



DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE PLAN – PART I			
Name of the Programme and Specialization	M.Tech. – Power Systems		
Course Title	ADVANCED POWER SYSTEM PROTECTION		
Course Code	EE604	No. of Credits	03
Course Code of Pre-requisite subject(s)	--		
Session	JANUARY 2020	Section (if, applicable)	-
Name of Faculty	P. RAJA	Department	EEE
Email	<a href="mailto:praja@nitt.edu">praja@nitt.edu</a> <a href="mailto:powsyspro17@gmail.com">powsyspro17@gmail.com</a>	Telephone No.	9942680653
Name of Course Coordinator(s) (if, applicable)	-		
Course Type	<input checked="" type="checkbox"/> Core course	<input type="checkbox"/> Elective course	
<b>Syllabus (approved in BoS)</b>			
<p>General philosophy of protection - Classification and Characteristic function of various protective relays- basic relay elements and relay terminology - Development of relaying scheme</p> <p>Digital Protection of power system apparatus – protection of generators – Transformer protection – magnetizing inrush current – Application and connection of transformer differential relays – transformer over current protection</p> <p>Bus bar protection - line protection - distance protection–long EHV line protection - Power line carrier protection</p> <p>Reactor protection – Protection of boosters - capacitors in an interconnected power system</p> <p>Digital signal processing – digital filtering in protection relays - numeric protection – testing Digital filtering in protection relays – digital data transmission – relay hardware – relay algorithms - Concepts of modern coordinated control system</p>			
<b>COURSE OBJECTIVES</b>			
<p>To give a braod coverage on all types of protective relaying schemes, circuit breakers and provide a strong background on working in a practical power system protection system.</p>			



COURSE OUTCOMES (CO)	
Course Outcomes	Aligned Programme Outcomes (PO)
Upon completion of the course the students would be able to	
1. Describe the characteristics of various relays	1,2,7,10,11,12,14
2. Develop analog and digital circuit based protection for alternators and transformers	1,2,5,6,7,10,11,12,14
3. Describe various schemes of protection for bus-bar, transmission line, capacitors and boosters	1,2,5,6,7,10,11,12,14
4. Illustrate the implementation flow of Numerical relays	1,2,6,7,10,11,12,14

**COURSE PLAN – PART II**

**COURSE OVERVIEW**

Electrical power system operates at various voltage levels from 415 V to 400 kV or even more. Electrical apparatus used may be enclosed (e.g., motors) or placed in open (e.g., transmission lines). All such equipment undergo abnormalities in their life time due to various reasons. For example, a worn out bearing may cause overloading of a motor. A tree falling or touching an overhead line may cause a fault. A lightning strike (classified as an act of God!) can cause insulation failure. Pollution may result in degradation in performance of insulators which may lead to breakdown. Under frequency or over frequency of a generator may result in mechanical damage to its turbine requiring tripping of an alternator. Even otherwise, low frequency operation will reduce the life of a turbine and hence it should be avoided.

It is necessary to avoid these abnormal operating regions for safety of the equipment. Even more important is safety of the human personnel which may be endangered due to exposure to live parts under fault or abnormal operating conditions. Hence, every electrical equipment has to be monitored to protect it and provide human and apparatus safety under abnormal operating conditions. This job is assigned to electrical protection systems. It encompasses apparatus protection and system protection.

This course is designed such a way that it covers basic relaying schemes and their applications towards the apparatus protection such as alternator, transformers, transmission lines and other ancillary power apparatus. The course covers the elementary design of relays such a electro-mechanical, digital and numerical relays. This course gives overall experince followed in the practical power system along with standards followed.



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<b>COURSE TEACHING AND LEARNING ACTIVITIES</b>			
S.No.	Week/Contact Hours	Topic	Mode of Delivery
1	2 <sup>nd</sup> Week of January (6 <sup>th</sup> to 10 <sup>th</sup> Jan) <b>(3 Contact Hours)</b>	Course plan details Discussion on fundamentals of Power System Protection	Discussion, Interactive Session, Lecture C&T
2	3 <sup>rd</sup> Week of January (13 <sup>th</sup> to 17 <sup>th</sup> Jan) <b>(2 Contact Hours)</b>	Over-current relays and Directional over-current relay	Lecture C&T
3	4 <sup>th</sup> Week of January (20 <sup>th</sup> to 24 <sup>th</sup> Jan) <b>(3 Contact Hours)</b>	Problems and relay co-ordination General Torque equation Introduction to Impedance relay	Lecture C&T and Group Discussion
4	5 <sup>th</sup> Week of January (25 <sup>th</sup> Jan to 31 <sup>st</sup> Jan) <b>(3 Contact Hours)</b>	Distance relays Differential relays	Lecture C&T
5	1 <sup>st</sup> Week of February (3 <sup>rd</sup> to 7 <sup>th</sup> Feb) <b>(3 Contact Hour)</b>	Differential relays Numerical Examples  <b>QUIZ - I</b>	Lecture C&T
6	2 <sup>nd</sup> Week of February (10 <sup>th</sup> to 14 <sup>th</sup> Feb) <b>(3 Contact Hour)</b>	Protection of Alternators	Lecture C&T
7	3 <sup>rd</sup> Week of February (17 <sup>th</sup> to 21 <sup>st</sup> Feb) <b>(3 Contact Hours)</b>	Protection of Alternators and Transformers	Lecture C&T PPT
8	4 <sup>th</sup> Week of February (24 <sup>th</sup> Feb to 28 <sup>th</sup> Feb) <b>(3 Contact Hour)</b>	Protection of Transformers	Lecture C&T PPT
9	1 <sup>st</sup> Week of March (2 <sup>nd</sup> to 6 <sup>th</sup> Mar) <b>(3 Contact Hour)</b>	Protection of Transmission Lines Protection of Bus- bars	Lecture C&T PPT
10	2 <sup>nd</sup> Week of March (9 <sup>th</sup> to 13 <sup>th</sup> Mar) <b>(2 Contact Hours)</b>	Protection of Transmission Lines And Protection of Bus- bars <b>QUIZ - II</b>	Lecture C&T PPT
11	3 <sup>rd</sup> Week of March (16 <sup>th</sup> to 20 <sup>th</sup> Mar) <b>(3 Contact Hours)</b>	Protection of Capacitors	Lecture C&T, PPT
12	4 <sup>th</sup> Week of March (23 <sup>rd</sup> to 27 <sup>th</sup> Mar) <b>(3 Contact Hours)</b>	Protection of Reactors and Boosters	Lecture C&T, PPT



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13	1 <sup>st</sup> Week of April (30 <sup>th</sup> Mar to 3 <sup>rd</sup> Apr) <b>(3 Contact Hour)</b>	Introduction to Numerical Relays	Lecture C&T, PPT
14	2 <sup>nd</sup> Week of April (6 <sup>th</sup> to 10 <sup>th</sup> Apr) <b>(2 Contact Hours)</b>	Introduction to Digital Signal Processing and requirement	Lecture C&T, PPT
15	3 <sup>rd</sup> Week of April (13 <sup>th</sup> to 17 <sup>th</sup> Apr) <b>(3 Contact Hours)</b>	Introduction to Digital Signal Processing and requirement <b>Seminar Presentation</b>	Lecture C&T
16	4 <sup>th</sup> Week of April (20 <sup>th</sup> to 24 <sup>th</sup> Apr) <b>(3 Contact Hours)</b>	Various relaying algorithm <b>COMPENSATION ASSESSMENT (CPA)</b>	Descriptive Written Exam
17	5 <sup>th</sup> Week of April and 2 <sup>nd</sup> Week of May (27 <sup>th</sup> Apr to 13 <sup>th</sup> May)	<b>ASSESSMENT - V</b>	Descriptive Written Exam

### **COURSE ASSESSMENT METHODS (shall range from 4 to 6)**

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Quiz I (objective type NOT MCQ)	1 <sup>st</sup> Week of February 2020	30 Minutes	<b>20</b>
2	Quiz II (objective type NOT MCQ)	2 <sup>nd</sup> Week of March 2020	60 Minutes	<b>20</b>
3	Surprise test	--	10 Minutes	<b>10</b>
4	Seminar Presentation	3 <sup>rd</sup> Week of April 2020	--	<b>10</b>
CPA	Compensation Assessment (Written Test)	4 <sup>th</sup> Week of April 2020	60 Minutes	<b>20</b>
5	Descriptive Type Examination (Final Assessment)	1 <sup>st</sup> Week of May 2020	120 Minutes	<b>40</b>

**\*mandatory; refer to guidelines on page 4**

### **COURSE EXIT SURVEY (mention the ways in which the feedback about the course shall be assessed)**

- Feedback from the students during class committee meetings
- Anonymous feedback through questionnaire (Mid of the semester & End of the semester) nd semester feedback on Course Outcomes

### **COURSE POLICY (preferred mode of correspondence with students, policy on attendance, compensation assessment, , academic honesty and plagiarism etc.)**

#### **MODE OF CORRESPONDENCE (email/ phone etc)**

1. All the students are advised to check their NITT WEBMAIL regularly. All the correspondence (schedule of classes/ schedule of assessment/ course material/ any other information regarding this course) will be done through their webmail only.



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2. Queries (if required) to the course teacher shall only be emailed to [powsyspro17@gmail.com](mailto:powsyspro17@gmail.com) / [praja@nitt.edu](mailto:praja@nitt.edu)

### ATTENDANCE

- At least 75% attendance in each course is mandatory.
- A maximum of 10% shall be allowed under On Duty (OD) category.
- Students with less than 65% of attendance shall be prevented from writing the final assessment and shall be awarded 'V' grade.

### COMPENSATION ASSESSMENT

1. Attending all the assessments are **MANADATORY** for every student.
2. One Compensation Assessment (CPA) will be conducted for those students who are being physically absent for the assessments 1 and 2.
3. At any case, CPA will not be considered as an improvement test.
4. Relative grading will be adopted for the course.

### ACADEMIC HONESTY & PLAGIARISM

- Possessing a mobile phone, carrying bits of paper, talking to other students, copying from others during an assessment will be treated as punishable dishonesty.
- Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.
- The departmental disciplinary committee including the course faculty member, PAC chairperson and the HoD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.

### ADDITIONAL INFORMATION

The faculty is available for consultation at times as per the intimation given by the faculty.

Queries may also be emailed to the Course Coordinator directly at [powsyspro17@gmail.com](mailto:powsyspro17@gmail.com) / [praja@nitt.edu](mailto:praja@nitt.edu)

### FOR APPROVAL

Course Faculty

*[Signature]*  
01/01/2020

CC-Chairperson

*[Signature]*  
2/1/2020  
(Dr. N. KUMARESAN)

HOD

*[Signature]*



Guidelines

- a) The number of assessments for any theory course shall range from 4 to 6.
- b) Every theory course shall have a final assessment on the entire syllabus with at least 30% weightage.
- c) One compensation assessment for absentees in assessments (other than final assessment) is mandatory. Only genuine cases of absence shall be considered.
- d) The passing minimum shall be as per the regulations.

B.Tech. Admitted in				P.G.
2018	2017	2016	2015	
35% or (Class average/2) whichever is greater.		(Peak/3) or (Class Average/2) whichever is lower		40%

- e) Attendance policy and the policy on academic dishonesty & plagiarism by students are uniform for all the courses.
- f) Absolute grading policy shall be incorporated if the number of students per course is less than 10.
- g) Necessary care shall be taken to ensure that the course plan is reasonable and is objective.