NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE OUTLINE			
Course Title	POWER SYSTEM STABILITY		
Course Code	EE603	No. of Credits	3
Department	Electrical and Electronics Engineering	Faculty	M.Venkata Kirthiga
Pre-requisites Course Code	Numerical Methods , Electrical Machines and Power System Analysis at B.Tech. level		
Course Coordinator(s)	Not Applicable		
Other Course Teacher(s)/Tutor(s) E-mail	pssmvk@gmail.com	Telephone No.	0431 - 2503263
Course Type	Core course		

COURSE OVERVIEW

Electric Power System comprises of multiple generating sources located far apart from each other. Most of the generating stations are located where abundant fuels are available and certain small generating units are located near load centers (at distribution level). The transmission system interconnects all major generating stations and the main load centers of the system. For reliable service, a bulk electricity system must remain intact and be capable of withstanding a wide variety of disturbances. Hence it becomes essential to design a power system that is operable in a secured and controlled manner such that more probable contingencies can be sustained with no loss of load as well as without cascading power interruptions.

To achieve the above said goal, every power engineer should be enriched with a deep knowledge on the stability issues. This course introduces the power system stability considerations to students. This course mainly focuses the transient stability and voltage stability related issues in a power system. It highlights the significance of dynamic modeling of generators, loads, excitation systems and prime movers in analyzing the stability issues. The course also enhances knowledge on effect of various components upon system dynamics. This course helps a student to extend the understanding of stability issues to a large system which includes many generators and buses.

The course also unfolds various aspects of voltage stability issues and appropriate methods for analyzing the same. Also this course helps to understand the implications of reactive power support in improving the power transfer capacity and stability of the power system. Finally the

course gives an overview on the different methodologies to improvise the rotor angle stability and voltage stability. This inculcates a drive among the students to come out with innovative solutions to various stability related problems in real time.

COURSE OBJECTIVES

To understand and analyze the dynamic mechanisms behind transient and voltage stability problems in electric power systems, including physical phenomena and modeling issues.

COURSE OUTCOMES (CO)

Course Outcomes	Aligned Programme Outcomes (PO)
On completion of the course the students would be able to	
1. Understand the basic modeling and stability considerations of power system.	**CO_1** – PO_1, PO_2,PO_3, PO_5-PO_{14}
2. Investigate transient stability issues of single and multiple synchronous machines in power systems.	**CO_2** – PO_1, PO_2,PO_3, PO_5-PO_{14}
3. Appraise and analyze the small signal stability and the effects of excitation systems on small signal stability.	**CO_3** – PO_1, PO_2,PO_3, PO_5-PO_{14}
4. Evaluate the various aspects of voltage stability in power systems.	**CO_4** – PO_1, PO_2,PO_3, PO_5-PO_{14}
5. Interpret and devise different schemes for improving transient stability and voltage stability.	**CO_5** –PO_1-PO_{14}

COURSE TEACHING AND LEARNING ACTIVITIES

S. No.	Week	Topic	Mode of Delivery
1.	I week of August (1^{st} – 5^{th}) **2 hrs**	Introduction to the course – Basics of stability – definitions and classifications	**Lecture** *Interactive session*
2.	I week of August (1^{st} – 5^{th}) **1 hr**	Rotor angle stability – Small signal stability and transient stability	**Lecture** *Power Point Presentation*
3.	II week of August (8^{th} – 12^{th}) **2 hrs**	Classical and dynamic modeling of Synchronous Machine, Equivalent circuit representation and Physical interpretation	**Flip class** *Discussion on 120mins video shared to the students earlier*
4.	II week of August (8^{th} – 12^{th}) **1 hr**		

5.	II week of August (8^{th} – 12^{th}) **2 hrs**	Load modeling and Modeling of excitation systems	**Flip class** *Discussion on 120mins video shared to the students earlier*
6.	III week of August (16^{th} – 19^{th}) **1 hr**	**Assessment 1**	**Written Test** *Objective type questions*
7.	III week of August (16^{th} – 19^{th}) **2 hrs**	Transient stability – Swing equation, power angle curve and equal area criterion	**Lecture** *Power Point Presentation*
8.	IV week of August (22^{nd} – 26^{th}) **2 hrs**	Solution of Swing Equation – Single machine	**Demo by simulation in MATLAB**
9.	IV week of August (22^{nd} – 26^{th}) **2 hrs**	Critical clearing time and angle	**Demo by simulation in MATLAB**
10.	V week of August (29^{th} August – 2^{nd} September) **3 hrs**	Numerical problems related to critical clearing time and angle	**Tutorial**
11.	II week of September (6^{th} – 9^{th}) **3 hrs**	**Assessment 2**	**Group Activity**
12.	IV week of September (19^{th} – 23^{rd}) **3 hrs**	Algorithms and numerical solutions to multi-machine stability analysis	**Lecture** *Power Point Presentation followed by* ***problem solving***
13.	V week of September (26^{th} - 30^{th}) **2 hrs**	Disturbances affecting rotor stability and effect of fault	**Lecture** *Power Point Presentation followed by discussions*
14.	I week of October (3^{rd} – 7^{th}) **2 hrs**	Small signal stability – state space representation, eigen values and modal matrices	**Lecture** *Power Point Presentation followed by discussions*
15.	I week of October (3^{rd} – 7^{th}) **1 hr**	Effect of field circuit dynamics, excitation systems and governor control	**Demo by simulation in MATLAB** *followed by discussions*
16.	II week of October (13^{th} – 14^{th}) **1 hr**		
17.	III week of October (17^{th} – 21^{st}) **2 hrs**	Effect of AVR and Power System Stabilizer	**Lecture** *Power Point Presentation followed by* **Demo by simulation in MATLAB**

17.	III week of October (17^{th} – 21^{st}) **3 hrs**	**Assessment 3**	**Group Activity**
18.	I week of November (1^{st} – 4^{th}) **2 hrs**	Voltage stability – generation, transmission and load aspects, PV, PQ and QV curves, loadability limits, sensitivity analysis and continuation power flow analysis	**Flip class** *Discussion on 120mins video shared to the students earlier*
19.	I week of November (1^{st} – 4^{th}) **2 hrs**	Voltage collapse – steps to limit, static and dynamic analysis of voltage stability	**Lecture** *Power point presentation followed by discussions*
20.	II week of November (7^{th} – 11^{th}) **1 hr**	**Assessment 4**	**Technical quiz – one mark questions**
21.	II week of November (7^{th} – 11^{th}) **1 hr**	Discussions on case studies & examples related to voltage stability problems	**Discussions**
22.	III week of November (15^{th} – 18^{th}) **4 hrs**	**Assessment 5**	**Demo and presentation by students**
23.	III week of November (15^{th} – 18^{th}) **1 hr**	**Assessment 5**	**Demo and presentation by students**
24.	I week of December/ examination week as per institute schedule	**Assessment 6**	**Written exam – descriptive type**

COURSE ASSESSMENT METHODS

S. No.	Mode of Assessment	Week/Date	Duration	% Weightage
1.	Written Test - Objective type questions	III week of August	1 hr	10 %
2.	Group activity	III week of September	3 hrs	10%
3.	Group activity	IV week of October	3 hrs	10%
4.	Technical quiz – one mark questions	II week of November	1 hr	10%
5.	Individual assignment – simulation and presentation	III and IV weeks of November	15 mins – (for each student)	20% (V unit)
6.	Written exam – Descriptive type	I week of December	2.5 hrs	40% (I – IV units)

ESSENTIAL READINGS

1. Prabha Kundur, 'Power System Stability and Control', Tata McGraw-Hill, second edition 2006.
2. K.R.Padiyar, 'Power System Dynamics', BS Publications, second reprint 2006.
3. Van Cutsem, T. and Vournas, C., 'Voltage Stability of Electric Power Systems', Kluwer Academic Publishers, 1998.
4. 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., 2015.
5. NPTEL lectures

COURSE EXIT SURVEY

1. Students' feedback through class committee meetings
2. Feedback questionnaire from students – twice during the semester
3. Feedback from students on Course Outcomes at the end of the semester

COURSE POLICY

1. All the students are expected to attend all the contact hours. Anyhow students who fall short of 75% attendance to the contact hours are not eligible to appear for the final written examination of 40% weightage.
2. No retest will be conducted for those students who are being physically absent for any of the evaluation / assessment methods. Anyhow flexibility is given to the students to fix the date for each mode of evaluation convenient to all the students. In case of emergency, the student may submit compensatory assignments on submission of appropriate documents as proof. Compensatory assignments would be framed according to the time frame available and the assessment task missed by the students.
3. Relative grading adhering to the instructions from the office of the Dean (Academic) will be adopted for the course. Anyhow 40% of the first mark scored will be fixed as the criterion for minimum pass grade (E).
4. In case of any student found guilty indulging in any mal practice, he/she will be awarded no marks in that particular assessment. If found using mobile phones or any other gadgets for any mal-practice during the final written examination, the answer sheet of the student will not be evaluated and will be awarded ZERO marks in the final written examination.

ADDITIONAL COURSE INFORMATION

1. The Course Coordinator is available for consultation during the time intimated to the students then and there.
2. All correspondence will be sent to the webmail id of the students alone. Hence all students are advised to check their webmail ids regularly.

FOR SENATE'S CONSIDERATION

Course Faculty: Dr.M.VenkataKirthiga **CC-Chairperson :** Dr.S.Arul Daniel **HOD/EEE**