

# NATIONAL INSTITUTE OF TECHNOLOGY TIRUCHIRAPPALLI

## DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

### COURSE PLAN – PART I

|                             |   |                       |                      |
|-----------------------------|---|-----------------------|----------------------|
| <b>Course Title</b>         | Power System Stability  |                       |                      |
| <b>Course Code</b>          | EE606   | <b>No. of Credits</b> | 03                   |
| <b>Department</b>           | Electrical and Electronics Engineering                        | <b>Faculty</b>        | Dr. Vivek Mohan      |
| <b>Session:</b>             | Jan 2019  | <b>Section:</b>       | M.Tech Power Systems |
| <b>Pre-requisite Course</b> | Numerical Methods, Electrical Machines, Power System Analysis |                       |                      |
| <b>Course Coordinator</b>   |   |                       |                      |
| <b>E-mail</b>               | vivekmohan@nitt.edu   | <b>Telephone No.</b>  | +91 8113093716       |
| <b>Course Type</b>          | Core  |                       |                      |

### **SYLLABUS (APPROVED BY BOS)**

Power system stability considerations – definitions-classification of stability - rotor angle and voltage stability- synchronous machine – Modeling - load modeling concepts - modeling of excitation systems - modeling of prime movers.

Transient stability - swing equation-equal area criterion - solution of swing equation- Numerical methods - Euler method-Runge-Kutte method - critical clearing time and angle - effect of excitation system and Governors - Multi-machine stability – extended equal area criterion - transient energy function approach.

Small signal stability – state space representation – eigen values - modal matrices - small signal stability of single machine infinite bus system – effect of field circuit dynamics - effect of excitation system-small signal stability of multi machine system.

Voltage stability – generation aspects - transmission system aspects – load aspects – PV curve – QV curve – PQ curve – analysis with static loads – loadability limit - sensitivity analysis - continuation power flow analysis - instability mechanisms – examples.

Methods of improving stability – transient stability enhancement – high speed fault clearing – steam turbine fast valving - high speed excitation systems - small signal stability enhancement - power system stabilizers – voltage stability enhancement – reactive power control.

### **ESSENTIAL READINGS : Textbooks, reference books, Website addresses, journals, etc**

1. Kundur, P., 'Power System Stability and Control', McGraw-Hill International Editions, 1994.
2. Van Cutsem, T. and Vournas, C., 'Voltage Stability of Electric Power Systems', Kluwer Academic Publishers, 1998.
3. Abhijit Chakrabarti, D.P. Kothari, A.K. Mukhopadhyay and Abhinandan De, 'An Introduction to Reactive Power Control and Voltage Stability in Power Transmission Systems', PHI Learning Private Ltd., 2010.
4. R.Ramanujam, 'Power System Dynamics: Analysis and Simulation', PHI Learning Private Ltd., 2009.

### **COURSE OBJECTIVES**

This course aims to give basic knowledge about the dynamic mechanisms behind angle and voltage stability problems in electric power systems, including physical phenomena and modeling issues.

### COURSE OUTCOMES (CO)

| Course Outcomes  | Aligned Programme Outcomes (PO) |
|--|---------------------------------|
| Upon completion of the course the students would be able to:   |                                 |
| 1. Understand the basic modeling and stability considerations of power system                                      | 1, 2, 3, 5, 14                  |
| 2. Investigate transient stability issues of single and multiple synchronous machines in power systems             | 1, 2, 3, 5, 14                  |
| 3. Appraise and analyze the small signal stability and the effects of excitation systems on small signal stability | 1, 2, 3, 5, 14                  |
| 4. Evaluate the various aspects of voltage stability in power systems  | 1, 2, 3, 5, 14                  |
| 5. Interpret and devise different schemes for improving transient stability and voltage stability.                 | 1, 14                           |

### COURSE PLAN – PART II

### COURSE TEACHING AND LEARNING ACTIVITIES

| S. No. | Week                               | Topic   | Mode of Delivery |
|--------|------------------------------------|---|------------------|
| 1.     | 2 <sup>nd</sup> Week of Jan (4hrs) | Stability, eigen values and vectors, concept of load angle, synchronizing & damping power | PPT/Chalk & Talk |
| 2.     | 3 <sup>rd</sup> Week of Jan (3hrs) | Multi-Machine System  | PPT/Chalk & Talk |
| 3.     | 4 <sup>th</sup> Week of Jan (3hrs) | Equal area criteria   | PPT/Chalk & Talk |
| 4.     | 1 <sup>st</sup> week of Feb (3hrs) | Small Signal Stability.   | PPT/Chalk & Talk |



|     |                                    |                                 |                  |
|-----|------------------------------------|---------------------------------|------------------|
| 5.  | 2 <sup>nd</sup> week of Feb (3hrs) | Small signal Stability          | PPT/Chalk & Talk |
| 6.  | 3 <sup>rd</sup> week of Feb (3hrs) | Voltage Stability               | PPT/Chalk & Talk |
| 7.  | 4 <sup>th</sup> week of Feb (3hrs) | Voltage Stability + MidSem Exam | PPT/Chalk & Talk |
| 8.  | 1 <sup>st</sup> week of Mar        | Improving Stability             | PPT/Chalk & Talk |
| 9.  | 2 <sup>nd</sup> week of Mar        | Improving stability             | PPT/Chalk & Talk |
| 10. | 3 <sup>rd</sup> week of Mar        | Improving stability             | PPT/Chalk & Talk |
| 11. | 1 <sup>st</sup> week of Apr        | Machine Modelling               | PPT/Chalk & Talk |
| 12. | 2 <sup>nd</sup> week of Apr        | Machine Modelling               | PPT/Chalk & Talk |
| 13. | 3 <sup>rd</sup> week of Apr        | Term Paper Presentation         | PPT/Chalk & Talk |
| 14. | 4 <sup>th</sup> week of Apr        | ''                              | PPT/Chalk & Talk |
| 15. | 1 <sup>st</sup> week of May        | End Sem Exam                    | PPT/Chalk & Talk |

### COURSE ASSESSMENT METHODS

| S. No. | Mode of Assessment                | Week/Date   | Duration         | % Weightage |
|--------|-----------------------------------|---|------------------|-------------|
| 1.     | Group Activity                    | Presentations from Feb                            | 15 minutes       | 20%         |
| 2.     | Mid-Sem Exam                      | Last week of Feb                                  | As per questions | 30%         |
| 3.     | Assignment                        | Periodic  | -                | 10%         |
| 4.     | Compensation test (Full Portions) | Between april 23 <sup>rd</sup> & 26 <sup>th</sup> | -                | 30%         |
| 5.     | End Semester Examination          | Last week of April/First week of May              | 2 hours          | 40%         |

### COURSE EXIT SURVEY

1. Students feedback through class committee meetings
2. Feedback from students on the course outcomes shall be obtained at the end of the course

## COURSE POLICY

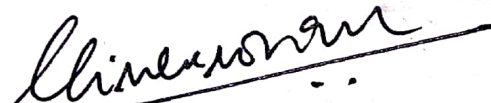
**COMPENSATION ASSESSMENT:** Attending all the assessments (1, 2, 3 & 5) are mandatory for every student. If any student fails to attend the assessment 2 due to genuine reason, the student is permitted to appear the compensation assessment (CPA) on submission of appropriate documents as proof. The compensation assessment (CPA) will cover full syllabus. CPA is not considered as an improvement test.

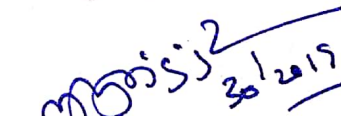
**ATTENDANCE POLICY:** All the students are expected to attend all the contact hours. Students should maintain 75% minimum physical attendance by the end of the course to attend the end semester examination. Students with less than 65% of attendance shall be prevented from writing the final assessment and shall be awarded 'V' Grade and will have to REDO the course. A maximum of 10% attendance shall be allowed under On Duty (OD) category. OD is allowed only for the students having minimum attendance of 65%.


**ACADEMIC HONESTY & PLAGIARISM:** In case of any student found guilty indulging in any mal practice, the student will be awarded 10 marks in that assessment. If found using mobile phones or any other gadgets for mal-practice during the examination, the answer sheet of the student will not be evaluated and will be awarded ZERO marks.

**MODE OF COMMUNICATION:** The Faculty is available for consultation during the time intimated to the students then and there. The lecture notes will be posted through the faculty homepage <https://sites.google.com/view/vivekmohan/lecture-notes>. For correspondence, please contact [vivekmohan@nitt.edu](mailto:vivekmohan@nitt.edu).

## FOR APPROVAL

  
[Dr. Vivek Mohan, AP/EEE]  
Course Faculty

  
30/2019  
Course Coordinator

  
HoD (Dept. of EEE)