

Ref No:

< Sri Krishna Institute of Technology, Bangalore >



COURSE PLAN

Academic Year 2019

Program:	B E – Electrical and Electronics Engineering
Semester :	7
Course Code:	15EE72
Course Title:	POWER SYSTEM PROTECTION
Credit / L-T-P:	4 / 4-0-0
Total Contact Hours:	50
Course Plan Author:	Vinutha S

Academic Evaluation and Monitoring Cell

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Note : Remove "Table of Content" before including in CP Book

Each Course Plan shall be printed and made into a book with cover page

Blooms Level in all sections match with A.2, only if you plan to teach / learn at higher levels

A. COURSE INFORMATION

1. Course Overview

Degree:	BE	Program:	EE
Semester:	7	Academic Year:	2019
Course Title:	POWER SYSTEM PROTECTION	Course Code:	15EE72
Credit / L-T-P:	4-0-0	SEE Duration:	180 Minutes
Total Contact Hours:	50 Hours	SEE Marks:	80 Marks
CIA Marks:	20 Marks	Assignment	1 / Module
Course Plan Author	Vinutha S	Sign ..	Dt:
Checked By:		Sign ..	Dt:
CO Targets	CIA Target : %	SEE Target: %

Note: Define CIA and SEE % targets based on previous performance.

2. Course Content

Content / Syllabus of the course as prescribed by University or designed by institute. Identify 2 concepts per module as in G.

Module	Content	Teaching Hours	Identified Module Concepts	Blooms Learning Levels
1	<p>Introduction to power system protection: Need for protective schemes, Nature and Cause of Faults, Types of Fault, Effects of Faults, Fault Statistics, Zones of Protection, Primary and Backup Protection, Essential Qualities of Protection, Performance of Protective Relaying, Classification of Protective Relays, Automatic Reclosing, Current Transformers for protection, Voltage Transformers for Protection.</p> <p>Relay construction and operating principle: Introduction, Electromechanical Relays, Static Relays Merits and Demerits of Static Relays, Numerical Relays, Comparison between Electromechanical Relays and Numerical Relays.</p> <p>Overcurrent protection: Over current Protection: Introduction, Time – current Characteristics, Current Setting, Time setting</p>	10	<p>-Protection system</p> <p>-Characteristics of relay</p>	<p>L3 Applying</p> <p>L4 Analysis</p>
2	<p>Over current Protective Schemes: Reverse Power or Directional Relay, Protection of Parallel Feeders, Protection of Ring Mains, Earth Fault and Phase Fault Protection, Combined Earth Fault and Phase Fault Protective Scheme, Phase Fault Protective Scheme, Directional Earth Fault Relay, Static Over current Relays, Numerical Over current Relays.</p> <p>Distance protection: Introduction, Impedance Relay, Reactance Relay, Mho Relay, Angle Impedance Relay, Effect of Arc Resistance on the Performance of Distance Relays, Reach of Distance Relays. Effect of Power Surges (Power Swings) on Performance of Distance Relays, Effect of Line Length and Source Impedance on Performance of Distance Relays</p>	10	<p>-Types of fault</p> <p>-Parameters of Relay</p>	<p>L4 Analysis</p> <p>L4 Analysis</p>
3	<p>Pilot relaying scheme: Introduction, Wire Pilot Protection, Carrier Current Protection</p> <p>Differential Protection: Introduction, Differential Relays, Simple Differential Protection, Percentage or Biased Differential Relay, Differential Protection of 3 Phase Circuits, Balanced (Opposed) Voltage Differential Protection.</p> <p>Rotating machine protection: Introduction, Protection of Generators.</p> <p>Transformer and Bus-zone Protection: Frame Leakage</p>	10	<p>-Change in parameter operation</p> <p>-Internal faults protection</p>	<p>Analyzing L4,</p> <p>Analyzing L4</p>

	Protection			
4	Circuit breakers: Introduction, Fault Clearing Time of a Circuit Breaker, Arc Voltage, Arc Interruption, Restriking Voltage and Recovery Voltage, Current Chopping, Interruption of Capacitive Current Classification of Circuit Breakers, Air – Break Circuit Breakers, Oil Circuit Breakers, Air – Blast Circuit Breakers, SF 6 Circuit Breakers, Vacuum Circuit Breakers, High Voltage Direct Current Circuit Breakers, Rating of Circuit Breakers, Testing of Circuit Breakers	10	Characteristics of circuit breaker Arc quenching medium	Understanding L2, Analyzing L4
5	Fuses: Introductions, Definitions, Fuse Characteristics, Types of Fuses, Applications of HRC Fuses, Selection of Fuses, Discrimination. Protection against over voltage: Causes of Over voltages, Lightning phenomena, Wave Shape of Voltage due to Lightning, Over Voltage due to Lightning, Klydonograph and Magnetic Link, Protection of Transmission Lines against Direct Lightning Strokes, Protection of Stations and Sub – Stations from Direct Strokes, Protection against Traveling Waves, Insulation Coordination, Basic Impulse Insulation Level	10	Characteristics of fuse Protection against Over voltages	Analyzing L4, Analyzing L4
-	Total	50	-	-

3. Course Material

Books & other material as recommended by university (A, B) and additional resources used by course teacher (C).

1. Understanding: Concept simulation / video ; one per concept ; to understand the concepts ; 15 – 30 minutes
2. Design: Simulation and design tools used – software tools used ; Free / open source
3. Research: Recent developments on the concepts – publications in journals; conferences etc.

Modul es	Details	Chapters in book	Availability
A	Text books (Title, Authors, Edition, Publisher, Year.)	-	-
1, 2, 3, 4, 5	Bhadri Ram,D N Vishwakarma		In Lib
	BhuvaneshOza et al		
B	Reference books (Title, Authors, Edition, Publisher, Year.)	-	-
	Protection and switchgear by bhavesh et al, oxford,1st edition,2011		
	Power system switchgear and protection,N Veerappan		
C	Concept Videos or Simulation for Understanding	-	-
C1	https://www.youtube.com/watch?v=uy9lZCdkQIM Lecture Series on Power System Generation, Transmission and Distribution		
C2	https://www.youtube.com/watch?v=gd1nruo4_iA Insulators for Overhead Lines		
C3	https://www.youtube.com/watch?v=lr1jgbR5ca8 https://www.youtube.com/watch?v=dhmYOIBcwOU Transmission Line parameters		
C4	https://www.youtube.com/watch?v=lr1jgbR5ca8 https://www.youtube.com/watch?v=dhmYOIBcwOU Transmission Line parameters		

C5	https://nptel.ac.in/courses/108102047/12 Performance of transmission lines		
C6	https://nptel.ac.in/courses/108102047/12 Performance of transmission lines		
C7	https://nptel.ac.in/courses/108105104/21 Disruptive critical voltage for single and three phase transmission lines, Formula for disruptive critical voltage, Visual critical voltage		
C8	https://nptel.ac.in/courses/108102047/18 Underground cable		
C9	https://www.youtube.com/watch?v=_iz8ZkjD7z8 Distribution Systems		
C10	https://nptel.ac.in/courses/108107112/3 Distribution Systems		
D	Software Tools for Design	-	-
1	Auto CAD		
E	Recent Developments for Research	-	-
	https://ieeexplore.ieee.org/document/7836860		
F	Others (Web, Video, Simulation, Notes etc.)	-	-
1			
?			

4. Course Prerequisites

Refer to GL01. If prerequisites are not taught earlier, GAP in curriculum needs to be addressed. Include in Remarks and implement in B.5.

Students must have learnt the following Courses / Topics with described Content ...

Mod ules	Course Code	Course Name	Topic / Description	Sem	Remarks	Blooms Level
1	17EE43	Power Generation and Economics	To understand the concepts of various methods of generation of power	4		L2

5. Content for Placement, Profession, HE and GATE

The content is not included in this course, but required to meet industry & profession requirements and help students for Placement, GATE, Higher Education, Entrepreneurship, etc. Identifying Area / Content requires experts consultation in the area.

Topics included are like, a. Advanced Topics, b. Recent Developments, c. Certificate Courses, d. Course Projects, e. New Software Tools, f. GATE Topics, g. NPTEL Videos, h. Swayam videos etc.

Mod ules	Topic / Description	Area	Remarks	Blooms Level
1	Load Forecasting Grounding Types of Transmission and Distribution Systems Testing of insulators	Advanced Topics		L3,L4

3	Characteristics of Transmission Line Methods of voltage Control	Advanced Topics		L3,L4
5	Electrical Distribution system analysis	Certificate Courses		L3,L4

B. OBE PARAMETERS

1. Course Outcomes

Expected learning outcomes of the course, which will be mapped to POs. Identify a max of 2 Concepts per Module. Write 1 CO per Concept.

Mod ules	Course Code.#	Course Outcome At the end of the course, student should be able to ...	Teach. Hours	Concept	Instr Method	Assessme nt Method	Blooms' Level
1	CO1	Understand of Protection zones for power system using relays	5	Protection system	Lecture	Assignme nt and Unit test	L2 Understand L3 Applying
1	CO2	Analysis of relay, types of relay and operation of relay	5	Characteris tics of relay	Lecture	Assignme nt and Unit test	L2 Understand ,L3 Applying, L4 Analysis
2	CO3	Analysis of Power flow in relay change in current	5	Types of fault	Lecture	Assignme nt and Unit test	L3 Applying,L4 Analysis
2	CO4	Analysis the performance of relay change in voltage	5	Parameters Relay	Lecture	Assignme nt and Unit test	L3 Applying ,L4 Analysis
3	CO5	Applying relay protection for transmission line static switches and contractors used	5	Change in parameter operation	Lecture	Assignme nt and Unit test	L3 Applying ,L4 Analysis
3	CO6	Analysis Protection for static and rotating machine combination of relays	5	Internal faults protection	Lecture	Assignme nt and Unit test	L2 Understand ing ,L3 Applying,L4 Analysis
4	CO7	Understand Circuit breaker, Performance of CB change in current and voltage	5	Characteris tics of circuit breaker	Lecture	Assignme nt and Unit test	L2 Understand ing ,L3 Applying,L4 Analysis
4	CO8	Analysis of CB, medium used for arc extinguish using liquid and gas	5	Arc quenching medium		Assignme nt and Unit test	L2 Understand ing,L3 Applying ,L4 Analysis
5	CO9	Analysis of Protection from short circuit current time-current characteristics of fuse	5	Characteris tics of fuse		Assignme nt and Unit test	L2 Understand ing,L3 Applying ,L4 Analysis L5 Evaluating
5	CO10	Analysis over voltage occurs and relays used to protect from over voltage	5	Protection against Over voltages		Assignme nt and Unit test	L2 Understand ing L3 Applying ,L4 Analysis L5 Evaluating

-	-	Total	50	-	-	-	-
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2. Course Applications

Write 1 or 2 applications per CO.

Students should be able to employ / apply the course learnings to . . .

Mod ules	Application Area Compiled from Module Applications.	CO	Level
1	Hydro power plant generating station	CO1	L2
1	Industries such as textile mill paper mill steel industry	CO2	L3
2	Nuclear Power plant Generating station	CO3	L3
2	Wind mill Power Plants	CO4	L4
3	Receiving and substation in power system	CO5	L4
3	Thermal Generating Power station	CO6	L3
4	Renewable power stations such as solar generating station	CO7	L3
4	Domestic purpose and Irrigation pump sets	CO8	L4
5	Distribution of Power system	CO9	L3
5	Bio-gas Power Plants	CO10	L4

3. Mapping And Justification

CO – PO Mapping with mapping Level along with justification for each CO-PO pair.

To attain competency required (as defined in POs) in a specified area and the knowledge & ability required to accomplish it.

Mod ules	Mapping CO	Mapping PO	Mapping Level	Justification for each CO-PO pair 'Area': 'Competency' and 'Knowledge' for specified 'Accomplishment'	Lev el
-	CO	PO	-		-
1	CO1	PO1	2.2	Knowledge on the power system	L2
1	CO1	PO2	2.2	Analyze the advantages of high voltage transmission HVAC, EHVAC, UHVAC and HVDC.	L3
1	CO2	PO1	2.2	Knowledge on the power system, overhead transmission lines, supporting structures used for overhead transmission lines.	L2
1	CO2	PO2	2.2	Analyze the different types of structures used for supporting overhead lines and types of conductors used overhead transmission and distribution. Analyzing the sag calculations when supports are at same and different level and the performance of transmission line when effected by atmospheric conditions. Analyzing different types of insulators classified based on their operating voltage levels and application.	L3
1	CO2	PO3	1.75	Design insulators for a given voltage level.	L6
2	CO3	PO1	2.2	Knowledge on transmission lines.	L2
2	CO3	PO2	2.2	Calculate and analyze the parameters of the transmission line for different configurations.	L3
2	CO4	PO1	2.2	Knowledge on transmission lines.	L2
2	CO4	PO2	2.2	Calculate and analyze the parameters of the transmission line for different configurations.	L3
3	CO5	PO1	2.2	Knowledge on transmission lines parameters.	L2
3	CO5	PO2	2.2	Analyzing the classification of overhead transmission lines and identifying the different terms related to analyze the performance of transmission line	L3
3	CO5	PO3	1.75	Develop a circuit model for short medium and long transmission lines to access the performance of lines.	L6
3	CO6	PO1	2.2	Knowledge on transmission lines parameters.	L2
3	CO6	PO2	2.2	Identifying the different terms related to analyze the performance of transmission line	L3
3	CO6	PO3	1.75	Develop a circuit model for short medium and long transmission lines to access the performance of lines.	L6
4	CO7	PO1	2.2	Knowledge on ionization.	L2

4	CO7	PO2	2.2	Analyzing the phenomenon of corona, important terms used in analysis of corona effects and advantages and disadvantages for designing transmission system.	L3
4	CO8	PO1	2.2	Knowledge on underground cables.	L2
4	CO8	PO2	2.2	Analyzing the necessary requirements for selection of cables , constructional features of underground cable construction and identifying the types of cables.	L3
5	CO9	PO1	2.2	Knowledge on the power system	L2
5	CO9	PO2	2.2	Analyzing about the main components of the distribution network and types of distribution systems.	L3
5	CO10	PO1	2.2	Knowledge on the Distribution systems	L2
5	CO10	PO2	2.2	Identifying the types of distribution systems and analyzing the power quality problems.	L3

4. Articulation Matrix

CO – PO Mapping with mapping level for each CO-PO pair, with course average attainment.

-	-	Course Outcomes	Program Outcomes															-
Mod ules	CO.#	At the end of the course student should be able to ...	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	Lev el
1	15EE72.1	Understand of Protection zones for power system using relays	X	X	X													L2
1	15EE72.2	Analysis of relay, types of relay and operation of relay		X	X													L2
2	15EE72.3	Analysis of Power flow in relay change in current	X		X		X											L2
2	15EE72.4	Analysis the performance of relay change in voltage		X	X		X											L3
3	15EE72.5	Applying relay protection for transmission line static switches and contractors used	X			X		X										L2
3	15EE72.6	Analysis Protection for static and rotating machine combination of relays					X											L2
4	15EE72.7	Understand Circuit breaker, Performance of CB change in current and voltage			X	X			X									L3
4	15EE72.8	Analysis of CB, medium used for arc extinguish using liquid and gas			X		X		X		X							L2
5	15EE72.9	Analysis of Protection from short circuit current time-current characteristics of fuse	X		X					X			X	X				L2
5	15EE72.10	Analysis over voltage occurs and relays used to protect from over voltage	X	X			X				X		X					
-	15EE81	Average attainment (1, 2, or 3)																-
-	PO, PSO	1.Engineering Knowledge; 2.Problem Analysis; 3.Design / Development of Solutions; 4.Conduct Investigations of Complex Problems; 5.Modern Tool Usage; 6.The Engineer and Society; 7.Environment and Sustainability; 8.Ethics; 9.Individual and Teamwork; 10.Communication; 11.Project Management and Finance; 12.Life-long Learning; S1.Software Engineering; S2.Data Base Management; S3.Web Design																

5. Curricular Gap and Content

Topics & contents not covered (from A.4), but essential for the course to address POs and PSOs.

Mod ules	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1					
2					

3					
4					
5					

6. Content Beyond Syllabus

Topics & contents required (from A.5) not addressed, but help students for Placement, GATE, Higher Education, Entrepreneurship, etc.

Mod ules	Gap Topic	Area	Actions Planned	Schedule Planned	Resources Person	PO Mapping

C. COURSE ASSESSMENT

1. Course Coverage

Assessment of learning outcomes for Internal and end semester evaluation. Distinct assignment for each student. 1 Assignment per chapter per student. 1 seminar per test per student.

Mod ules	Title	Teach. Hours	No. of question in Exam						CO	Levels
			CIA-1	CIA-2	CIA-3	Asg	Extra Asg	SEE		
1	Introduction to power system Overhead transmission Lines Overhead line insulators	14	2	-	-	1	1	2	CO1, CO2	L2, L2
2	Line parameters	11	2	-	-	1	1	2	CO3,CO4	L3,L3
3	Performance of transmission lines	12	-	2	-	1	1	2	CO5,CO6	L4,L4
4	Corona Underground cable	12	-	2	-	1	1	2	CO7, CO8	L2 L4
5	Distribution Reliability and Quality of Distribution system	11	-	-	4	1	1	2	CO9, CO10	L4,L2
-	Total	60	4	4	4	5	5	10	-	-

2. Continuous Internal Assessment (CIA)

Assessment of learning outcomes for Internal exams. Blooms Level in last column shall match with A.2.

Mod ules	Evaluation	Weightage in Marks	CO	Levels
1, 2	CIA Exam – 1	30	CO1, CO2, CO3, CO4	L2, L2, L3,L3
3, 4	CIA Exam – 2	30	CO5, CO6, CO7, Co8	L4,L4,L2,L4
5	CIA Exam – 3	30	CO9, CO10	L4,L2
1, 2	Assignment - 1	10	CO1, CO2, CO3, CO4	L2, L2, L3,L3
3, 4	Assignment - 2	10	CO5, CO6, CO7, Co8	L4,L4,L2,L4
5	Assignment - 3	10	CO9, CO10	L4,L2
1, 2	Seminar - 1		-	-
3, 4	Seminar - 2		-	-
5	Seminar - 3		-	-
1, 2	Quiz - 1		-	-
3, 4	Quiz - 2		-	-
5	Quiz - 3		-	-
1 - 5	Other Activities – Mini Project	-		

	Final CIA Marks	40	-	
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D1. TEACHING PLAN - 1

Module - 1

Title:	Divide and Conquer	Appr Time:	16 Hrs
a	Course Outcomes	-	Blooms Level
-	The student should be able to:	-	
1	Evaluate time and space complexity and calculate performance	CO1	L2
2	Understand searching and sorting schemes	CO2	L3
b	Course Schedule	-	-
Class No	Module Content Covered	CO	Level
1	Introduction to relay circuit breaker, Protection system faults different faults	CO1	L2
2	Zones of Protection Primary and back up protection		
3	Essential quantities of protection		
4	Performance of protective relaying		
5	Classification of Protective relay		
6	Automatic closing		
7	Current Transformers for protection		
8	Voltage transformer Protection		
9	Comparison of numerical and statical relay		
10	Nature and cause of faults		
11	Types of faults		
12	Time current characteristics of relay		
c	Application Areas	CO	Level
1	Use to Protect electrical equipments from faults	CO1	L3
2	Protection zones scheme	CO2	L4
d	Review Questions	-	-
1	State and Explain fuse Law	CO1	L1
2	Explain fuse Time-Current characteristics	CO1	L3
3	Draw and explain a line diagram of substation with use of isolating switches	CO2	L2
4	What are the essential qualities of relay	CO2	L4
5	Explain with neat diagram of primary and back up protection	CO2	L2
6	Explain with neat diagram of Protection zones	CO2	L5
7	Define Electromechanical relay and static relay	CO2	L2
8	Write merits and demerits of static and numerical relay	CO2	L3
9	Mention some difference between static and numerical relay	CO2	L4
10	What are the Protection for current and voltage transformer	CO1	L1
e	Experiences	-	-

Module – 2

Title:	Divide and Conquer	Appr Time:	10 Hrs
a	Course Outcomes	-	Blooms Level
-	The student should be able to:	-	
1	Explain the constructional and working of distance relay, differential relay	CO3	L3
2	Explain the principle of circuit interruption in different types of circuit breaker	CO4	L4

b	Course Schedule	-	-
Class No	Module Content Covered	CO	Level
17	Over current Protective schemes		
18	Reverse Power or directional relay Protection of parallel feeders		
19	Protection of ring mains earth fault and phase fault protection scheme		
20	Combined Earth Fault and Phase Fault Protective Scheme		
21	Directional earth fault relay static over-current relays		
22	Distance protection impedance relay reactance relay		
23	Mho relay angle impedance relay		
24	Effect of arc resistance on the performance of distance relay		
25	Effect of power surges on performance of distance relay		
26	Effect of line length and source impedance on performance of distance relay		
c	Application Areas	CO	Level
1	Used in Generation transmission and distribution	CO1	L3
2	Used in various industries and Domestic Purposes	CO3	L4
d	Review Questions	-	-
11	Explain with neat sketch of directional earth fault relay	CO3	L1
12	With neat sketch explain static relays	CO4	L3
13	What are the protection scheme for earth and phase fault	CO3	L2
14	With neat sketch explain Impedance relay	CO4	L4
15	Explain the construction and working of mho relay	CO4	L2
17	Explain arc resistance on the performance of distance relay	CO3	L5
		CO3	L2
		CO3	L3
e	Experiences	-	-

E1. CIA EXAM – 1

a. Model Question Paper - 1

Crs Code:	15EE72	Sem:	7	Marks:	30	Time:	75 minutes	
Course:	Power syatem Protection							
-	-	Note: Answer any 3 questions, each carry equal marks.				Marks	CO	Level
1	a	State and Explain fuse Law				20	CO1	L1
	b	Explain fuse Time-Current characteristics						L2
	c	Draw and explain a line diagram of substation with use of isolating switches					CO2	L3
	d	What are the essential qualities of relay						L1
2	a	Explain with neat diagram of primary and back up protection				20		L2
	b	Explain with neat diagram of Protection zones						L4
	c	Define Electromechanical relay and static relay						L3
	d	Write merits and demerits of static and numerical relay						L2
3	a	Write merits and demerits of static and numerical relay				20	CO3	L1
	b	Mention some difference between static and numerical relay					CO4	L2
	c	What are the Protection for current and voltage transformer						L1
	d	Explain with neat sketch of directional earth fault relay						L2
4	a	What are the protection scheme for earth and phase fault				20		L2
	b	With neat sketch explain Impedance relay						L2
	c	Explain arc resistance on the performance of distance relay						L1

b. Assignment -1

Note: A distinct assignment to be assigned to each student.

Model Assignment Questions					
Crs Code:	15ee72	Sem:	7	Marks:	5 / 10
Time:	90 – 120 minutes				
Course:	Power system protection				
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.					
SNo	USN	Assignment Description	Marks	CO	Level
1	1KT15EE001	State and Explain fuse Law	5	CO1	L2
2	1KT15EE002	Explain fuse Time-Current characteristics	5	CO2	L3
3	1KT15EE003	Draw and explain a line diagram of substation with use of isolating switches		CO2	L4
4	1KT15EE004	What are the essential qualities of relay	5	CO1	L3
5	1KT15EE005	Explain with neat diagram of primary and back up protection			
6	1KT15EE006	Explain with neat diagram of Protection zones			
7	1KT15EE007	Define Electromechanical relay and static relay			
8	1KT15EE008	Write merits and demerits of static and numerical relay			
9	1KT15EE009	Mention some difference between static and numerical relay			
10	1KT15EE010	What are the Protection for current and voltage transformer			
11	1KT15EE011	Over current Protective schemes			
12	1KT15EE012	Reverse Power or directional relay Protection of parallel feeders			
13	1KT16EE400	Protection of ring mains earth fault and phase fault protection scheme			
14	1KT16EE401	Combined Earth Fault and Phase Fault Protective Scheme			
15	1KT15EE001	Directional earth fault relay static over-current relays			
16	1KT15EE002	Distance protection impedance relay reactance relay			
17	1KT15EE003	Mho relay angle impedance relay			
18	1KT15EE004	Effect of arc resistance on the performance of distance relay			
19	1KT15EE005	Effect of power surges on performance of distance relay			
20	1KT15EE006	Effect of line length and source impedance on performance of distance relay			
21	1KT15EE007	Explain with neat sketch of directional earth fault relay			
22	1KT15EE008	With neat sketch explain static relays			

D2. TEACHING PLAN - 2**Module – 3**

Title:	Divide and Conquer	Appr Time:	16 Hrs
a	Course Outcomes	-	Blooms Level
-	The student should be able to:	-	
1	Evaluate Relay and its performance	CO5	L2
2	Understand searching and sorting schemes	CO6	L3
b	Course Schedule		
Class No	Module Content Covered	CO	Level
1	Introduction Differential Relays,	C6	
2	Wire Pilot Protection,		
3	Carrier Current Protection Differential Protection:		
4	Simple Differential Protection, Percentage or Biased Differential Relay		
5	Differential Protection of 3 Phase Circuits	C5	
6	Balanced (Opposed) Voltage Differential Protection.		
7	Introduction, Protection of Generators.		
8	Transformer and Bus-zone Protection.		
9	Frame Leakage Protection		
c	Application Areas	CO	Level

1	Used in industries and generating stations	CO1	L3
2	Used in Power System	CO2	L4
d	Review Questions	-	-
1	Explain Wire pilot protection	CO1	L1
2	Explain Carrier current protection	CO1	L3
3	With neat sketch explain Biased differential relay	CO2	L2
4	Explain differential protection of 3 phase circuits	CO2	L4
5	With neat sketch Balanced voltage differential relay	CO2	L2
6	Explain Buchzz relay for transformer protection	CO2	L5
7	What are the different protection for generator explain	CO2	L2
8	Explain bus zone Protection with neat sketch	CO2	L3
9	Explain frame leakage Protection with neat sketch	CO2	L4
e	Experiences	-	-

Module – 4

Title:	Divide and Conquer	Appr Time:	16 Hrs
a	Course Outcomes	-	Blooms Level
-	The student should be able to:	-	
1	Know the different Protection for generator and transformer	CO7	L2
2	Understand the differential relay for 3 phase protection	CO8	L3
b	Course Schedule		
Class No	Module Content Covered	CO	Level
1	Introduction of circuit breakers		
2	Fault Clearing Time of a Circuit Breaker		
3	Arc Voltage		
4	Arc Interruption		
5	Restriking Voltage and Recovery Voltage		
6	Current Chopping		
7	Interruption of Capacitive Current		
8	Classification of Circuit Breakers		
9	Air – Break Circuit Breakers Air–Blast Circuit Breakers		
10	Oil Circuit Breakers		
11	SF 6 Circuit Breakers		
12	Binary Search		
13	High Voltage Direct Current Circuit Breakers		
14	Rating of Circuit Breakers		
15	Vacuum Circuit Breakers		
16	Testing of Circuit Breakers		
c	Application Areas	CO	Level
1	Used in Power system	CO8	L3
2	Used in industries and domestic applications	CO7	L4
d	Review Questions	-	-
1	How interruption of capacitive currents takes place in AC circuit breaker? Explain	CO7	L1
2	With a neat sketch Explain the construction and working of air break circuit breaker	CO7	L3
3	Describe working Principle of SF6 circuit breaker with the help of a neat sketch. Mention the advantages over other type of circuit breaker	CO8	L2
4	Explain the construction and working of a vacuum circuit breaker	CO7	L4
5	Describe i) Unit testing ii) Synthetic testing of circuit breaker	CO8	L2
6	Explain current chopping phenomenon in circuit breaker	CO8	L5

7	Explain various properties of SF6 gas		L2
8	Explain the following tests performed on CB i) substitution test ii) Compensation test iii) Capacitance test		L3
9	Explain the phenomenon of arc and how it is maintained in the CB		L4
10	Explain the arc interruption theories of AC Circuit breaker		L1
11	With a neat diagram explain cross blast and axial blast circuit breaker		L4
12	Explain with a neat diagram the construction and working of minimum oil circuit breaker		
e	Experiences	-	-

E2. CIA EXAM – 2

a. Model Question Paper - 2

Crs Code:	15EE72	Sem:	7	Marks:	30	Time:	75 minutes	
Course:	Power system protection							
-	-	Note: Answer any 2 questions, each carry equal marks.				Marks	CO	Level
1	a	Explain Wire pilot protection			20	CO5	L1	
	b	Explain Carrier current protection					L2	
	c	With neat sketch explain Biased differential relay				CO6	L3	
	d	Explain differential protection of 3 phase circuits					L1	
2	a	With neat sketch Balanced voltage differential relay			20	CO7	L2	
	b	Explain Buchzz relay for transformer protection					L4	
	c	What are the different protection for generator explain					L3	
	d	Explain bus zone Protection with neat sketch					L2	
3	a	How interruption of capacitive currents takes place in AC circuit breaker? Explain			20	CO8	L1	
	b	With a neat sketch Explain the construction and working of air break circuit breaker				CO8	L2	
	c	Describe working Principle of SF6 circuit breaker with the help of a neat sketch. Mention the advantages over other type of circuit breaker					L1	
	d	Explain the construction and working of a vacuum circuit breaker					L2	
4	a	Explain current chopping phenomenon in circuit breaker			20		L2	
	b	Explain various properties of SF6 gas					L2	
	c	Explain the following tests performed on CB i) substitution test ii) Compensation test iii) Capacitance test					L1	
	d	Explain the phenomenon of arc and how it is maintained in the CB					L3	

b. Assignment – 2

Note: A distinct assignment to be assigned to each student.

Model Assignment Questions							
Crs Code:	15EE72	Sem:	7	Marks:	5 / 10	Time:	90 – 120 minutes
Course:	Power system protection						
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.							
SNo	USN	Assignment Description			Marks	CO	Level
1	1KT15EE001	Explain current chopping phenomenon in circuit breaker			5	CO8	L2
2	1KT15EE002	Explain various properties of SF6 gas			5	CO9	L3
3	1KT15EE003	Explain the following tests performed on CB i) substitution test ii) Compensation test iii) Capacitance test				CO10	L4
4	1KT15EE004	Explain the phenomenon of arc and how it is maintained in the CB			5	CO9	L3
5	1KT15EE005	Explain Wire pilot protection					
6	1KT15EE006	Explain Carrier current protection					
7	1KT15EE007	With neat sketch explain Biased differential relay					

8	1KT15EE008	Explain differential protection of 3 phase circuits			
9	1KT15EE009	With neat sketch Balanced voltage differential relay			
10	1KT15EE010	Explain Buchzz relay for transformer protection			
11	1KT15EE011	How interruption of capacitive currents takes place in AC circuit breaker? Explain			
12	1KT15EE012	With a neat sketch Explain the construction and working of air break circuit breaker			
13	1KT16EE400	Describe working Principle of SF6 circuit breaker with the help of a neat sketch. Mention the advantages over other type of circuit breaker			
14	1KT16EE401	Explain the construction and working of a vacuum circuit breaker			
15	1KT15EE001	With neat sketch Balanced voltage differential relay			
16	1KT15EE002	Explain Buchzz relay for transformer protection			
17	1KT15EE003	What are the different protection for generator explain			
18	1KT15EE004	Explain bus zone Protection with neat sketch			
19	1KT15EE005	Explain frame leakage Protection with neat sketch			

D3. TEACHING PLAN - 3

Module – 5

Title:	Divide and Conquer	Appr Time:	16 Hrs
a	Course Outcomes	-	Blooms Level
-	The student should be able to:	-	
1	Understand the fuse and its characteristics	Og	L2
2	Understand the phenomena of lighting and over voltage occurs	CO10	L3
b	Course Schedule		
Class No	Module Content Covered	CO	Level
1	Introductions		L3
2	Definitions, Fuse Characteristics		L3
3	Types of Fuses, Applications of HRC Fuses		L4
4	Selection of Fuses		L3
5	Causes of Over voltages		L5
6	Lightning phenomena		L4
7	Wave Shape of Voltage due to Lightning		L4
8	Over Voltage due to Lightning, Klydonograph and Magnetic Link		L3
9	Protection of Transmission Lines against Direct Lightning Strokes		L4
10	Protection against Traveling Waves		L3
11	Insulation Coordination,		L4
12	Basic Impulse Insulation Level		L5
c	Application Areas	CO	Level
1	Use to protect from high voltages	CO10	L3
2	Used in power system to protect equipments from high voltages	CO9	L4
d	Review Questions	-	-
1	What is fuse	CO10	L1
2	What are different types of fuse	CO10	L3
3	Explain the construction and working of HRC fuse	CO9	L2
4	What are the causes of over voltages.	CO9	L4
5	Explain lighting phenomena		L2
6	Explain Protection of transmission lines against direct lighting strokes		L5
7	Explain protection of stations and sub station from direct strokes		L2
8	Mention some basic impulse insulation level		L3
9	Explain the protection against traveling waves		L4

e	Experiences	-	-
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E3. CIA EXAM – 3

a. Model Question Paper - 3

Crs Code:	15EE72	Sem:	7	Marks:	30	Time:	75 minutes	
Course:	Power system protection							
-	-	Note: Answer any 2 questions, each carry equal marks.				Marks	CO	Level
1	a	With neat sketch Balanced voltage differential relay				20	CO9	L1
	b	Explain Buchzz relay for transformer protection						L2
	c	What are the different protection for generator explain					CO9	L3
	d	Explain bus zone Protection with neat sketch						L1
		Explain frame leakage Protection with neat sketch						
2	a	What is fuse				20	CO10	L2
	b	What are different types of fuse						L4
	c	Explain the construction and working of HRC fuse						L3
	d	What are the causes of over voltages.						L2
3	a	Explain lighting phenomena				20	CO10	L1
	b	Explain Protection of transmission lines against direct lighting strokes					CO10	L2
	c	Explain protection of stations and sub station from direct strokes						L1
	d	Mention some basic impulse insulation level						L2
4	a	Explain Buchzz relay for transformer protection				20		L2
	b	How interruption of capacitive currents takes place in AC circuit breaker? Explain						L2
	c	With a neat sketch Explain the construction and working of air break circuit breaker						L1
	d	Describe working Principle of SF6 circuit breaker with the help of a neat sketch. Mention the advantages over other type of circuit breaker						L3

b. Assignment – 3

Note: A distinct assignment to be assigned to each student.

Note: 9 distinct assignments are to be assigned to each student.

Model Assignment Questions							
Crs Code:	15EE72	Sem:	7	Marks:	5 / 10	Time:	90 – 120 minutes
Course:	Power system protection						
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.							
SNo	USN	Assignment Description			Marks	CO	Level
1	1KT15EE001	What is fuse			5	CO9	L2
2	1KT15EE002	What are different types of fuse			5	CO9	L3
3	1KT15EE003	Explain the construction and working of HRC fuse				CO10	L4
4	1KT15EE004	What are the causes of over voltages.			5	CO10	L3
5	1KT15EE005	Explain lighting phenomena					
6	1KT15EE006	Explain Protection of transmission lines against direct lighting strokes					
7	1KT15EE007	Explain protection of stations and sub station from direct strokes					
8	1KT15EE008	Mention some basic impulse insulation level					
9	1KT15EE009	Explain the protection against traveling waves					

F. EXAM PREPARATION

1. University Model Question Paper

Course:	Power system protection					Month / Year	May /2018		
Crs Code:	15EE72	Sem:	7	Marks:	100	Time:	180 minutes		
-	Note	Answer all FIVE full questions. All questions carry equal marks.					Marks	CO	Level

1	a	Draw and explain a line diagram of substation with use of isolating switches	16 / 20	CO1	
	b	What are the essential qualities of relay			
	c	Explain with neat diagram of primary and back up protection		CO2	
	d	Explain with neat diagram of Protection zones			
		OR			
-	a	Define Electromechanical relay and static relay	16 / 20	CO1	
	b	Write merits and demerits of static and numerical relay		CO2	
	c	Mention some difference between static and numerical relay			
	d	What are the Protection for current and voltage transformer			
2	a	What are the essential qualities of relay	16 / 20	CO3	
	b	Explain with neat diagram of primary and back up protection			
	c	Explain with neat diagram of Protection zones		CO4	
	d	Define Electromechanical relay and static relay			
		OR			
-	a	What are the Protection for current and voltage transformer	16 / 20	CO3	
	b	Over current Protective schemes		CO4	
	c	Reverse Power or directional relay Protection of parallel feeders			
	d	Protection of ring mains earth fault and phase fault protection scheme			
3	a	Explain Wire pilot protection	16 / 20	CO5	
	b	Explain Carrier current protection			
	c	With neat sketch explain Biased differential relay		CO6	
	d	Explain differential protection of 3 phase circuits			
-	a	With neat sketch Balanced voltage differential relay	16 / 20	CO5	
	b	Explain Buchzz relay for transformer protection			
	c	What are the different protection for generator explain		CO6	
	d	Explain bus zone Protection with neat sketch			
4	a	How interruption of capacitive currents takes place in AC circuit breaker? Explain	16 / 20	CO7	
	b	With a neat sketch Explain the construction and working of air break circuit breaker			
	c	Describe working Principle of SF6 circuit breaker with the help of a neat sketch. Mention the advantages over other type of circuit breaker		CO8	
	d	Explain the construction and working of a vacuum circuit breaker			
		OR			
-	a	Explain the following tests performed on CB i) substitution test ii) Compensation test iii) Capacitance test	16 / 20	CO7	
	b	Explain the phenomenon of arc and how it is maintained in the CB		CO8	
	c	Explain the arc interruption theories of AC Circuit breaker			
	d	With a neat diagram explain cross blast and axial blast circuit breaker			
		Explain the following tests performed on CB i) substitution test ii) Compensation test iii) Capacitance test			
5	a	Explain the phenomenon of arc and how it is maintained in the CB	16 / 20	CO9	
	b	Explain the arc interruption theories of AC Circuit breaker		CO10	
	c	With a neat diagram explain cross blast and axial blast circuit breaker			
	d	Explain the following tests performed on CB i) substitution test ii) Compensation test iii) Capacitance test			
		OR			
	a	Explain lighting phenomena.	16 /	CO9	

			20		
	b	What are the causes of over voltages.			
	c	What are different types of fuse		C010	
	d	Explain the construction and working of HRC fuse			

2. SEE Important Questions

Course:	Power system protection				Month / Year	May / 2018	
Crs Code:	15EE72	Sem:	7	Marks:	80	Time:	180 minutes
	Note	Answer all FIVE full questions. All questions carry equal marks.				-	-
Module	Qno.	Important Question	Marks	CO	Year		
1	1	Draw and explain a line diagram of substation with use of isolating switches	16 / 20		2004		
	2	What are the essential qualities of relay			2004		
	3	Explain with neat diagram of primary and back up protection			2004		
	4	Explain with neat diagram of Protection zones			2007		
	5	Define Electromechanical relay and static relay			2007		
2	1	What are the essential qualities of relay	16 / 20		2005		
	2	Explain with neat diagram of primary and back up protection			2005		
	3	Explain with neat diagram of Protection zones			2009		
	4	Define Electromechanical relay and static relay			2006		
	5	Protection of ring mains earth fault and phase fault protection scheme			2004		
3	1	Explain Wire pilot protection	16 / 20		2006		
	2	Explain Carrier current protection			2006		
	3	With neat sketch explain Biased differential relay			2007		
	4	Explain differential protection of 3 phase circuits			2004		
	5	With neat sketch Balanced voltage differential relay			2004		
4	1	How interruption of capacitive currents takes place in AC circuit breaker? Explain	16 / 20		2004		
	2	With a neat sketch Explain the construction and working of air break circuit breaker			2004		
	3	Describe working Principle of SF6 circuit breaker with the help of a neat sketch. Mention the advantages over other type of circuit breaker			2006		
	4	Explain the construction and working of a vacuum circuit breaker			2004		
	5	Explain the following tests performed on CB i) substitution test ii) Compensation test iii) Capacitance test			2007		
5	1	What are different types of fuse	16 / 20		2009		
	2	Explain the construction and working of HRC fuse			2007		
	3	What are the causes of over voltages.			2007		
	4	Explain lighting phenomena			2004		
	5	Explain Protection of transmission lines against direct lighting strokes			2005		