase. The line delivers a load of 100MW at 0.8 pf lagging and 200kV between the lines. Calculate the sending-end voltage and current by the rigorous method. [10M]

5 a) Discuss the phenomenon of wave reflection and refraction. Derive expressions for reflection and refraction coefficients. [7M]

b) A 200 kV surge travels on a transmission line of 400 ohms surge impedance and reaches a junction where two branch lines of surge impedances of 500 ohms and 300 ohms respectively are connected with the transmission line. Find the surge voltage and current transmitted into each branch line. Also find the reflected voltage and current. [9M]
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Code No: RT31023 **R13** SET - 1

6 a) What is corona loss? Why is it different in different weather conditions? How can it be estimated [8M]

b) Explain the effect on resistance of solid conductors [8M]

7 a) Explain the methods used for improving the voltage distribution along the string of insulators in overhead lines. [8M]

b) Calculate the minimum sag permissible for a 160 m span 1.0 cm diameter copper conductor allowing a maximum tensile stress of 2000 kg/cm^2. Assume a horizontal wind pressure of 4 kg/cm^2 of projected area. Take the specific gravity of copper as 8.9 gm/cm^3. [8M]

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Code No: RT31023 **R13** SET - 2

III B. Tech I Semester Regular/Supplementary Examinations, October/November- 2017

POWER SYSTEMS-II

(Electrical and Electronics Engineering)

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2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**

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PART –A

1 a) What do you understand by the constants of an overhead transmission line? [4M]
b) What are the physical significance of the generalized constants A, B, C and D? [4M]
c) What is meant by Nominal π method of solution for the performance of long transmission lines? [3M]
d) What is the importance of surge impedance. [3M]
e) What is meant by Skin and Proximity effects? [4M]
f) What is the importance of conductor spacing and ground clearance of overhead transmission lines? [4M]

PART -B

2 a) Show that the inductance per loop meter of two wire transmission line using solid round conductors is given by $L = 4\times10^{-7}\log\frac{D}{r'}$ henries where D is the distance between the conductors and r′ is the GMR of the conductors. [8M]
b) Calculate the capacitance charging current of a 100km long, 3 phase, 66kV, 50Hz, overhead transmission line consisting of 3-conductors each of diameter 2.2cm and spaced 3.5meters at the corners of an equilateral triangle. [8M]

3 a) What do you mean by performance of transmission lines [6M]
b) A 3-phase, 50Hz transmission line has conductors of section $90mm^2$ and diameter 1cm placed at the vectors of an equilateral triangle of side 1m. The line is 30km long and delivers load of 0.8 MW at 33kV at a p.f. 0.8 lagging. Neglecting capacitance and assuming temperature of 20^0C. Find efficiency and regulation of the line. Take resistance of each conductor as 3.83 ohms at 20^0C. [10M]

4 a) Explain the interpretation of the long line equations. [7M]
b) A three-phase, 200 km long transmission line has the following constants. Resistance/ ph/ km = 0.15 ohm, reactance/ ph/km = 0.20 ohm, shunt admittance/ph/km = 1.2×10^{-6} mho. Calculate by rigorous method, the sending-end voltage and current when the line is delivering a load of 20 MW at 0.8 p.f lagging. The receiving-end voltage is kept constant at 110 kV. [9M]

5 a) Discuss 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. [8M]
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Code No: RT31023 **R13** SET - 2

b) A transmission line has an inductance of 0.93 H/km and a capacitance of 0.0078 µF/km. This overhead line is connected to an underground cable having an inductance of 0.155 mH/km and a capacitance of 0.187 µF/km. If a surge of crest 100 kV travels in the cable towards its junction with the line, find the surge transmitted along the line. [8M]

6 a) Explain the effect on regulation of the transmission line. [7M]

b) 132kV overhead line conductor of radius 1cm is built so that corona takes place if the line voltage is 210 kV (r.m.s). If the value of voltage gradient at which ionization occurs can be taken as 21.21 kV (r.m.s) per cm, determine the spacing between the conductors. [9M]

7 a) What is a strain insulator and where is it used? Give a sketch to show its location. [7M]

b) A transmission line has a span of 150m between level supports. The line conductor has a cross-sectional area of 1.25 sq.cm and it weighs 120 kg per 100 meters. If the breaking stress of the copper conductor is 4220 kg per sq.cm. Calculate the maximum sag for a safety factor of 4. Assume a maximum wind pressure of 90 kg per square meter of projected surface. [9M]

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Code No: RT31023 **R13** SET - 3

III B. Tech I Semester Regular/Supplementary Examinations, October/November - 2017

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(Electrical and Electronics Engineering)

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2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**

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PART –A

1	a)	What are stranded conductors?	[3M]
	b)	What is the purpose of an overhead transmission line? How are these lines classified?	[4M]
	c)	Define the characteristic impedance and propagation constants of a transmission line.	[4M]
	d)	What is the phenomenon of wave reflection and refraction?	[3M]
	e)	Define disruptive critical voltage and visual critical voltage.	[4M]
	f)	What is string efficiency? Why is it necessary to have high string efficiency?	[4M]

PART -B

2	a)	Determine the capacitance of three phase transmission lines when spacing between the conductors is equally spaced.	[8M]
	b)	Calculate the inductance per phase of a three-phase double circuit line if the conductors are spaced at the vertices of a hexagon of side 2 m each. The diameter of each conductor is 2.0 cm.	[8M]
3	a)	Define precisely the regulation of a transmission line and discuss qualitatively its dependence on the load power factor. Show that the regulation is zero when $\phi_r = (\theta - \pi/2)$ where ϕ_r is the load power factor angle and θ is the line impedance angle. Can the regulation is negative? If so, under what conditions? State clearly the assumptions made?	[8M]
	b)	A single-phase, 11kV line with a length of 15km is to transmit 500kVA. The inductive reactance of the line is 0.5 ohm per km and the resistance 0.3 ohm per km. Calculates the efficiency and regulation for a p.f. of (i) 0.8 lagging (ii) 0.8 leading and (iii) unity.	[8M]
4	a)	Derive equations which represent the performance of a long transmission line with its electrical parameters uniformly distributed along its length.	[8M]
	b)	The per-unit-length parameters of a 132kV, 350km, 50Hz, three phase long transmission line are $Y = j2.5\times10^{-6}$ mhos per km per phase and $Z = (0.2 + j\ 0.4)$ ohm/km. The line supplies a 130 MW load at 0.8 power factor lagging. Determine (i) the voltage regulation, (ii) the sending-end power and (iii) the efficiency of transmission.	[8M]
5	a)	List and explain the different types of system transients and how do they effect the overall performance of the sytem?	[8M]
	b)	An inductance of 700 μH connects two sections of a transmission line each having a surge impedance of 350Ω. A 400 kV, 1μ sec rectangular surge travels along the line towards the inductance. Find the maximum value of the transmitted wave.	[8M]
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Code No: RT31023 **R13** SET - 3

6 a) Explain the effect of charging current on the performance of transmission lines [7M]

b) In a 3-phase overhead line, the conductors have an overall diameter of 3.0 cm each and are arranged in delta formation. Assuming a critical disruptive voltage of 250 kV between lines and an air density factor of 0.90 and $m_0 = 0.95$, find the minimum spacing between conductors allowable, assume fair weather conditions. [9M]

7 a) Show that in a string of suspension insulators, the disc nearest to the conductor has the highest voltage across it. [8M]

b) A transmission line has a span of 150 m between supports, the supports being at the same level. The conductor has a cross-sectional area of 2 cm^2. The ultimate strength is 5,000 kg/cm^2. The specific gravity of the material is 8.9 gm/cm^3. If the coating of ice is 1.0 cm, calculate the sag at the center of the conductor if factor of safety is 5. [8M]

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Code No: RT31023 **R13** SET - 4

III B. Tech I Semester Regular/Supplementary Examinations, October/November - 2017

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2. Answering the question in **Part-A** is compulsory
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PART –A

1 a) Enumerate the materials used for transmission lines. [3M]
b) Define the terms voltage regulation and transmission efficiency as applied to transmission line. [4M]
c) What is the surge impedance loading of transmission line? [4M]
d) What is meant by the surge phenomena? [3M]
e) What are the factors which affect corona loss? [4M]
f) Give the applications of different types of insulators. [4M]

PART -B

2 a) Determine the capacitance of single-phase transmission line when earth effect is considered. [7M]
b) Calculate the inductance per phase of a three-phase double circuit line if the conductors are spaced at the vertices of a hexagon of side 3.2 m each. The diameter of each conductor is 1.5 cm. [9M]

3 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 line. [8M]
b) A 3-phase line delivers 3600kW at a power factor 0.8 lagging to a load. If the sending end voltage is 33kV, determine (i) the receiving end voltage (ii) line current (iii) transmission efficiency. The resistance and reactance of each conductor is 5.31 ohm and 5.54 ohm respectively. [8M]

4 a) Starting from first principles derive an expression for the sending end voltage and current of a long transmission line interms of the line parameters and receiving end voltage and current. [8M]
b) Determine the auxiliary constants of a 3-phase, 50Hz. 200km long transmission line having resistance, inductance and capacitance per phase per km of 0.15 ohm, 3.5mH and 0.009μF respectively. [8M]

5 a) What is a travelling wave? Explain the development of such a wave along an overhead transmission line. [8M]
b) Two stations are connected together by an underground cable having a surge impedance of 60 ohms joined to an overhead line with a surge impedance of 400 ohms. If a surge having a maximum valve of 100 kV travels along the cable towards the junction with the overhead line, determine the value of the reflected and transmitted wave of voltage and current at the junction. [8M]
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Code No: RT31023 **R13** SET - 4

6 a) Explain the effect of shunt compensation on transmission lines. [6M]

b) Determine the disruptive critical voltage and the visual critical voltages for local and general corona on a 3-phase overhead transmission line consisting of three stranded copper conductors spaced at 2.5 meters apart at the corners of an equilateral triangle. Air temperature and pressure are 21^0C and 73.5 cm of Hg respectively. Conductor diameter is 1.8 cm, irregularity factor (m_0) 0.85, and surface factors (m_v) 0.7 for local and general corona 0.7 and 0.8 respectively. Breakdown strength of air is 21.1 kV (r.m.s) / cm. [10M]

7 a) Explain the significance of guard ring in suspension string type insulator. Deduce the relation for determining the capacitance formed by the ring. [8M]

b) A transmission line conductor has an effective diameter of 19.5 mm and weighs 1.0 kg/m. If the maximum permissible sag with a horizontal wind pressure of 39 kg/m^2 of projected area and 12.7 mm radial ice coating is 6.3m. Calculate the permissible span between two supports at the same level allowing a safety factor of 2. Finally, strength of the conductors is 800kg and weight of ice is 910 kg/m^3. [8M]

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