MUZAFFARPUR INSTITUTE OF TECHNOLOGY, Muzaffarpur

COURSE FILE

OF

Power System I

(031404)

Faculty Name:

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ASSOCIATE PROFESSOR, DEPARTMENT OF ELECTRICAL ENGINEERING

Content

Govt. of Bihar

MUZAFFARPUR INSTITUTE OF TECHNOLOGY,
MUZAFFARPUR-842003

(Under the Department of Science & Technology Govt. of Bihar, Patna)

VISION STATEMENT OF ELECTRICAL ENGINEERING DEPARTMENT

To produce cutting edge Electrical Engineers, innovators, researchers, and entrepreneurs with high human values to serve society, industry, nation and the world.

MISSION STATEMENT OF ELECTRICAL ENGINEERING DEPARTMENT

M1. To create state-of-the-art facilities for under-graduate, post- graduate and R&D work.

M2. To cater the needs of society with recent technologies, innovative ideas and inculcate ethical responsibilities.

M3. To develop strong collaborative links with premier industries, institutions and the government agencies.

Program Educational Objectives (PEOs) of Electrical Engineering Department:

PEO 1. Students will be able to engage in life-long learning and research including supportive and responsible roles on multi-disciplinary tasks.

PEO 2. Students will acquire, use and develop skills as required for effective professional and societal practices and leadership quality.

PEO 3. Students will be able to create a new dimension of innovation and entrepreneurship.

Program Outcomes (POs) based on Program Educational Objectives (PEOs) of Electrical Engineering Department:

PO 1. Students will be able to apply knowledge of applied mathematics & science in electrical engineering problems.

PO 2. Students will be able to identify, formulate and solve society and industries related problems.

PO 3. Students will be able to apply knowledge to design a system, component or process to meet desired needs within realistic constraints.

PO 4. Students will be able to conduct laboratory experiments and to critically analyze and interpret experimental data.

PO 5. Students will be able to use the recent techniques, skills, and modern tools necessary for engineering practices.

PO 6. Students will be able to understand the impact of engineering problems, solutions in a global and societal context.

PO 7. Students will be able to demonstrate professional and ethical responsibilities.

PO 8. Students will be able to apply leadership quality to work with team in the area of electrical engineering towards the solution of multi-disciplinary tasks.

PO 9. Students will be able to communicate effectively through verbally, technical writing, reports and presentation.

PO 10. Students will be able to develop confidence for self-education and ability to engage in life-long learning.

COURSE OBJECTIVE AND COURSE OUTCOMES:

Institute/college Name	Muzaffarpur Institute of Technology, Muzaffarpur
Program Name	B.E. Electrical (IV semester)
Course Code/course credits	031404 (4)
Course Name	Power System I
Lecture/ Sessional (per week)	3/1
SEE duration	4 hours
Course Coordinator Name	DR. Yagyanand Sharma

Course objective:

This course is designed to review the fundamentals and practices of Power Systems within the Electrical and Electronics Engineering curriculum. Students will explore Power Systems processes in the theoretical and applied realm in the fields of Distribution of Power, Line Parameters in Electrical Design, Mechanical Design, Performance of Lines, and Underground Cables. The Power System-I curriculum is designed to prepare interested students for future careers in Power System Engineering.

Course outcomes (CO):

CO1: Understanding the fundamentals of power system at Distribution level for real time economic operation.

CO2: Calculation of Line Parameters involved in Electrical Design and its effects.

CO3: Understanding the Mechanical Design involved in building Power System Structure.

CO4: Design a power system solution based on the problem requirements and realistic Constraints.

CO5: Develop a major design experience in power a system that prepares them for engineering practice.

MAPPING OF COs AND POs

Sr. No.	Course Outcome	PO
1.	**CO1**: Understanding the fundamentals of power system at Distribution level for real time economic operation.	PO1, PO2, PO3, PO5, PO9
2.	**CO2**: Calculation of Line Parameters involved in Electrical Design and its effects.	PO3, PO4, PO7
3.	**CO3**: Understanding the Mechanical Design involved in building Power System Structure.	PO3, PO4, PO7, PO10
4.	**CO4**: Design a power system solution based on the problem requirements and realistic Constraints.	PO3, PO4, PO7, PO8, PO9, PO10
5.	**CO5:** Develop a major design experience in power a system that prepares them for engineering practice.	PO1, PO3, PO4, PO5, PO6, PO9, PO10

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	√	√	√	-	√	-	-	-	√	-
CO2	-	-	√	√	-	-	√	-	-	-
CO3	-	-	√	√	-	-	√	-	-	√
CO4	-	-	√	√	-	-	√	√	√	√
C05	√	-	√	√	√	√	-	-	√	√

Course Syllabus:

UNIT-I

Introduction: Structure of power system, practical aspects of power system, effects of parameters of power system in India.

Distribution: Effect of system voltage on transmission efficiency, single phase AC, 3 phase AC system, choice of conductor size, choice of voltage, radial and ring feeders and calculation of voltage drop in AC radial and ring system.

UNIT-II

Electrical Design: Calculation of inductance of conductor due to internal and external flux, inductance of single phase system, skin and proximity effects, GMR of solid conductor, GMR of stranded conductor, Mutual GMD inductance of opposite conductor lines, inductance of 3 phase lines, single circuit and double circuits, symmetrical and unsymmetrical spacing, inductance of bundled conductor system, calculation of capacitance of single phase and three phase system, symmetrical and unsymmetrical spacing, single circuit and double circuit bundled conductor system, effect of earth on capacitance of line.

UNIT-III

Mechanical Design: Types of support cross arms and conductors, calculation of sag and tension, cases of unequal height of supports, string chart, earth clearance of live conductor, vibration, dampers.

Performance of lines: Short, medium and long lines, A, B, C, D constants, Nominal T and Nominal π representation, surge impedance, surge impedance loading of line, universal power circle diagram, lossless line.

UNIT-IV

Underground Cable: Types, insulating materials, stress in insulation and capacitance of inner sheath and capacitance grading, PF in cables, capacitance of 3- core cables, instantaneous and longtime breakdown strength, dielectric loss, ionization, deterioration, heat production, sheath current, thermal characteristics.

Books:

- **'Elements of Power System Analysis ' by Stevenson (McGraw Hill)**
- **'Modern Power System Analysis' by D P Kothari & I J Nagarath(TMH)**
- **'Elective Power System' by Soni, Bhatnagar &Gupta**

GATE Syllabus of Power System I:

Section: Power Systems

Power generation concepts, ac and dc transmission concepts, **Models and performance of transmission lines and cables, Series and shunt compensation, Electric field distribution and insulators, Distribution systems**, Per-unit quantities, Bus admittance matrix, Gauss-Seidel and Newton-Raphson load flow methods, Voltage and Frequency control, Power factor correction, Symmetrical components, Symmetrical and unsymmetrical fault analysis, Principles of over-current, differential and distance protection; Circuit breakers, System stability concepts.

MUZAFFARPUR INSTITUTE OF TECHNOLOGY

B.Tech. 4th (Fourth) Semester (2016 Batch)

DAY	I (10-10.50AM)	II (10.50-11.40AM)	III (11.40-12.30PM)	IV (12.30-01.20PM)		V (01.50-1.40PM)	VI (2.40-3.30PM)	VII (3.30-4.20PM)
MON	Dig Elec (HCV)33	O.B.I.P (SK)33	I.E&A (IH) 33	PS 1(YNS) 33		NMCT (SKJ)33		
TUE					B	PS 1(YNS) 33	PS 1-T(YNS) 33	NMCT (SKJ)33
WED	I.E & A (I H) 33	Dig Elec (HCV)33			R	……..NMCT Lab(SKJ)……		
THU	Elect Mc 2(RKM) 33	O.B.I.P (SK)33	NMCT (SKJ)33	I.E & A (I H) 33	E	PS 1(YNS) 33	Elect Mc 2(RKM) 33	
FRI	Dig Elec (HCV)33	Dig Elec-T(HCV) 33	O.B.I.P (SK)33	Elect Mc 2(RKM) 33	A	…….. Elect Mc 2 Lab (RKM)/ Dig Elec Lab(HCV+MS)…….		
SAT	Dig Elec (HCV)33	….. Elect Mc 2 Lab (RKM)/ Dig Elec Lab(HCV+MS)…….			K			

HCV-Hari Charan Verma, SK- Santosh Kumar, RKM- Roushan Kumar Mishra, IH- Irfan Haider, YNS- Yagyanand Sharma

Asst.Prof.-in-charge (TT) Prof.-in-charge (TT) Principal

STUDENT LIST:

S.NO.	*Roll No*	*Name*
1	16EE01	NANDAN KUMAR
2	16EE02	ANJALI KUMARI
3	16EE03	KAUSTUBHA
4	16EE04	RISHABH KUMAR
5	16EE05	AMRITA KUMARI
6	16EE06	SUMIT KUMAR
7	16EE07	RITESH RAJ
8	16EE08	VIPUL MISHRA
9	16EE09	SAMEER KUMAR
10	16EE10	MD SAIFULLAH SADIQUE
11	16EE11	PREETI KUMARI
12	16EE12	KULDEEP THAKUR
13	16EE13	SHANTANU KUMAR SINGH
14	16EE14	SEEMA KUMARI
15	16EE15	PRIYAM KUMARI
16	16EE16	VANDANA BIHARI
17	16EE17	RAJNANDANI
18	16EE18	SANJAY KUMAR YADAV
19	16EE19	PRAVEEN DIVAKAR
20	16EE20	AMIT KUMAR PANDIT
21	16EE21	CHANDAN KUMAR THAKUR
22	16EE22	ALOK KUMAR
23	16EE23	DEVENDRA KUMAR
24	16EE24	ARVIND KUMAR
25	16EE25	AMITESH KUMAR
26	16EE26	VIVEK KUMAR
27	16EE27	VIKASH KUMAR RAY
28	16EE28	ROHIT KUMAR

29	16EE29	OM PRAKASH KUMAR
30	16EE30	RAVI KUMAR
31	16EE31	SANDEEP KUMAR
32	16EE32	DEO ALOK
33	16EE33	BAJRANGI KUMAR
34	16EE34	MANOJ KUMAR SONI
35	16EE35	SANJEEV KUMAR
36	16EE36	NEERAJ KUMAR
37	16EE37	SATYAM KUMAR
38	16EE38	PRASHANT GAURAV
39	16EE39	NITISH KUMAR RAJAK
40	16EE40	UJJAWAL KUMAR
41	16EE41	PRABHAT KUMAR
42	16EE42	MD HASIM JILANI
43	16EE43	SHIV CHARAN KUMAR
44	16EE44	ANISH BHARTI
45	16EE45	RAHUL KUMAR
46	16EE46	RAJEEV RANJAN PRASAD
47	16EE47	SHUBHAM KUMAR
48	16EE48	TAHIR QAMAR
49	16EE49	PRASHANT KUMAR
50	16EE50	NAMAN KUMAR
51	16EE51	KESHAV CHANDRA
52	16EE52	SWETA BHARTI
53	16EE53	PRATIK ANAND
54	16EE54	SHAGUFTA ANJUM
55	16EE55	GOLDEN KUMAR
56	16EE56	MURLI MANOHAR
57	16EE57	ARPIT ANAND
58	16EE58	AKSHAT RAJ
59	16EE59	ANJAN KUMAR
60	16EE60	SUMAN KUMAR BHARTIYA

62	16EE61	SAKET
63	16EE62	RISHABH KUMAR
64	16EE63	SUMAN KUMAR
65	16EE64	SUNITA KUMARI
66	16EE65	NISHANT RAJ
67	16EE66	VIPIN SINGH
68	16EE67	ANKIT RAJ
69	16EE68	GUNJAN KUMAR
70	16EE69	PRATAP CHANDRA CHOUDHARY
71	17(LE)EE01	VIVEK KUMAR
72	17(LE)EE02	RITIK KUMAR
73	17(LE)EE03	ANAND RANJAN
74	17(LE)EE04	ABHISHEK KUMAR
75	17(LE)EE05	POONAM KUMARI
76	17(LE)EE06	SAURABH KUMAR JHA
77	17(LE)EE07	PARMANAND KUMAR
78	17(LE)EE08	ROHAN RAJ
79	17(LE)EE09	ANAND KUMAR
80	17(LE)EE10	MANISH

Course Plan:

Text Books:

TB1: 'Elements of Power System Analysis ' by Stevenson (McGraw Hill)
TB2: 'Modern Power System Analysis' by D P Kothari & I J Nagarath(TMH)
TB3: 'Elective Power System' by Soni, Bhatnagar &Gupta

Reference Books:

RB1: 'Electrical Power Systems' by C L Wadhwa
RB2: 'Electrical Energy Systems Theory and Introduction' by Olle I.Elgerd
RB3: 'Principles of Power System' by V.K Mehta
RB4: 'Power System Analysis' by Hadi Saadat

Other readings and relevant websites

S.No.	Link of Journals, Magazines, websites and Research Papers
1.	https://www.youtube.com/watch?v=Yg6XsepGCKY&list=PLD4ED2FAF3C155625&index=2
2.	https://www.youtube.com/watch?v=lr1jgbR5ca8&list=PLD4ED2FAF3C155625&index=10
3.	https://www.youtube.com/watch?v=y_UJvHMEun0&index=11&list=PLD4ED2FAF3C155625
4.	https://www.youtube.com/watch?v=1Ym2OviN0XM&index=18&list=PLD4ED2FAF3C155625
5.	http://nptel.ac.in/courses/108104051/1
6.	https://en.wikipedia.org/wiki/Electric_power_system

COURSE PLAN

Lecture Number	Topics	Web Links for video lectures	Text Book / Reference Book / Other reading material	Page numbers of Text Book(s)
1-2	**Introduction**		TB1, RB3	1-8
	Structure of power system, practical aspects of power system, effects of parameters of power system in India.	1.https://www.youtube.com/watch?v=pWd2b-F4STw 2.https://www.youtube.com/watch?v=fBm1dr_gRBk	http://nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/power-system/chapter_1/1_1b.html	
3-4	**Distribution**		TB1, RB3	7-45

	Effect of system voltage on transmission efficiency, single phase AC, 3 phase AC system, choice of conductor size, choice of voltage, radial and ring feeders and calculation of voltage drop in AC radial and ring system.	1.http://www.yourelectrichome.com/2013/01/effect-of-high-voltage-in-transmission.html 2.http://ieeexplore.ieee.org/document/6538516/	https://www.quora.com/What-are-advantages-and-disadvantages-of-radial-and-ring-distributors-for-electrical-power-distribution/answer/Paul-Freeman-60?share=73bca4bb&srid=QToq	
5-7	**Electrical Design**		TB1, RB3	46-69
	Calculation of inductance of conductor due to internal and external flux, inductance of single phase system, skin and proximity effects, GMR of solid conductor, GMR of stranded conductor, Mutual GMD inductance of opposite conductor lines, inductance of 3 phase lines, single circuit and double circuits, symmetrical and unsymmetrical spacing, inductance of bundled conductor system, calculation of capacitance of single phase and three phase system, symmetrical and unsymmetrical spacing, single circuit and double circuit bundled conductor system, effect of earth on capacitance of line.	https://www.youtube.com/watch?v=Gys7lki6eTI		
8-12	**Mechanical Design**		TB1, RB3	70-140
	Types of support cross arms and conductors, calculation of sag and tension, cases of unequal height of supports, string chart, earth clearance of live conductor, vibration, dampers.	https://www.youtube.com/watch?v=y_UJvHMEun0&index=11&list=PLD4ED2FAF3C155625		
13-16	**Performance of Lines**		TB1, RB3	141-202
	Short, medium and long lines, A, B, C, D constants, Nominal T and Nominal π representation, surge impedance, surge impedance loading of line, universal power circle diagram , lossless line.	https://www.electrical4u.com/performance-of-transmission-line/	http://nptel.ac.in/courses/108102047/12	
17-20	**Underground Cables**		TB1, RB3	141-202

	Types, insulating materials, stress in insulation and capacitance of inner sheath and capacitance grading, PF in cables, capacitance of 3- core cables, instantaneous and longtime breakdown strength, dielectric loss, ionization, deterioration, heat production, sheath current, thermal characteristics.	https://www.youtube.com/watch?v=1Ym2OviN0XM&index=18&list=PLD4ED2FAF3C155625	http://nptel.ac.in/courses/108102047/18	

DETAILS OF ASSIGNMENTS:

S.No.	Assignment	Topic No.
1	Assignment 1	1
2	Assignment 2	2
3	Assignment 3	2
4	Assignment 4	3
5	Assignment 5	3

DETAILS OF TUTORIALS:

S.No.	Tutorial	Topic No.
1	Tutorial 1	1
2	Tutorial 2	2

Power System I (EE-031404)
Assignment 1

1. A three-phase transmission line has flat horizontal spacing with 2 m between adjacent conductors. At a certain instant the charge on one of the outside conductors is 60 u/km, and the charge on the center conductor and on the other outside conductor is - 30 J L/km. The radius of each conductor is 0.8 cm. Neglect the effect of the ground and fid the voltage drops between the two identically charged conductors at the instant specified.

2. What is the effect of earth on capacitance of overhead line. Explain

3. Explain Skin effect and Proximity effect on overhead transmission lines.

4. Derive expressions for A, B, C, D parameters of a Long line model transmission line.

Power System I (EE-031404)
Assignment 2

1. What are the various systems of power transmission? Compare the requirements of conductor material for various types of overhead systems used for power transmission.
2. What do you understand by medium transmission lines? How capacitance effects are taken into account in such lines?
3. Discuss the advantage & disadvantage of AC & DC transmission.
4. Derive an expression for line to neutral capacitance for a single phase two wire line.
5. Using Rigorous method, derive expressions for sending end voltage and current for a long transmission line.
6. Write short notes on followings (i) Skin effect (ii) Proximity effect (iii) Kelvin's Law for size of conductor for transmission & its limitations
7. Define & explain String Efficiency. Explain various methods to improve it
8. What do you understand by generalized circuit constants of a transmission line? What is their importance?

Power System I (EE-031404)
Assignment 3

1. Discuss the advantages of High Transmission Voltage.
2. Derive an expression for line to neutral capacitance for a 3 phase overhead transmission line when conductors are (i) symmetrically spaced (ii) un-symmetrically placed but transposed.
3. Explain the different components of an overhead transmission line.
4. Show how regulation and transmission efficiency are determined for medium lines using
   (i) end condensor method
   (ii) nominal T method
   (iii) nominal π method
   Illustrate your answer with suitable vector diagrams
5. Write short notes on followings (i) Line Supports (ii) Stringing Chart (iii) Conductor Vibrations.
6. Explain Self GMD & Mutual GMD.
7. What do you understand by generalised circuit constants of a transmission line? What is their importance?

8. Compare the volume of conductor material required for a d.c. 3-wire system and 3-phase, 3-wire system on the basis of equal maximum potential difference between one conductor and earth. Make suitable assumptions.

Power System I (EE-031404)

Assignment 4

1. Explain following for a distribution system (i) Radial System (ii) Ring Main System (iii) Inter-connected System.
2. Derive the expression for inductance of composite conductor, having two conductors 'A' & 'B'. Assume that conductor A has '**m'** no. of strands & conductor B has '**n**' no. of strands.
3. What is Sag? Calculate sag when conductors are at equal level & when conductors are at unequal level.
4. Write short notes on followings (i) Pin insulator (ii) Suspension insulator (iii) Strain insulator (iv) Shackle insulator.
5. Draw a vector diagram and derive expression for voltage regulation of a short transmission line.

Power System I (EE-031404)

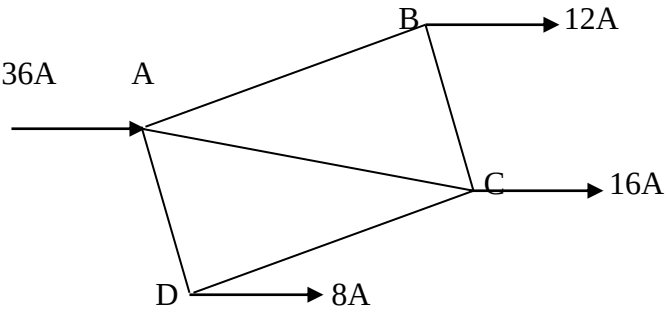
Assignment 5

1. Draw a Single Line Diagram of a complete Power System and explain the following terms (i) Primary Transmission (ii) Secondary Transmission (iii) Primary Distribution (iv) Secondary Distribution.
2. Derive an expression for flux linkage & hence inductance of a single current carrying conductor.
3. Why insulators are used with overhead lines? Discuss the desirable properties of insulators.
4. What is ACSR conductor and why ACSR conductors are mostly preferred for transmission & distribution of power.
5. Write short notes on followings (i) Classification of Overhead Transmission Lines (ii) Voltage Regulation (iii) Transmission Efficiency

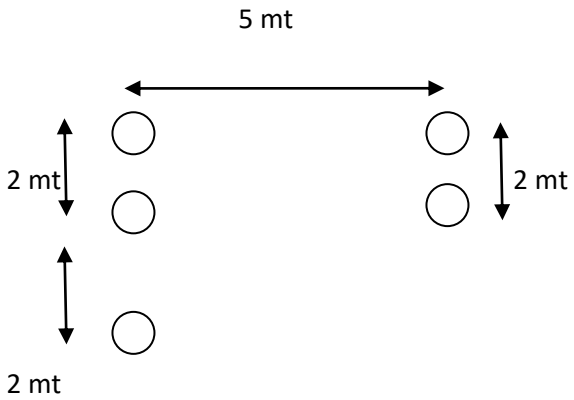
Power System I (EE-031404)

Tutorial Sheet I

1. In the DC network shown below, A is the feeding point and is maintained at 250V. The resistances of the various branches (go & return) are indicated in figure. Determine the current in each branch. Resistances of different sections are as follows: AB=0.4 ohm, BC 0.8 ohm, CD=0.4 ohm, AD= 0.4 ohm, AC=0.8 ohm.



2. Determine the inductance & capacitance of a single phase transmission line having the following arrangement of conductors. One circuit consists of three wires of 2 mm diameter each and the other circuit two wires of 4 mm diameter each. Operating voltage is 220 kV.



Conductor A Conductor B

3. 30,000 kW at power factor 0·8 lagging is being transmitted over a 220 kV, three-phase transmission line. The length of the line is 275 km and the efficiency of transmission is 90%. Calculate the weight of copper required. Also calculate the weight of copper had the power been transmitted over a single-phase transmission line for the same line voltage and losses. Assume that the resistance of 1 km long conductor and 1 sq. cm is 0·173 Ω and specific gravity of copper is 8·9.

4. A 2-wire d.c. distributor AB, 1000 m long has a total resistance of 0·1 Ω. The ends A and B are fed at 240 V. The distributor is uniformly loaded at 0.5 A/metre length and has concentrated loads of 120 A, 60 A, 100 A and 40 A at points distant 200, 400, 700 and 900 m respectively from end A. Calculate: (i) the point of minimum potential (ii) value of minimum potential (iii) current fed at both ends.

Power System I (EE-031404)

Tutorial Sheet II

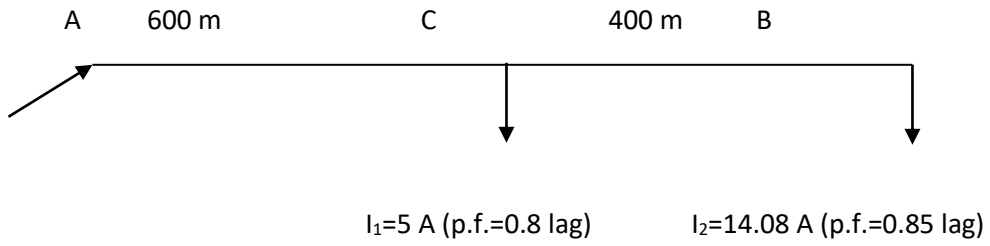
1. A 2 conductor cable 1 km long is required to supply a constant current of 200 A throughout the year. The cost of cable including installation is Rs. (20a + 20) per meter where ‘a’ is the area of cross section of the conductor in sq. cm. The cost of energy is 5P per kWh and interest and

depreciation charges amount to 10%. Calculate the most economical conductor size. Assume resistivity of conductor material to be 1.73 micro-ohm-cm.

2. The three conductors of a 3 phase overhead line are arranged in a horizontal plane with a spacing of 4 m between adjacent conductors. The diameter of each conductor is 2 cm. Determine the inductance per km per phase of the line assuming that the line are transposed.
3. A single phase a.c. distributor AB 300 metres long is fed from end A and is loaded as under : (i) 100 A at 0·707 p.f. lagging 200 m from point A (ii) 200 A at 0·8 p.f. lagging 300 m from point A. The load resistance and reactance of the distributor is 0·2 Ω and 0·1 Ω per kilometre. Calculate the total voltage drop in the distributor. The load power factors refer to the voltage at the far end.
4. A 200 km, 3 phase transmission line has its conductors placed at the corner of an equilateral triangle of 2.5 m side. The radius of each conductor is 1 cm. determine,
   (i) Line to neutral capacitance of the line.
   (ii) Charging current per phase if the line is maintained at 66 kV, 50Hz.

5. An overhead transmission line at a river crossing is supported from two towers at heights of 50 m and 100 m above the water level. The horizontal distance between the towers is 400 m. If the maximum allowable tension is 1800 kg and the conductor weighs 1 kg/m, find the clearance between the conductor and water at a point mid-way between the supports.

6. A 3-phase, 400V distributor AB is loaded as shown in Fig. The 3-phase load at point C takes 5A per phase at a p.f. of 0·8 lagging. At point B, a 3-phase, 400 V induction motor is connected which has an output of 10 H.P. with an efficiency of 90% and p.f. 0·85 lagging. If voltage at point B is to be maintained at 400 V, what should be the voltage at point A? The resistance and reactance of the line are 1Ω and 0·5Ω per phase per kilometre respectively.



MUZAFFARPUR INSTITUTE OF TECHNOLOGY, MUZAFFARPUR
B.Tech 4th Semester Mid-Term Examination, 2018
Power system I (031404)

Time: 2 hours **Full Marks: 20**

Instructions: **(i) Attempt any Three questions.**
(ii) The marks are indicated in the right-hand margin.
(iii) All questions carry equal marks.

M.I.T. Muzaffarpur
Mid-semester examination (IV Semester, Electrical) Time - 2Hrs FM - 20
Subject - Power System-I
Answer any THREE questions.

(1) Derive the expression for 1-ϕ 2-W composite conductor system.

(2) Derive the expression for capacitance of 1-ϕ 2 wire system. Also discuss the effect of earth on capacitance.

(3) Draw the phasor diagram of the short line. Derive the condition of the maximum voltage regulation.

(4) A 3-ϕ 50Hz 132 KV transmission line is delivering a load of 100 MW at p.f. of 0.9 lagging. Determine the voltage regulation and efficiency of the line if

$R = 20\ \Omega$, $X = 50\ \Omega$, $Y = 4 \times 10^{-4}\ \mho$

Use π - model for analysis.

(5) Write brief notes on any TWO of the following:
a) Ferranti effect
b) Bundled conductor
c) Surge Impedance loading

[Note - The missing data and misprints may be suitably assumed.]

Question Bank:

Code : 031404

B.Tech 4th Semester Exam., 2016

POWER SYSTEM—I

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

*(ii) There are **NINE** questions in this paper.*

*(iii) Attempt **FIVE** questions in all.*

*(iv) Question No. **1** is compulsory.*

1. Choose and write the correct option (any *seven*) : 2×7=14

(a) The angle of *A*, constant of the transmission line normally lies between

(i) 90°–70°

(ii) 70°–40°

(iii) 40°–10°

(iv) 10°–0°

(b) By increasing the transmission voltage to double of its original value, the same power can be despatched keeping the line loss

(i) equal to original value

(ii) half the original value

(iii) double the original value

(iv) one-fourth of original value

(c) Power transmission by cable is generally adopted for line lengths

(i) above 100 km

(ii) up to 200 km

(iii) less than 50 km

(iv) less than 10 km

(d) Reactive power is

(i) rate of energy transfer

(ii) the product of r.m.s. volt and quadrature component of r.m.s. current

(iii) the product of r.m.s. volt and r.m.s. current

(iv) the product of r.m.s. volt and in phase component of r.m.s. current

(v) None of the above

(e) In a long transmission line under no-load condition

(i) the receiving end voltage is less than the sending end voltage

(ii) the sending end voltage is less than the receiving end voltage

(iii) the sending end voltage is equal to the receiving end voltage

(iv) None of the above

(f) The presence of earth in case of overhead lines

(i) increases the capacitance

(ii) increases the inductance

(iii) decreases the capacitance

(iv) decreases the inductance

(g) The effect of bonding the cable is

(i) to increase the effective resistance and resistance

(ii) to increase the effective resistance but reduce inductance

(iii) to reduce the effective resistance and inductance

(iv) to reduce the effective resistance but increase the inductance

(h) Effect of increase in temperature in overhead line is to

(i) increase the stress and the length

(ii) decrease the stress but increase in length

(iii) decrease the stress and length

(iv) Any of the above

(i) The capacitance between any two conductors of a 3-core cable with sheath earthed is 3 μF. The capacitance per phase will be

(i) 1·5 μF

(ii) 6 μF

(iii) 1 μF

(iv) None of the above

(j) To obtain the minimum value of stress in cable R/r ratio should be

(i) 2·13

(ii) 3·14

(iii) 2·718

(iv) 1·96

(e) In a long transmission line under no-load condition

(i) the receiving end voltage is less than the sending end voltage

(ii) the sending end voltage is less than the receiving end voltage

(iii) the sending end voltage is equal to the receiving end voltage

(iv) None of the above

(f) The presence of earth in case of overhead lines

(i) increases the capacitance

(ii) increases the inductance

(iii) decreases the capacitance

(iv) decreases the inductance

(g) The effect of bonding the cable is

(i) to increase the effective resistance and resistance

(ii) to increase the effective resistance but reduce inductance

(iii) to reduce the effective resistance and inductance

(iv) to reduce the effective resistance but increase the inductance

(h) Effect of increase in temperature in overhead line is to

(i) increase the stress and the length

(ii) decrease the stress but increase in length

(iii) decrease the stress and length

(iv) Any of the above

(i) The capacitance between any two conductors of a 3-core cable with sheath earthed is 3 μF. The capacitance per phase will be

(i) 1·5 μF

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(iii) 1 μF

(iv) None of the above

(j) To obtain the minimum value of stress in cable R/r ratio should be

(i) 2·13

(ii) 3·14

(iii) 2·718

(iv) 1·96

2. Compare the volume of copper required for the distributor cable in a low-voltage distribution network in a DC 3-wire system, with a 3-ϕ, 4-wire system. Assume the same consumer voltage, same percentage loss, unity power factor and balanced load. The neutrals of half the *X*-section of corresponding outer. 14

3. *(a)* Write a short note on 'choice of transmission voltage'. 5

(b) A 2-core, 11 kV cable is to supply 1 MW at 0·8 p.f. lag for 3000 hours in a year. Capital cost of the cable is ₹ (20+400a) per meter, where a is the *X*-sectional area of core in cm^2. Interest and depreciation total 10% and cost per unit of energy is 15 P. If the length of cable is 1 km, calculate the most economical *X*-section of the conductor. The specific resistance of copper is 1·75 $\mu\Omega$/cm. 9

4. A 1-ϕ distributor, one km long has resistance and reactance 0·4 Ω and 0·6 Ω (go and return) respectively. At the far end, the voltage $V_B = 240$ V and the current is 100 A at a p.f. of 0·8 lag. At the mid-point *B* of the distributor current of 100 A is tapped at a power factor of 0·6 lag with reference to the voltage V_B at the mid-point. Calculate the supply voltage V_S for the distributor and the phase angle between supply end and receiving end. 14

(Turn Over)

5. Derive from first principles the capacitance per km to neutral of a 3-ϕ overhead transmission line with unsymmetrical spacing of conductors assuming transposition. 14

6. *(a)* Discuss the effect of wind and ice on sag. 7

(b) What is a stringing chart? What is its utility? 7

7. Explain the physical significance of the generalized *ABCD* constants of a transmission line. State the units of these constants. Determine these constants for a medium transmission line with nominal-*T* configuration. Draw neatly corresponding vector diagram. 14

8. Explain in detail how the receiving end power circle diagram can be drawn. Obtain the condition for maximum power. 14

9. *(a)* Find expression for the capacitance of a cable per km length. 7

(b) Write a short note on 'Thermal resistance of cables'. 7

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Result of the students

Roll No	Name	Theory			
		Marks of attendance	Class test	Mid semester exam	Total
16EE02	ANJALI KUMARI	5	5	20	30
16EE03	KAUSTUBHA	5	5	20	30
16EE05	AMRITA KUMARI	5	5	20	30
16EE06	SUMIT KUMAR	5	5	20	30
16EE07	RITESH RAJ	5	5	19	29
16EE08	VIPUL MISHRA	4	5	19	28
16EE10	MD SAIFULLAH SADIQUE	5	5	18	28
16EE11	PREETI KUMARI	5	5	19	29
16EE12	KULDEEP THAKUR	4	5	8	17
16EE13	SHANTANU SINGH	5	5	19	29
16EE14	SEEMA KUMARI	5	5	20	30
16EE15	PRIYAM KUMARI	5	5	20	30
16EE16	VANDANA BIHARI	5	5	20	30
16EE17	RAJNANDANI	5	5	20	30
16EE18	SANJAY KUMAR	5	5	20	30
16EE19	PRAVEEN DIVAKAR	5	5	19	29
16EE20	AMIT KUMAR PANDIT	5	5	0	10
16EE21	CHANDAN KUMAR THAKUR	5	5	19	29
16EE22	ALOK KUMAR	5	5	14	24
16EE23	DEVENDRA KUMAR	4	3	11	18
16EE24	ARVIND KUMAR	4	5	16	25

16EE25	AMITESH KUMAR	5	5	20	30
16EE26	VIVEK KUMAR	5	5	19	29
16EE27	VIKASH KUMAR RAY	5	5	19	29
16EE28	ROHIT KUMAR	5	5	16	26
16EE30	RAVI KUMAR	5	5	20	30
16EE31	SANDEEP KUMAR	4	5	16	25
16EE32	DEO ALOK	5	5	18	28
16EE33	BAJRANGI KUMAR	5	5	18	28
16EE34	MANOJ KUMAR SONI	5	5	12	22
16EE36	NEERAJ KUMAR	5	5	7	17
16EE39	NITISH KUMAR RAJAK	5	5	17	27
16EE40	UJJAWAL KUMAR	5	3	20	28
16EE41	PRABHAT KUMAR	5	5	14	24
16EE42	MD HASIM JILANI	5	3	6	14
16EE44	ANISH BHARTI	5	5	6	16
16EE45	RAHUL KUMAR	5	5	17	27
16EE46	RAJEEV RANJAN PRASAD	4	3	8	15
16EE49	PRASHANT KUMAR	5	5	13	23
16EE50	NAMAN KUMAR	5	5	19	29
16EE51	KESHAV CHANDRA	4	5	19	28
16EE52	SWETA BHARTI	5	5	20	30
16EE53	PRATIK ANAND	5	5	20	30
16EE54	SHAGUFTA ANJUM	5	5	20	30
16EE55	GOLDEN KUMAR	5	5	20	30
16EE56	MURLI MANOHAR	5	5	19	29

16EE57	ARPIT ANAND	4	5	8	17
16EE58	AKSHAT RAJ	5	3	12	20
16EE59	ANJAN KUMAR	5	5	19	29
16EE60	SUMAN KUMAR BHARTIYA	5	5	20	30
16EE61	SAKET	4	5	20	29
16EE62	RISHABH KUMAR	4	5	15	24
16EE63	SUMAN KUMAR	5	5	16	26
16EE64	SUNITA KUMARI	5	5	20	30
16EE65	NISHANT RAJ	5	5	10	20
16EE66	VIPIN SINGH	5	5	19	29
16EE67	ANKIT RAJ	4	5	8	17
16EE68	GUNJAN KUMAR	5	5	9	19
16EE69	PRATAP CHANDRA CHOUDHARY	5	5	18	28
17(LE)EE01	VIVEK KUMAR	5	5	20	30
17(LE)EE02	RITIK KUMAR	5	5	15	25
17(LE)EE03	ANAND RANJAN	4	5	19	28
17(LE)EE04	ABHISHEK KUMAR	5	5	16	26
17(LE)EE05	POONAM KUMARI	5	5	16	26
17(LE)EE06	SAURABH KUMAR JHA	5	5	18	28
17(LE)EE07	Parmanand Kumar	4	5	19	28
17(LE)EE08	ROHAN RAJ	5	5	11	21
17(LE)EE09	ANAND KUMAR	5	5	18	28
17(LE)EE10	MANISH	5	5	16	26

RESULT ANALYSIS