

**DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING**  
**NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI**

COURSE PLAN – PART I			
Course Title	Flexible AC Transmission Systems		
Course Code	EE661	No. of Credits	3
Course Code of Pre-requisite subject(s)	EE601, EE603		
Session	Jan-2018	Section (if, applicable)	M.Tech-Power Systems
Name of Faculty	Dr.C.Nagamani	Department	EEE
Email	cnmani@nitt.edu	Telephone No.	04312503254
Name of Course Coordinator(s) (if, applicable)	NA		
Course Type	<input type="checkbox"/> Core course <input checked="" type="checkbox"/> Elective course		
<b>Syllabus (approved in BoS)</b>			
Fundamentals of ac power transmission - transmission problems and needs - emergence of FACTS - FACTS control considerations - FACTS controllers Principles of shunt compensation – Variable Impedance type & switching converter type - Static Synchronous Compensator (STATCOM) configuration - characteristics and control Principles of static series compensation using GCSC, TCSC and TSSC – applications - Static Synchronous Series Compensator (SSSC) Principles of operation - Steady state model and characteristics of a static voltage regulators and phase shifters - power circuit configurations UPFC - Principles of operation and characteristics - independent active and reactive power flow control - comparison of UPFC with the controlled series compensators and phase shifters.			
<b>COURSE OBJECTIVES</b>			
To familiarize students with the transmission challenges of modern electrical power systems. The course will present the basic concepts, principles and operation of fast high power electronic controllers known as Flexible AC Transmission Systems (FACTS) that enhance power system stability and effectively increase transmission capacity thus yielding significantly higher flexibility of operation. The course will focus on concepts and applications of various configurations of FACTS controllers. Both thyristor based and voltage source converter based FACTS Controllers are discussed			
<b>COURSE OUTCOMES (CO)</b>			
<b>Course Outcomes</b>			<b>Aligned Programme Outcomes (PO)</b>
1. To identify the conditions in conventional power system where the installation of FACTS controllers or Devices becomes vital.			PO1 to PO3 and PO5 to PO14

2. <b>To analyze</b> the performance of a conventional transmission system and apply the principles of reactive power compensation for improvement.	PO1 to PO3 and PO5 to PO14
3. <b>To illustrate</b> the modes of operation of thyristor based and voltage source converter based FACTS controllers and <b>explain</b> the capabilities and modeling aspects	PO1 to PO3 and PO5 to PO14
4. <b>To analyze</b> different series, shunt or combined series-shunt FACTS controllers and <b>compute</b> the performance when installed in a given transmission system	PO1 to PO3 and PO5 to PO14
5. <b>To compare</b> the characteristics of different FACTS controllers and <b>defend</b> the choice of a particular controller to suit the given system/ scenario	PO1 to PO3 and PO5 to PO14

## COURSE PLAN – PART II

### COURSE OVERVIEW

The course presents the basic concepts, principles and operation of fast high power electronic controllers known as Flexible AC Transmission Systems (FACTS) that enhance power system stability and effectively increase transmission capacity thus yielding significantly higher flexibility of operation. The course will focus on concepts and applications of various configurations of FACTS controllers. Both thyristor based and voltage source converter based FACTS Controllers are discussed.

### COURSE TEACHING AND LEARNING ACTIVITIES

S.No.	Week/Contact Hours	Topic	Mode of Delivery
1.	Weeks 1-3	Fundamentals of ac power transmission - transmission problems and needs - emergence of FACTS- FACTS control considerations - FACTS controllers	Lecture/Discussions
2.	Weeks 4-6	Principles of shunt compensation – Variable Impedance type & switching converter type - Static Synchronous Compensator (STATCOM) configuration - characteristics and control	Lecture/Discussions
3.	Weeks 7-9	Principles of static series compensation using GCSC, TCSC and TSSC – applications - Static Synchronous Series Compensator (SSSC)	Lecture/Discussions
4.	Weeks 10-12	Principles of operation - Steady state model and characteristics of a static voltage regulators and phase shifters - power circuit configurations	Lecture/Discussions
5.	Weeks 13-15	UPFC - Principles of operation and characteristics - independent active and reactive power flow control - comparison of UPFC with the controlled series compensators and phase shifters	Lecture/Discussions

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

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	<b>Assessment – 1</b> (written examination covering units-1&2)	7 <sup>th</sup> week	75 minutes	25
2	<b>Assessment – 2</b> (written examination covering units-3&4)	12 <sup>th</sup> week	75 minutes	25
3	<b>Assessment - 3</b> (Assignment/Seminar)	Work will be carried out along with the course		10
CPA	<b>Compensation Assessment</b> (written examination covering units-1 to 4)	15 <sup>th</sup> week	75 minutes	25
4	<b>Assessment - 4</b> <b>Final Assessment</b> (written examination covering entire syllabus)	17 <sup>th</sup> week	180 minutes	40

\*mandatory; refer to guidelines on page 4

**ESSENTIAL READINGS****Text Books:**

1. Song, Y.H. and Allan T. Johns, 'Flexible AC Transmission Systems (FACTS)', Institution of Electrical Engineers Press, London, 1999.
2. Hingorani, L.Gyugyi, 'Concepts and Technology of Flexible AC Transmission System', IEEE Press New York, 2000 ISBN –078033 4588.
3. Mohan Mathur R. and Rajiv K.Varma, 'Thyristor- based FACTS controllers for Electrical transmission systems', IEEE press, Wiley Inter science, 2002.
4. Padiyar K.R., 'FACTS controllers for Transmission and Distribution systems' New Age International Publishers, 1st Edition, 2007.
5. Enrique Acha, Claudio R.Fuerte-Esquivel, Hugo Ambriz-Perez, Cesar Angeles-Camacho 'FACTS –Modeling and simulation in Power Networks' John Wiley & Sons, 2002.

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

Apart from the formal feedback (arranged by academic office) at the end of the course, informal and objective feedback shall be encouraged along the course work for improving the teaching – learning process.

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

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

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 through webmail.(Alternate email:407114007@nitt.edu)

**ATTENDANCE**

1. Attendance will be taken by the faculty in all the contact hours. Every student should maintain atleast 75% attendance in these contact hours to be eligible to attend the final assessment.
2. Any student, who fails to maintain 75% attendance needs to appear for the Compensation assessment (CPA). Student who scores more than 50% marks in the Compensation assessment (CPA) will be eligible for attending the final assessment.
3. Students not having 75% minimum attendance at the end of the semester and also failing to score at least 50% in the compensation assessment will not be able to sit for the final assessment and will have to RE-DO the course.

**COMPENSATION ASSESSMENT**

1. Attending all the assessments (Assessment 1, 2, 3 and 4) is MANDATORY for every student.
2. If any student is not able to attend Assessment-1 or Assessment-2 due to genuine reasons, he/ she can seek permission to write the Compensation Assessment (CPA) with 25% weightage (25 marks).
3. In any case, Compensation Assessment will not be offered as an improvement test.

**ACADEMIC HONESTY & PLAGIARISM**

1. Copying in any form during assessments is considered as academic dishonesty and will attract suitable penalty.

**ADDITIONAL INFORMATION**

**FOR APPROVAL**

Course Faculty

*Abhimanu*

CC-Chairperson

*Dr. N. Narasimhan*  
10.01.18

HOD

*S.P.S.*  
11/1/18

*DR. C. NARASIMHAN*

Date: 10.1.2018

**Guidelines:**

- a) The number of assessments for a course shall range from 4 to 6.
- b) **Every 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. This is not applicable for project work/industrial lectures/internship.**
- d) The policy for attendance for the course should be clearly specified.
- e) Necessary care shall be taken to ensure that the course plan is reasonable and is objective.