

Name of Institute: Indus Institute of Technology & Engineering
Name of Faculty: Virendra Pandya

Course code: EL0602
Course name: Switchgear and protection

Pre-requisites:
Basics of Electrical Engineering, Power System
Credit points: 05
Offered Semester: VI

Course Coordinator

Full Name: Dr. Sweta Shah
Department with siting location: Electrical Engineering Department, 3rd floor
Bhawar Building.Staff room
Telephone: 9979884434
Email: swetashah.el@ indusuni.ac.in
Consultation times: Wednesday:2:25-4:15.

Course Lecturer

Full Name: Dr. Sweta Shah
Department with siting location: Electrical Engineering Department, 3rd floor
Bhawar Building.Staff room
Telephone: 9979884434
Email: swetashah.el@ indusuni.ac.in
Consultation times: Wednesday:2:25-4:15.

Students will be contacted throughout the Session via Mail with important information relating to this Course.

Course Objectives

By participating in and understanding all facets of this Course a student will:

- 1) Be able to develop understanding for basic arc interruption theory.
- 2) Be able to understand arc extinguishing process in various types of CB
- 3) Understand applications of various CB and their comparison.
- 4) Be able to provide the understanding of basic requirements of protection systems.
- 5) Understand the construction and working of various types of relays

Course Outcomes (CO)

- CO 1: Students will be able to understand the physics of arc interruption and will be able to know the concept of various CB mechanisms and operating principles
- CO 2: Students will be able to apply comparative study for selection of CB
- CO 3: The student can understand the necessity of requirements of Power system Protection and importance of relay selection and factors affecting it.
- CO 4: Student will be able to apply relay coordination of interconnected system and testing of relays.
- CO 5: Students will be able to discriminate between healthy and faulty conditions of apparatus and implementation of practical schemes and associated calculations
- CO 6: Students will be able to analyze the fault behavior with different grounding methods

Course Outline

This course mainly deals with different types of Power system protection against different types of faults. It covers how the reactive behavior is achieved with different construction of the protective relay and how to protect various power system components like transmission lines, transformers, motors, generators and distribution networks.

Method of delivery

Face to face lectures

Study time

4 Hour Lecture and 2 Hour practical per week

CO-PO Mapping (PO: Program Outcomes)

Mapping CO's with PO's

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO 1	3	2	2	1	1	1	1	-	1	1	-	2
CO	3	2	2	1	1	1	1	-	1	1	-	2

2												
CO 3	3	3	3	2	2	1	1	1	1	1	1	2
CO 4	3	3	3	3	2	1	1	2	2	1	1	2
CO 5	3	2	2	1	1	1	1	-	1	1	-	2
CO 6	3	3	3	2	2	1	1	1	1	1	1	2

1-Lightly Mapped 2- Moderately Mapped 3- Highly Mapped

Blooms Taxonomy and Knowledge retention (For reference)
 (Blooms taxonomy has been given for reference)

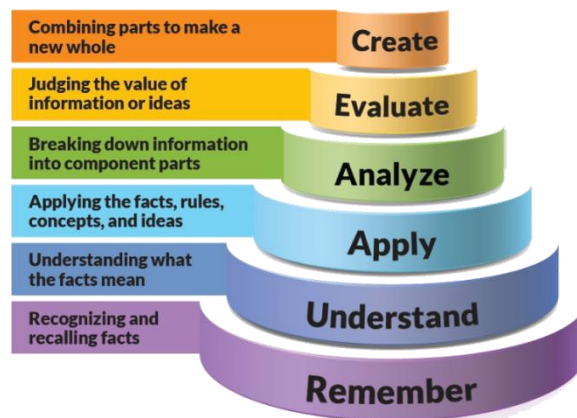


Figure 1: Blooms Taxonomy

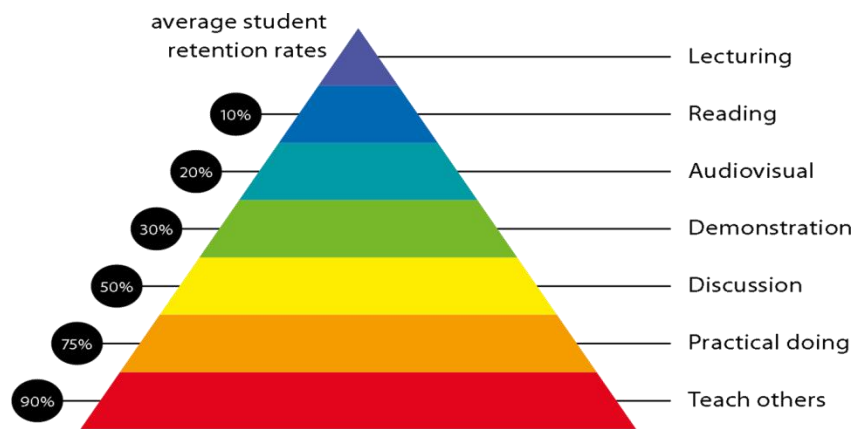


Figure 2: Knowledge retention

Graduate Qualities and Capabilities covered
 (Qualities graduates harness crediting this Course)

General Graduate Qualities	Specific Department of Graduate Capabilities
Informed Have a sound knowledge of an area of study or profession and understand its current issues, locally and internationally. Know how to apply this knowledge. Understand how an area of study has developed and how it relates to other areas.	1 Professional knowledge, grounding & awareness
Independent learners Engage with new ideas and ways of thinking and critically analyze issues. Seek to extend knowledge through ongoing research, enquiry and reflection. Find and evaluate information, using a variety of sources and technologies. Acknowledge the work and ideas of others.	2 Information literacy, gathering & processing
Problem solvers Take on challenges and opportunities. Apply creative, logical and critical thinking skills to respond effectively. Make and implement decisions. Be flexible, thorough, innovative and aim for high standards.	4 Problem solving skills
Effective communicators Articulate ideas and convey them effectively using a range of media. Work collaboratively and engage with people in different settings. Recognize how culture can shape communication.	5 Written communication
	6 Oral communication
	7 Teamwork
Responsible Understand how decisions can affect others and make ethically informed choices. Appreciate and respect diversity. Act with integrity as part of local, national, global and professional communities.	10 Sustainability, societal & environmental impact

Practical work:

(Mention what practical work this Course involves)

Lecture/tutorial times

(Give lecture times in the format below)

Lecture: Monday:11:00-11:55
 Tuesday:11:55-12:50
 Thursday:11:00-11:55
 Lab
 Tuesday:9:00-10:50
 Friday: 1:30-3:20

Attendance Requirements

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the Course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for mid and end semester examinations.

Details of referencing system to be used in written work

Text books

1. Power System Protection and Switchgear-Oza, Nair, Mehta, Makwana/TMH/2010.
2. Power System Protection and Switchgear , Badri Ram &Vishvakarma, TMH
3. Protective Relays – Theory & Practice Vol I, II, A R Van C Warington, Chapman & Hall.
4. Principles of Power Systems V.K Mehta-S Chand

Additional Materials

5. JNP switchgear Handbook, R.T. Lythall,Newnes Butterworth
6. Switchgear and protection, J.B. Gupta, S. K. Kataria
7. Digital Protection, L. P. Singh, Willey Eastern

ASSESSMENT GUIDELINES

Your final course mark will be calculated from the following:

Sv	Example:	
	Class Test	20%
	Quiz	10%
	Assignment	20%
	Class Participation	10%
	Final exam (<i>closed book</i>)	40%

SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in mid semester or end semester will be considered for supplementary assessment in the respective components (i.e mid semester or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (mid semester or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

Practical Work Report/Laboratory Report:

A report on the practical work is due the subsequent week after completion of the class by each group.

Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of -% of the maximum mark per calendar day

Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. **Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.**

Retention of Written Work

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

University and Faculty Policies

Students should make themselves aware of the University and/or Faculty Policies regarding plagiarism, special consideration, supplementary examinations and other educational issues and student matters.

Plagiarism - Plagiarism is not acceptable and may result in the imposition of severe penalties. Plagiarism is the use of another person's work, or idea, as if it is his or her own - if you have any doubts at all on what constitutes plagiarism, please consult your Course coordinator or lecturer. Plagiarism will be penalized severely.

Do not copy the work of other students.

Do not share your work with other students (except where required for a group activity or assessment)

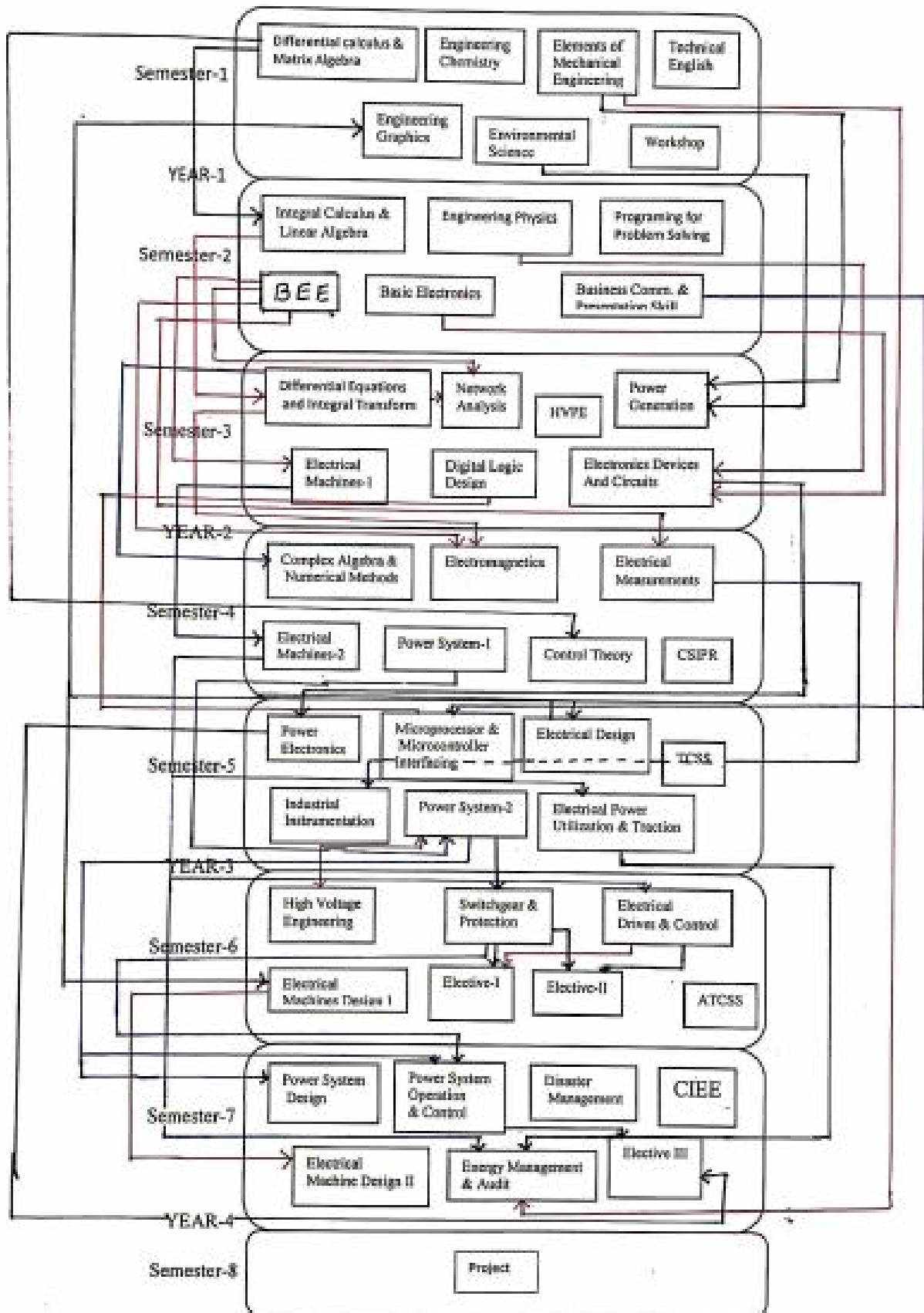
Course schedule (subject to change)

(Mention quiz, assignment submission, breaks etc as well in the table under the Teaching Learning Activity Column)

Week #	Topic & contents	CO Addressed	Teaching Learning Activity (TLA)
Weeks 1	Elementary principles of arc interruption, Recovery, Restriking Voltage and Recovery voltages, Restriking Phenomenon. RRRV,	CO1	Chalk & Talk
Weeks 2	Current Chopping and Resistance Switching, Circuit Breaker ratings and Specifications, Fuse material, HRC fuse, liquid fuse, Application of fuse.,	CO1	Chalk & Talk
Week 3	Description and Operation of: Air Break Circuit Breaker, Air Blast Circuit breakers, Interruption methods, Description and Operation of: Bulk oil circuit breaker, single and multi-break construction, Description and Operation of: Minimum oil circuit breaker, Voltage distribution in oil circuit breakers with arc control devices,	CO1,	Chalk & Talk
Week 4	Fault statistic, basic protection scheme, Zones of protection, basic terminology. Basic requirements, Types of protection schemes,	CO1, CO2	Chalk & Talk
Week 5	Relay Classification, Construction & Operations of Electromagnetic Relays, Construction & Operations of Electromagnetic Relays,-2	CO1, CO2, CO3	Chalk & Talk

Week 6	Construction & Operations of Static Relays Construction & Operations of Microprocessor based Relays.	CO5	Chalk & Talk
Week 7	Basic line protections, methods of discrimination, Rules for relay settings, problems in overcurrent relays, Directional overcurrent and earth fault protection schemes, Problems in directional protection,	CO3, CO4, CO5	Chalk & Talk
Week 8	Distance protection, problems in distance measurement, Pilot wire protection scheme, carrier current protections	CO3,CO4,CO5	Chalk & Talk
Week 9	Protection of transformers, Buchholtz relay Protection. Percentage Differential Protection,	CO5, CO6	Chalk & Talk
Week 10	Numerical Problem on Design of CT s Ratio, Protection of generators against Stator faults, Rotor faults, and Abnormal Conditions.	CO5, CO6	Chalk & Talk
Week 11	Restricted Earth fault and Inter-turn fault Protection. Bus-zone protection-requirements, Non-unit protection, unit protections-frame earth protection breaker back up protection	CO1, CO2, CO5, CO6	Chalk & Talk
Week 12	Various differential protections, (High and Low impedance) Induction Motor Protection, ,	CO5, CO6	Chalk & Talk
Week 13	Grounded and Ungrounded Neutral Systems, Effects of Ungrounded Neutral on system performance. Arcing Grounds and Grounding Practices.	CO1, CO2, CO5, CO6	Chalk & Talk

	Week 14	Installation and commissioning tests, Special tests, overshoot tests, accuracy tests, range tests and stability tests,	CO4, CO6	Chalk & Talk
	Week 15	Test procedure, current injection set, Programmable testing equipment, Digital based relay testing schemes.	CO4,CO6	Chalk & Talk



Elective-I: Advanced Control Theory, Industrial Automation, Soft Computing
 Elective-II: Electrical Power Quality, HV AC & DC, Special Machines, MOOC
 Elective-III: FACTS, Advanced Power Electronics, Power System Planning, MOOC