

<b>Institute / College Name :</b>		Darbhanga College Of Engineering, Darbhanga	
<b>Program Name</b>		B.Tech., Electrical And Electronics Engineering	
<b>Course Code</b>		03 1713	
<b>Course Name</b>		PROTECTION OF POWER APPARATUS & SYSTEM	
<b>Lecture / Tutorial (per week):</b>	3/0	<b>Course Credits</b>	3
<b>Course Coordinator Name</b>		Ms. SWETA KUMARI	

### 1. Scope and Objectives of the Course

Power system protection is an integral part of every power system. All power equipment including power generators, step-up transformers, step-down transformers, transmission lines, power capacitors and electric motors and other loads etc need protection. The necessity for protection is incurred by all kinds of contingencies such as equipment failure due to insulation deterioration, lightning strike, short-circuit by nature force or creature-made happenings, inappropriate operation of power system and other inadvertent incidences. Some power equipment is very expensive such as MW generators which could cost millions of dollars. Furthermore outage due to failure of power system causes severe damage to economy and inconvenience to people's daily life. A properly designed protection can ensure power supply cut to minimum users yet continue supply power to other end users in case that a fault occurs in the system. It is a sophisticated art which needs a systematic study in order to master. All these call for a new module for undergraduate students to learn in the field of power system protection.

The course is aimed at students who have been introduced with fundamental knowledge of power system.

The objectives of this course are :

- To understand the need of protection of electric equipment and their protection schemes.
- Introduce students to power system protection and switchgear.
- To understand operations & characteristics of various electromagnetic and static relays.
- To understand the operations of various types of circuit breakers and their ratings.
- To understand the unit protection and over voltage protection of different apparatus in power system.
- Develop in students an ability and skill to design the feasible protection systems needed for each main part of a power system.

### **Course Outcomes:**

After the completion of this course the students will be able to:

- Understand the working of different types of switchgear equipments like circuit breakers and relays.
- Design the ratings for fuses according to the requirement
- Application of various protection schemes of various power system components like alternators, transformers and bus-bars.

- Decision for various methods of protection in power systems.

## 2. Textbooks

TB1. Power System Protection & switch Gear by B.Ram & D.N Vishwakarma, TMH  
TB2. Power System Protection and switch gear by R & C

## 3. Reference Books

RB1. Art & science Protection Relaying by Moson  
RB2. Switch gear and Protection by Sunil S.Rao, Khanna Publication

## Other readings and relevant websites

S.No.	Link of Journals, Magazines, websites and Research Papers
1.	<a href="https://www.youtube.com/watch?v=hheFiTk6dMk">https://www.youtube.com/watch?v=hheFiTk6dMk</a>
2.	<a href="https://www.youtube.com/watch?v=zCiPIEBolsI">https://www.youtube.com/watch?v=zCiPIEBolsI</a>
3.	<a href="https://ieeexplore.ieee.org/document/8410154/">https://ieeexplore.ieee.org/document/8410154/</a>
4.	<a href="http://www.delnet.in">www.delnet.in</a>
5.	<a href="https://www.scribd.com/document/331381692/Switchgear-and-Protection-By-Sunil-S-Rao-pdf">https://www.scribd.com/document/331381692/Switchgear-and-Protection-By-Sunil-S-Rao-pdf</a>
6.	<a href="https://scholar.google.co.in/scholar?q=sciencedirect+journal+power+system+protection&amp;hl=en&amp;as_sdt=0&amp;as_vis=1&amp;oi=scholar">https://scholar.google.co.in/scholar?q=sciencedirect+journal+power+system+protection&amp;hl=en&amp;as_sdt=0&amp;as_vis=1&amp;oi=scholar</a>

## 4. Course Plan

Lecture Number	Date of Lecture	Topics	Web Links for video lectures	Text Book / Reference Book / Other reading material	Page numbers of Text Book(s)
		<b>Name And Cause of Faults.</b>			
1-2		Introduction To Protection, Need of Protection, Nature, Causes And Consequences of Faults, Types of Faults.	<a href="https://slideplayer.com/slide/9298404/">https://slideplayer.com/slide/9298404/</a>	TB1	1-5
		<b>Schemes Of Protection</b>			
3-4		Fault Statistics, Zone of Protection, Qualities of Protection, Various Protective Schemes.	<a href="https://slideplayer.com/slide/7248051/">https://slideplayer.com/slide/7248051/</a>	TB1	5-15
<b>Assignment I</b>					
1. Describe the need of protective scheme.					

2. Explain the nature and cause of faults. Discuss the consequences of fault on a power system.					
		<b>Protective relays</b>			
5-10		Construction And Operating Principle of – Over Current Relays(Time-Current Characteristics, Current Setting, Time Setting), Directional Relays, Distance Relays(Impedance, Reactance, MHO), Differential Relays(Transformer, Generator And Bus Bar).	<a href="https://www.powershow.com/viewfl/7c014-ZDc1Z/Protection_and_Relay_Schemes_powerpoint_ppt_presentation">https://www.powershow.com/viewfl/7c014-ZDc1Z/Protection_and_Relay_Schemes_powerpoint_ppt_presentation</a>  <a href="https://www.powershow.com/viewfl/7c014-ZDc1Z/Protection_and_Relay_Schemes_powerpoint_ppt_presentation">https://www.powershow.com/viewfl/7c014-ZDc1Z/Protection_and_Relay_Schemes_powerpoint_ppt_presentation</a>  <a href="https://slideplayer.com/slide/8473935/">https://slideplayer.com/slide/8473935/</a>  <a href="https://www.youtube.com/watch?v=S3vuNgus4uM">https://www.youtube.com/watch?v=S3vuNgus4uM</a>	TB1	36-67 68-82 94-110
		<b>Protection Of Feeders</b>			
11-15		Current Protection And Distance Protection	<a href="https://slideplayer.com/slide/4467430/">https://slideplayer.com/slide/4467430/</a>	TB1	82-92
<b>Assignment II</b>					
<ol style="list-style-type: none"> <li>1. Explain the operation of electro-mechanical reactance relay of electro-mechanical reactance relay with proper diagram and supporting equations.</li> <li>2. In what way is distance protection superior to over-current protection of transmission lines?</li> </ol>					
		<b>Protection of Transformer And Generator.</b>			
16-19		Generator Protection : Stator, Rotor And Miscellaneous Transformer Protection : External And Internal , Percentage Differential Protection	<a href="https://www.youtube.com/watch?v=J5ITZAnGFXw">https://www.youtube.com/watch?v=J5ITZAnGFXw</a>  <a href="https://www.youtube.com/watch?v=ZQgRzATOn6k">https://www.youtube.com/watch?v=ZQgRzATOn6k</a>	TB1	179-202
<b>Assignment III</b>					
<ol style="list-style-type: none"> <li>1. What is Buchholz relay? Which equipment is protected by it? For what types of faults is it employed? Discuss its working principle.</li> <li>2. With a neat sketch, discuss the differential scheme for bus-zone protection.</li> </ol>					

		<b>Mechanism of Arc Interruption</b>			
20-24		Restriction Voltage ,Recovery Voltage, RRRV, Factors Affecting The Performance of Circuit Breaker, Current Chopping.		TB1	346-358
<b>Mid semester exam (1- 24 lecture)</b>					
		<b>Circuit breaker</b>			
25-31		Construction And Operating Principle of Air Blast,Oil,SF6 And Vacuum Circuit Breaker.	<a href="https://www.youtube.com/watch?v=_0T2Osgxdxs">https://www.youtube.com/watch?v=_0T2Osgxdxs</a>  <a href="https://www.youtube.com/watch?v=zCiPIEBolsI">https://www.youtube.com/watch?v=zCiPIEBolsI</a>	TB1	358-384
<b>Assignment IV</b>					
1. Explain the phenomenon of current chopping in a circuit breaker. What measures are taken to reduce it?					
		<b>Protection Against Over Voltage</b>			
32-36		Cause of Over Voltage , Lightning Phenomenon, Lightning Arrestors, Surge Absorber , Insulation Co-Ordination.	<a href="https://slideplayer.com/slide/6291981/">https://slideplayer.com/slide/6291981/</a>  <a href="https://slideplayer.com/slide/4499927/">https://slideplayer.com/slide/4499927/</a>	TB1	402- 431
		<b>Grounding</b>			
37-40		Advantage, Solid, Resistance And Reactance Grounding, Peterson Coil.	<a href="http://nptel.ac.in/courses/108108034/19">http://nptel.ac.in/courses/108108034/19</a>	TB1	

\*All classes have home work with multiple choice questions.

1. **Evaluation Scheme:**

Component 1	Mid Semester Exam	20
Component 2	Assignment Evaluation/Attendance/ Class Test	10
Component 3**	End Term Examination**	70
	<b>Total</b>	<b>100</b>

\*\* The End Term Comprehensive examination will be held at the end of semester. The mandatory requirement of 75% attendance in all theory classes is to be met for being eligible to appear in this component.

**SYLLABUS**

Topics	No of lectures	Weightage
Name and cause of faults	2	5%
Schemes of protection	2	5%
Protective relays	6	20%
Protection of feeders	5	10%
Protection of transformer and generator	4	15%
Mechanism of are interruption	5	9%
Circuit breaker	7	20%
Protection against over voltage	5	9%
Grounding	4	7%

**Evaluation and Examination Blue Print:**

Internal assessment is done through quiz tests, presentations, assignments and project work. Evaluation is a very transparent process and the answer sheets of sessional tests, internal assessment assignments are returned back to the students.

The components of evaluations along with their weightage followed by the University is given below

Mid sem	20%
Assignments/Quiz Tests/Seminars	10%
End term examination	70%

**This Document is approved by:**

Designation	Name	Signature
Course Coordinator	Ms. Sweta Kumari	
H.O.D	Mr. Santosh Kumar Gupta	
Principal	Dr. A. K. Rai	
Date	18-07-2018	