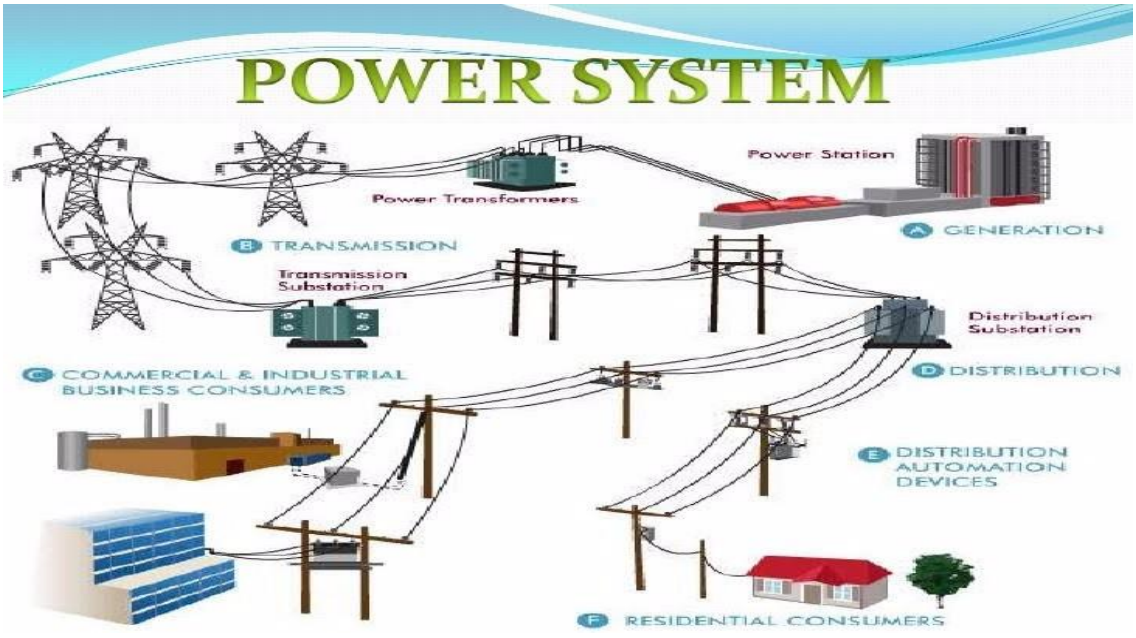
MUZAFFARPUR INSTITUTE OF TECHNOLOGY, Muzaffarpur

COURSE FILE

OF

Power System Design

(031814)



Faculty Name:

DR. YAGYANAND SHARMA

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 (VIII semester)
Course Code/course credits	0331814 (3)
Course Name	Power System Design
Lecture/ Sessional (per week)	3/1
SEE duration	3 hours
Course Coordinator Name	Mr. Yagyanand Sharma

Course objective:

This course is designed to review the fundamentals and practices of Power System Design within the Electrical Engineering curriculum. Students will explore Power System Design processes in the practical and applied realm in the fields of Per Unit System Representation, Load flow Analysis, Symmetrical Short Circuit Analysis, Symmetrical components of fault analysis, Unsymmetrical Short Circuit Analysis, Power System Stability Problems, and Transient Stability. The Power System Design curriculum is designed to prepare interested students for future careers in SCADA, Industrial management, Power Sector.

Course outcomes (CO):

CO1: Demonstrate the ability to conduct experiments in the Electrical Engineering Laboratory in accordance with Health and Safety Regulations and to record, interpret and report on the experimental results.

CO2: Apply load flow analysis to an electrical power network and interpret the results of the analysis

CO3: Per Unit representation of entire power system network. Practical symmetrical and unsymmetrical fault analysis study.

CO4: Analysis of Power System Stability, Steady State Stability and Transient Stability and the associated problems.

MAPPING OF COs AND POs

Sr. No.	Course Outcome	PO
1.	**CO1**: Demonstrate the ability to conduct experiments in the Electrical Engineering Laboratory in accordance with Health and Safety Regulations and to record, interpret and report on the experimental results.	PO1, PO3, PO4, PO5, PO6
2.	**CO2**: Apply load flow analysis to an electrical power network	PO3, PO4, PO6, PO10

	and interpret the results of the analysis	
3.	**CO3**: Per Unit representation of entire power system network. Study of practical symmetrical and unsymmetrical fault analysis.	PO1, PO7, PO8, PO9, PO10
4.	**CO4**: Analysis of Power System Stability, Steady State Stability and Transient Stability and the associated problems.	PO1,PO2,PO3, PO4, PO6, PO7, PO9, PO10

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

Course Syllabus:

UNIT-I

Understand the basic concept of transmission lines, generating stations, receiving stations, industrial applications of meters, performance of transmission lines, VAR compensators and prediction of power flow, faults in the line etc.

UNIT-II

Reactance diagram, impedance diagram. Load flow problem, y bus, formulation of problem, solution technique using Gauss seidel method.

Short circuit of synchronous machine on No load, short circuit of loaded synchronous machine, Thevenin's equivalent circuit approach for short circuit analysis.

UNIT-III

Transformation, phase shift in star delta transformer, Sequence impedance and sequence network of transmission line, synchronous machine, transformer and power system.

Symmetrical component analysis of unsymmetrical short circuits, single line to ground fault, double line to ground fault and line to line fault.

UNIT-IV

Swing Equation, system response to small disturbances, power angle equation and diagram

Equal area criterion, Measures for improving transient stability

Books:

- **‘Elements of Power System Analysis ' by Stevenson and Grainger (McGraw Hill)**
- **'Electrical Energy Systems Theory and Introduction' by Olle I.Elgerd**
- **‘Power System Analysis’ by Hadi Saadat**

GATE Syllabus of Power System Design:

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, Equal area criterion.**

MUZAFFARPUR INSTITUTE OF TECHNOLOGY

B.Tech. 8th (Eight) Semester (2014 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			M CTRL(NK)53	P.M.&I.R.(H)48		---------- PROJECT (MAJOR) (YNS)----------		
TUE		---------- PROJECT (MAJOR) (YNS) 48 ----------			B	---------- SEMINAR (RSS) IT4 ----------		
WED	SGP(HCV)50	P.M.&I.R.(H)48	Pwr S Des(YNS)48		R	---------- POWER SYSTEM DESIGN (YNS)----------		
THU	SGP(HCV)50	SGP(HCV)50	M CTRL(NK) 53	M CTRL(NK) 53	E	---------- PROJECT (YNS) 15A ----------		
FRI	M CTRL(NK)53	P.M.&I.R.(H)53	SGP(HCV)50	Pwr S Des(YNS)53	A	---------- PROJECT (YNS) ----------		
SAT		---------- PROJECT MAJOR (YNS)IT3 ----------			K			

HCV-Hari Charan Verma, NK-Nayan Kumar, RSS- Ram Sagar Singh, YNS- Yagyanand Sharma

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

STUDENT LIST:

S.NO.	*Roll No*	*Name*
1	14EE01	AYUSH KUMAR
2	14EE02	ANSHU PRIYA
3	14EE03	ANJALI SINHA
4	14EE04	NIHARIKA
5	14EE05	ABHISHEK
6	14EE06	UDIT KUMAR
7	14EE07	NEHA KUMARI
8	14EE08	DEEPAK KUMAR
9	14EE09	NAVENDU JHA
10	14EE10	VIKASH KUMAR
11	14EE11	PANKAJ KUMAR RAMAN
12	14EE12	KUMAR AYUSH
13	14EE13	ADITYA KUMAR
14	14EE14	SUDHAKAR PRASAD
15	14EE15	SHWETA KUMARI
16	14EE16	LAVANYA
17	14EE17	PAMIT KUMAR
18	14EE18	DEEP SHIKHA
19	14EE19	MD SHAH JAHAN
20	14EE20	CHANDAN PRAKASH
21	14EE21	ASHUTOSH KUMAR
22	14EE22	ANURANJAN KUMAR

23	14EE23	SHALU KUMARI
24	14EE24	KANHAIYA LAL MANDAL
25	14EE25	DEEPAK KUMAR
26	14EE27	RAHUL KUMAR
27	14EE28	SURYA KANT PATEL
28	14EE30	GULSHAN KUMAR
29	14EE31	ARVIND KUMAR
30	14EE32	SATISH KUMAR SINGH
31	14EE33	AVINASH KUMAR
32	14EE34	RANJIT KUMAR
33	14EE35	RAVI RANJAN
34	14EE36	ABHISHEK KUMAR
35	14EE37	AMIT KUMAR
36	14EE38	ALAKH NIRANJAN KUMAR
37	14EE39	KAMLESH KUMAR
38	14EE40	DHARAMVEER KUMAR
39	14EE41	ABHISHEK RAJ
40	14EE42	RAVINDAR KUMAR
41	14EE43	SHOAA AKBARI
42	14EE44	NITESH
43	14EE45	KAMLESH KUMAR
44	14EE46	CHANDAN KUMAR
45	14EE47	BHAWNA SINHA
46	14EE48	AHMAD RAJA
47	14EE51	NIDHI

48	14EE52	ROHIT
49	14EE53	KUMARI PALLAVI
50	14EE54	RAVI KANT SINGH
51	14EE55	PRASHANT KUMAR
52	14EE56	RAJAN KUMAR
53	14EE57	MAHBOOB AKHTAR
54	14EE58	MD NAHID ALAM
55	14EE59	PRINCE KUMAR
56	14EE60	MANI RAJ
57	14EE61	PANKAJ KUMAR SAW
58	14EE62	ALEKH RAJ
59	14EE63	SURAJ KUMAR
60	15(LE)EE01	VICKEY KUMAR
62	15(LE)EE03	ANAND KUMAR
63	15(LE)EE04	SONAM SINHA
64	15(LE)EE05	SARITA KUMARI
65	15(LE)EE06	PRATIBHA KUMARI
66	15(LE)EE07	ABHISHEK KUMAR
67	15(LE)EE08	ASHUTOSH KUMAR
68	13EE17	NEERAJ KUMAR

Course Plan:

Text Books:

TB1: 'Elements of Power System Analysis ' by Stevenson and Grainger (McGraw Hill)
TB2: 'Electrical Energy Systems Theory and Introduction' by Olle I.Elgerd
TB3: 'Power System Analysis' by Hadi Saadat

Reference Books:

RB1: ''Modern Power System Analysis' by I J Nagarath & Kothari (TMH)
RB2: 'Electrical Power Systems' by C L Wadhwa
RB3: 'A Course in Power Systems' by J. B. Gupta
RB4: 'Electrical Power Systems' by Debapriya Das

Other readings and relevant websites

Sl.No.	**Link of Journals, Magazines, websites and Research Papers**
1.	https://onlinecourses.nptel.ac.in/noc17_ec08
2.	http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=59
3.	https://www.journals.elsevier.com/international-journal-of-electrical-power-and-energy-systems
4.	https://www.researchgate.net/topic/Power-Systems
5.	http://www.iaras.org/iaras/journals/ijps

COURSE PLAN

Lecture Number	**Topics**	**Web Links for video lectures**	**Text Book / Reference Book**	**Page numbers of Text Book(s)**
1-2	**Introduction**		TB1	6-8
	Understand the basic concept of transmission lines, generating stations, receiving stations, industrial applications of meters, performance of transmission lines, VAR compensators and prediction of power flow, faults in the line etc..	https://www.youtube.com/watch?v=QAZk-UDuPPA		
3-4	**Per unit system representation**		TB1	151-180
	Reactance diagram, impedance diagram.	https://www.youtube.com/watch?v=BYtY61hOiaw		

5-7	**Load flow analysis**		RB2	591-608
	Load flow problem, y bus, formulation of problem, solution technique using Gauss seidel method.	https://www.youtube.com/watch?v=rEyE3NxK8vE&index=26&list=PLD4ED2FAF3C155625 https://www.youtube.com/watch?v=MYGT1_9mwpg&t=319s		
8-12	**Symmetrical short circuit analysis**		TB1, RB3	188-205
	Short circuit of synchronous machine on No load, short circuit of loaded synchronous machine, Thevenin's equivalent circuit approach for short circuit analysis.	https://www.youtube.com/watch?v=HcMh7ahJxfo&index=25&list=PL32863433E8B69ABB		
13-16	**Symmetrical component**		TB1, RB3	210-220
	Transformation, phase shift in star delta transformer, Sequence impedance and sequence network of transmission line, synchronous machine, transformer and power system	https://www.youtube.com/watch?v=NHxGvHHZTQQ&index=27&list=PL32863433E8B69ABB		
17-20	**Unsymmetrical short circuits**		RB2	297-356
	Symmetrical component analysis of unsymmetrical short circuits, single line to ground fault, double line to ground fault and line to line fault.	https://www.youtube.com/watch?v=24X4znh4nl0&list=PL32863433E8B69ABB&index=26		
21-28	**Power system stability problem**		TB1	319-328
	Swing Equation, system response to small disturbances, power angle equation and diagram	https://www.youtube.com/watch?v=-NkoZx8gdqM&index=33&list=PL32863433E8B69ABB		
29-35	**Transient stability**		TB1, RB3	328-348
	Equal area criterion, Measures for improving transient stability	https://www.youtube.com/watch?v=Tt5mh2H2-YM&index=35&list=PL32863433E8B69ABB		

DETAILS OF ASSIGNMENTS:

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

Power System Design (EE-031814)

Assignment 1 (Per unit system)

Q.1 - Prove that per unit impedance of transformer remains same in either side.

Q.2- Write the importance of per unit representation of power system network.

Q.3- Derive the expression for new per unit impedance in terms of old per unit impedance.

Q.4-

Draw an impedance diagram for the electric power system as shown in Fig. 5.34, and all impedances in per-unit on a 100 MVA base. Select 20 kV base voltage for generator. The three-phase power and line ratings are given below.

$G1$: 90 MVA, 20 kV, $x_{g1} = 0.09$ pu

$G2$: 90 MVA, 18 kV, $x_{g2} = 0.09$ pu

$T1$: 80 MVA, 20/200 kV, $x_{t1} = 0.16$ pu

$T2$: 80 MVA, 200/20 kV, $x_{t2} = 0.20$ pu

Line : 200 kV, $x_{line} = 120\ \Omega$

Load : 200 kV, $S = (48 + j64)$MVA.

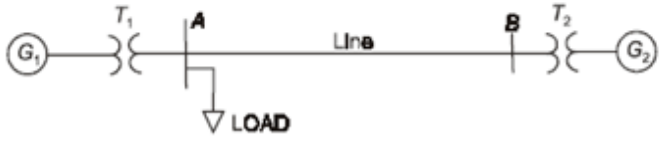


Fig. 5.34: Single line diagram for problem 5.3.

Power System Design (EE-031814)
Assignment 2 (Load Flow Analysis)

Q.1- Derive the expression for static load flow equations.

Q.2- Why load flow analysis is carried out in power systems. What are the various methods of load flow analysis write their limitations and advantages.

Q.3- Write the algorithm for formulation of load flow problem using Gauss-Siedal method.

Q.4-

Figure 7.11 shows single line diagram of a 3-bus power system. BUS 3 is a $P|V|$ bus.
(*a*) Using *G-S* method and initial assumed voltage $V_2^{(0)} = 1.0 + j0.0$ and $V_3^{(0)} = 1.03 + 0.0$, and keeping $|V_3| = 1.03$ pu, determine V_2 and V_3. Perform two iterations.
(*b*) Calculate line flows and line losses.
(*c*) Calculate slack bus power.

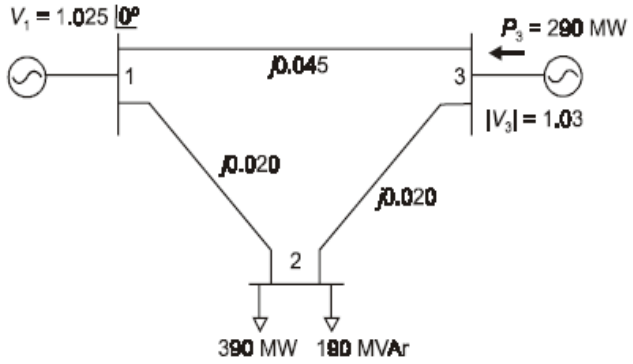


Fig. 7.11: Sample power system.

Power System Design (EE-031814)
Assignment 3(Symmetrical and Unsymmetrical Fault)

Q.1- Differentiate between symmetrical and unsymmetrical faults.

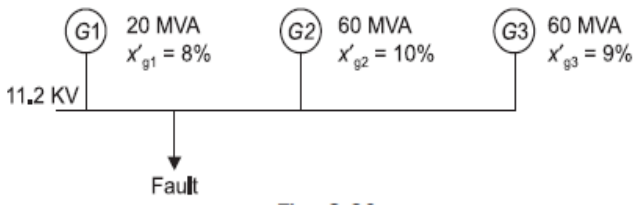
Q.2- Write the Thevenin's equivalent circuit approach for short circuit analysis.

Q.3- Derive the expression for short circuit MVA for synchronous machine.

Q.4-

An 11.2 KV bus-bar is fed from three synchronous generators as shown in Fig. 8.30. Calculate the fault current and MVA if three phase symmetrical fault occurs on the bus-bar

[**Ans:** 1071 MVA, 55.209 KA]



Power System Design (EE-031814)

Assignment 4 (Per unit System)

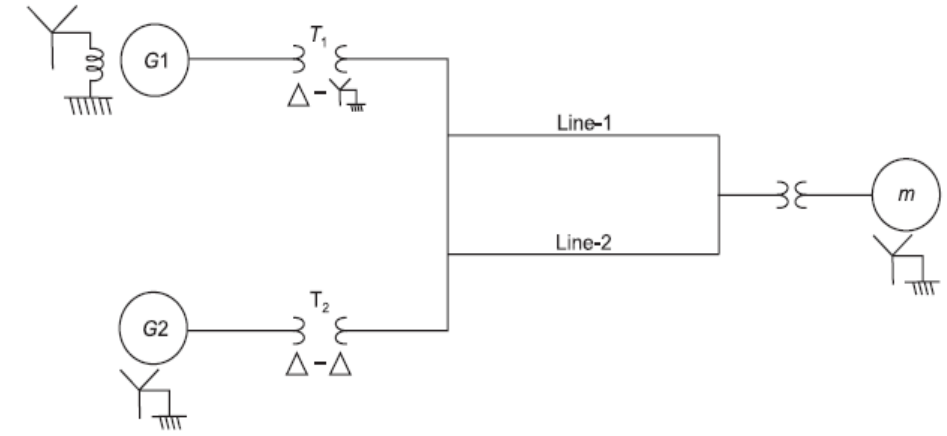
Q.1- What is the source of negative sequence and zero sequence current in transmission line?

Q.2- Draw the sequential network of three phase transformer with respect to earth fault.

Q.3- How neutral terminal can be used as protection in transformer?

Q.4-

Draw the positive, negative and zero-sequence networks of the sample power system shown in Fig. 9.21.



MUZAFFARPUR INSTITUTE OF TECHNOLOGY, MUZAFFARPUR
B.Tech 8th Semester Mid-Term Examination, 2018
Power System Design (031814)

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 – VIII Semester (Electrical)

Subject – Power System Design, FM-20, Time – 2 Hrs.

Answer any THREE questions

(1) State and explain the theory of symmetrical components.

(2) Prove that PSN, NSN and ZSN are connected in series for L-G fault. Also derive the formula for the fault current.

(3) What do you mean by sequence network. Derive sequence networks for unloaded 3-ϕ alternator.

(4) State the equal area criterion of stability.
An alternator operating at 50 Hz delivers 1 p.u. power to infinite bus. When a fault occurs it reduces the maximum power transferable to 0.4 p.u., whereas the maximum power transferable before the fault was 1.75 p.u. and is 1.25 p.u. after the fault is cleared. Determine the critical clearing angle.

(5) Write brief notes on any TWO of the following:
a) classification of bus
b) Steady state stability
c) fault.

Question Bank:

Code : 031814

B.Tech. 8th Semester Exam., 2017

Power System Design

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) Questions No. 1 is compulsory.

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

(a) A 100 MVA, 33 kV, three-phase generator has a sub-transient reactance of 15% Calculate the per unit reactance of the generator for the base value of 120 MVA, 33 kV.

(i) 0.15 p.u.

(ii) 0.03 p.u.

(iii) 0.18 p.u.

(iv) 0.12 p.u.

(b) Which of the fault in power system is very severe?

(i) L-G

(ii) L-L

(iii) L-L-G

(iv) L-L-L

(a) Which of the matrix is sparse in nature ?

(i) Bus impedance matrix

(ii) Bus admittance matrix

(iii) Inverse of the Jacobian matrix

(iv) All of the above

(d) The bus admittance matrix of a power system is given as

$$\begin{array}{c} \\ 1 \\ 2 \\ 3 \end{array}\begin{array}{c} \begin{array}{ccc} 1 & 2 & 3 \end{array} \\ \begin{bmatrix} -j50 & j10 & j5 \\ j10 & -j30 & j10 \\ j5 & j10 & -j25 \end{bmatrix} \end{array}$$

The impedance of the line between bus 2 and bus 3 will be equal to

(i) +j0.1

(ii) –j0.1

(iii) +j0.2

(iv) –j0.2

(e) Which one of the following is correct?

(i) $X_d'' = X_d' = X_d$

(ii) $X_d'' < X_d' < X_d$

(iii) $X_d'' = \frac{X_d}{2}$

(iv) $X_d'' = 2X_d$

(f) Zero sequence current can flow form a line into a transformer bank if the windings are in

(i) Grounded star-delta

(ii) star-grounded star

(iii) Delta-delta

(iv) Delta-star

(g) In whih type of fault, all the three components I_{a0}, I_{a1}, I_{a2}, are equal

(i) L–G

(ii) L–L

(iii) L-L-G

(iv) None of the above

(h) For a turbo alternator of 100 MVA, the inertia constant is 5. The value of H for a alternator of 50 MVA is

(i) 8

(ii) 12

(iii) 10

(iv) 15

(i) By using the method of equal area criterion, we get the information about

(i) Swing curve

(ii) Stability region

(iii) Relative stability

(iv) Absolute stability

(j) In Gauss-Seidel method of power flow problem, the number of iterations may be reduced if the correction in voltage at each bus is multiplied by

(i) Gauss constant

(ii) Acceleration constant

(iii) Blocking factor

(iv) Deceleration constant

2. (a) Define per unit system. What are the advantages of per unit system? 2+3

(b) Two generators rated at 10 MVA, 13.2 kV and 15 MVA, 13.2 kV are connected in parallel to a bus bar. They feed supply to two motors of inputs 8 MVA and 12 MVA, respectively. The operating voltage of motors is 12.5 kV. Assuming base quantities as 50 MVA and 13.8 kV, draw the reactance diagram. The % reactance for generators is 15% and that for motors is 20%. 9

3. (a) Classify the different buses used in load flow study. Discuss briefly.

(b) What is the advantage of bus admittance matrix over bus impedance matrix?

(c) Write down the equation that needs to be solved during each iteration of Gauss-Seidel load flow. Define each term used in this expression.

(d) What is the reason for asymmetrical bus admittance matrix? 4+2+6+2

4. (a) Describe all type of reactance of synchronous machine under no-load condition. Also draw the approximate circuit model for a short circuit under different conditions.

(b) Write down all the steps to calculate short circuit current of synchronous machine using Thevenin's theorem. What are the assumptions being made to simplify the short circuit computation?

(c) What are the different methods to formulate bus-impedance matrix? 6+6+2

5. (a) Define positive, negative and zero sequence components.

(b) Write down the expression for symmetrical components in terms of original phasors.

(c) Determine the symmetrical components of three voltages.

$V_a = 180\angle 5^\circ$ V

$V_b = 180\angle 250^\circ$ V

$V_c = 180\angle 110^\circ$ V

(d) Derive the complex power in terms of symmetrical components. 3+2+3+6

6. (a) Draw the sequence network for all type of asymmetrical fault with fault impedance Z_f and neutral impendance Z_n.

(b) Write all the steps involved to evaluate the actual voltage and current for L-L-G fault for solidly grounded unloaded alternator. 6+8

7. (a) Explain all the methods to improve transient stability limit of a power system.

(b) Describe the equal area criterion of stability for a sudden change in mechanical input in a single machine infinite busbar system. 8+6

8. (a) Derive and plot the power-angle equation for a synchronous machine connected to infinite bus.

(b) A 50 Hz, 4-pole turbo-generator rated 100 MVA, 11 kV has an inertia constant of 8 MJ/MVA.

(i) Find the energy stored in the rotor at synchronous speed.

(ii) If the mechanical input is suddenly changed to 80 MW for an electrical load of 50 MW, find rotor acceleration, neglecting mechnical and electrical losses.

(iii) If the acceleration calculated in part(ii) is maintained for 10 cyccles, find the change in torque angle and rotor speed in revolution per minute at the end of this period.

(c) Write the combined swing equation of two machines on a common system base. 6+6+2

9. Write short notes on the following: 7×2

(a) ZBUS build block algorithm

(b) Analysis of unsymmetrical fault.

***

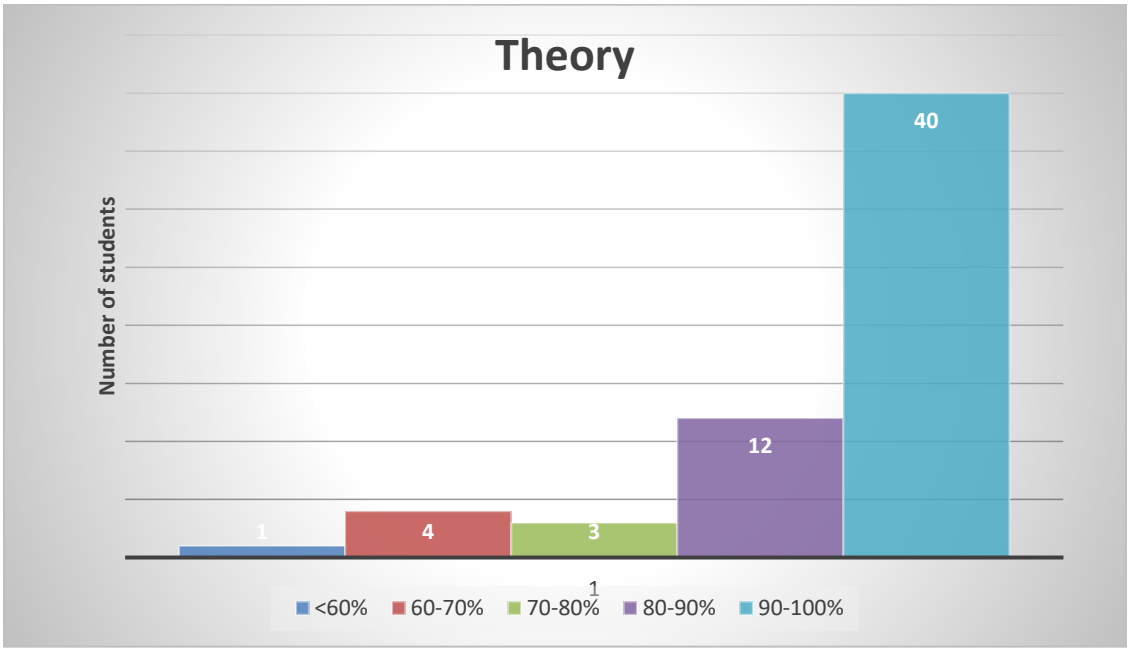
Result of the students

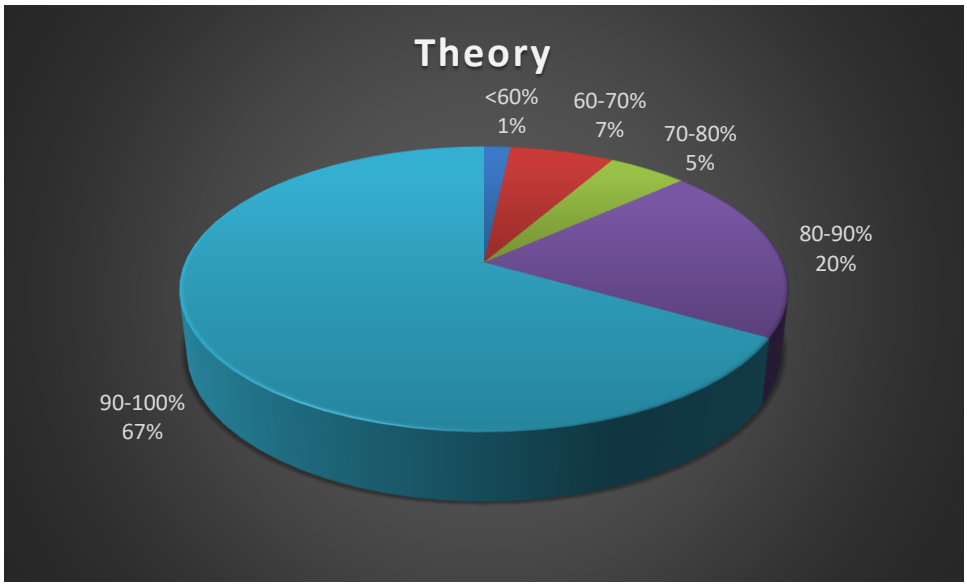
Roll No	Name	Theory				Practical			
		Marks of attendance	Class test	End semester exam	Total	Marks of attendance	Class test	End semester exam	Total
14EE01	AYUSH KUMAR	5	5	19	29	5	5	10	20
14EE02	ANSHU PRIYA	5	5	20	30	5	5	10	20
14EE05	ABHISHEK	5	5	16	26	5	4	9	18
14EE06	UDIT KUMAR	5	5	20	30	5	5	10	20
14EE07	NEHA KUMARI	5	5	20	30	5	5	10	20
14EE08	DEEPAK KUMAR	5	5	16	26	5	4	9	18
14EE09	NAVENDU JHA	4	5	19	28	4	5	10	19
14EE10	VIKASH KUMAR	5	5	19	29	5	5	10	20
14EE11	PANKAJ KUMAR RAMAN	5	5	20	30	5	5	10	20
14EE12	KUMAR AYUSH	4	5	17	26	4	4	9	17
14EE13	ADITYA KUMAR	5	5	18	28	4	4	9	17
14EE14	SUDHAKAR PRASAD	4	5	15	24	4	4	9	17
14EE15	SHWETA KUMARI	4	5	18	27	4	4	9	17
14EE16	LAVANYA	4	5	17	26	4	4	9	17
14EE17	PAMIT KUMAR	5	5	17	27	5	4	9	18
14EE18	DEEP SHIKHA	4	5	20	29	4	5	10	19
14EE19	MD SHAH JAHAN	4	5	19	28	4	5	10	19
14EE20	CHANDAN PRAKASH	5	4	16	25	5	4	9	18
14EE21	ASHUTOSH KUMAR	4	5	16	25	4	4	9	17
14EE22	ANURANJAN KUMAR	4	5	15	24	5	4	9	18
14EE23	SHALU KUMARI	5	5	20	30	5	5	10	20
14EE25	DEEPAK KUMAR	5	5	16	26	4	4	9	17

14EE28	SURYA KANT PATEL	5	5	19	29	5	5	10	20
14EE30	GULSHAN KUMAR	5	5	19	29	5	5	10	20
14EE31	ARVIND KUMAR	5	5	19	29	5	5	10	20
14EE32	SATISH KUMAR SINGH	5	5	19	29	5	5	10	20
14EE33	AVINASH KUMAR	5	5	19	29	5	5	10	20
14EE34	RANJIT KUMAR	5	5	19	29	5	5	10	20
14EE35	RAVI RANJAN	5	5	17	27	5	4	9	18
14EE36	ABHISHEK KUMAR	5	4	14	23	5	4	9	18
14EE38	ALAKH NIRANJAN KUMAR	5	5	20	30	5	5	10	20
14EE39	KAMLESH KUMAR	5	5	19	29	5	5	10	20
14EE40	DHARAMVEER KUMAR	5	5	18	28	5	4	9	18
14EE41	ABHISHEK RAJ	5	5	20	30	5	5	10	20
14EE42	RAVINDAR KUMAR	5	5	10	20	5	4	9	18
14EE43	SHOAA AKBARI	4	5	19	28	4	5	10	19
14EE44	NITESH	5	5	19	29	5	5	10	20
14EE45	KAMLESH KUMAR	5	5	19	29	5	5	10	20
14EE46	CHANDAN KUMAR	5	5	17	27	5	4	9	18
14EE47	BHAWNA SINHA	5	5	19	29	5	5	10	20
14EE48	AHMAD RAJA	4	5	12	21	4	4	9	17
14EE51	NIDHI	4	5	19	28	4	5	10	19
14EE52	ROHIT	4	5	10	19	4	4	9	17
14EE53	KUMARI PALLAVI	5	5	20	30	5	5	10	20
14EE54	RAVI KANT SINGH	4	5	20	29	4	5	10	19
14EE55	PRASHANT KUMAR	4	5	18	27	4	4	9	17
14EE58	MD NAHID ALAM	4	5	19	28	4	4	10	18

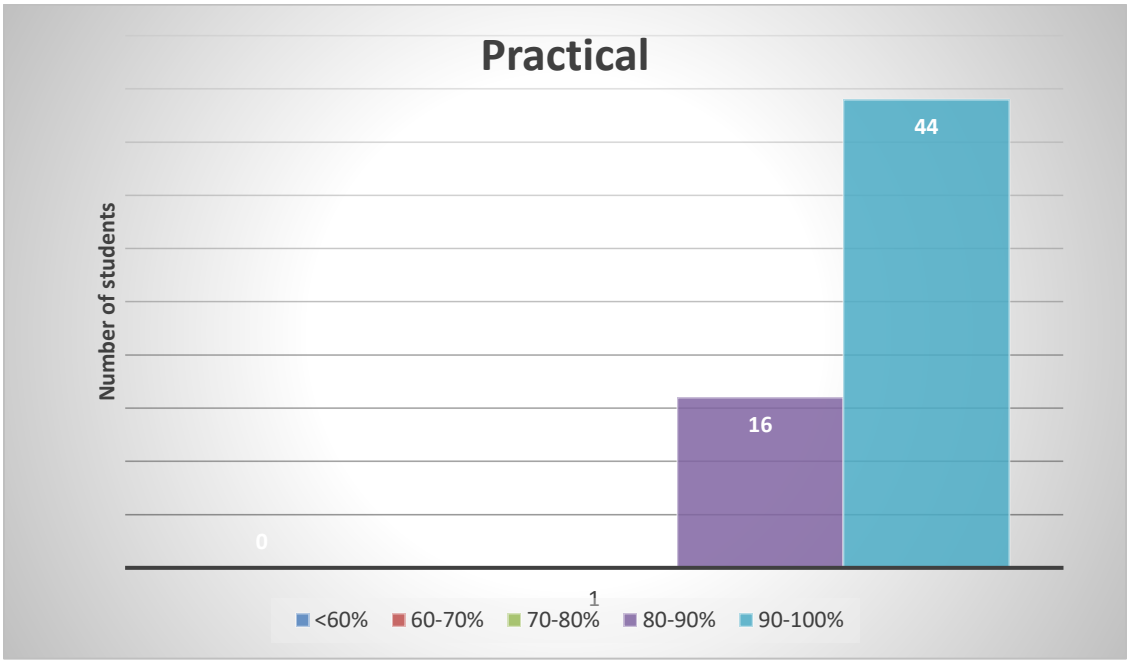
14EE59	PRINCE KUMAR	4	5	19	28	5	5	10	20
14EE60	MANI RAJ	5	4	12	21	5	4	9	18
14EE61	PANKAJ KUMAR SAW	5	5	20	30	5	5	10	20
14EE62	ALEKH RAJ	4	5	16	25	4	4	9	17
14EE63	SURAJ KUMAR	4	4	10	18	4	4	9	17
15(LE)EE01	VICKEY KUMAR	4	5	16	25	4	4	9	17
15(LE)EE03	ANAND KUMAR	4	5	19	28	4	5	10	19
15(LE)EE04	SONAM SINHA	4	5	18	27	4	4	9	17
15(LE)EE05	SARITA KUMARI	4	4	16	24	5	4	9	18
15(LE)EE06	PRATIBHA KUMARI	4	5	19	28	5	5	10	20
15(LE)EE07	ABHISHEK KUMAR	4	4	8	16	4	4	9	17
15(LE)EE08	ASHUTOSH KUMAR	4	5	10	19	4	4	9	17
13EE17	NEERAJ KUMAR	5	4	20	29	5	5	10	20

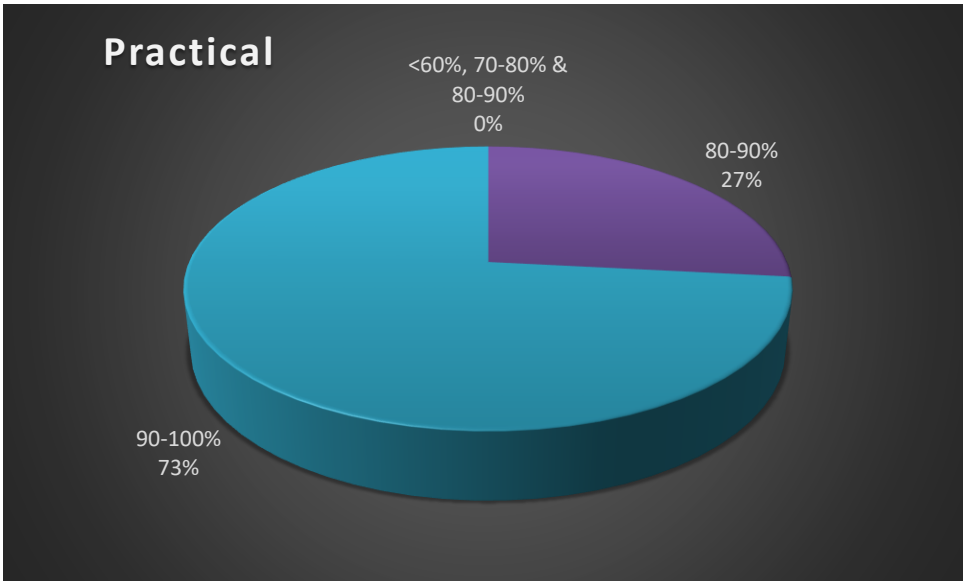
RESULT ANALYSIS





Practical:


Practical
Number of students
0
16
44
1
<60%
60-70%
70-80%
80-90%
90-100%


Practical
<60%, 70-80% &
80-90%
0%
80-90%
27%
90-100%
73%