# Subject Description Form

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| **Subject Code** | EE526 |
| **Subject Title** | Power System Analysis and Dynamics |
| **Credit Value** | 3 |
| **Level** | 5 |
| **Pre-requisite/ Co-requisite/ Exclusion** | Nil |
| **Objectives** | 1. To introduce the students to the advanced concepts and analytical skills for the stability analysis in modern power systems.<br>2. To understand the causes and impact of different system instabilities.<br>3. To analyse and provide solutions to the power system stability problems. |
| **Intended Learning Outcomes** | Upon completion of the subject, students will be able to:<br>a. Acquire in-depth understanding of different types of power system stability problems.<br>b. Model the dynamic behaviours of system components under disturbances.<br>c. Apply mathematics and engineering knowledge and skills in the analysis of stability problems.<br>d. Discuss the causes and effects of instabilities and recommend possible solutions.<br>e. Acquire skills in presentation and interpretation of experimental results and communicate in written form |
| **Subject Synopsis/ Indicative Syllabus** | 1. ***Power system stability*****:** Basic concepts and classification. Past incidents of system instability and consequences. Power system stability issues and solutions.<br>2. ***Reactive power compensation*****:** System Q-V Characteristics. Reactive support theory. Load Characteristics. Synchronous condensers, Static Var Compensators (SVS), Thyristor Switched Capacitor (TSC), Thyristor controlled Reactor (TCR).<br>3. ***Voltage stability*****:** Fundamental concepts. Singularities and multiple load flow techniques, eigenvalue methods. Load modelling, tap-changer effects, voltage controllability and voltage compensation. Proximity of collapse, Measures against collapse. Practical experience.<br>4. ***Dynamic stability & power system stabilisers*****:** Eigenvalue and modal analysis. Generator and load modelling. Power system stabiliser. Small-signal stability of multi-machine systems. Selection of input signal and installation location, parameter design and commissioning of PSS.<br>5. ***Application of HVDC, FACTS and ESS in improving stability*****:** HVDC link operation and its control for stability improvement. Flexible AC transmission devices, power angle control. Energy storage system, e.g. BESS, SOFC, FESS, and its application in stability control.<br>**Mini-projects:**<br>1. Power system stability analysis using industrial power systems design and analysis software<br>2. Power system stabiliser design for damping of low frequency power oscillation |

**Teaching/Learning Methodology**

Lectures and tutorials are the primary means of conveying the basic concepts and theories. Experiences on system analysis, design and practical applications are given through experiments, in which the students are expected to solve the power system stability and control design problems with practical constraints and to attain pragmatic solutions with critical and analytical thinking. Students will be required to form groups to work through a mini-project for a selected topic. Mini-Projects are used to enhance students learning experiences and practical applications.

| Teaching/Learning Methodology | Outcomes | | | | |
|---|---|---|---|---|---|
| | a | b | c | d | e |
| Lectures | ✓ | ✓ | ✓ | ✓ | |
| Tutorials | | | ✓ | | |
| Mini-project | ✓ | ✓ | ✓ | ✓ | ✓ |

**Assessment Methods in Alignment with Intended Learning Outcomes**

| Specific assessment methods/tasks | % weighting | Intended subject learning outcomes to be assessed | | | | |
|---|---|---|---|---|---|---|
| | | a | b | c | d | e |
| 1. Examination | 60% | ✓ | ✓ | ✓ | ✓ | |
| 2. Class Test | 18% | ✓ | ✓ | ✓ | ✓ | |
| 3. Mini-project/report | 12% | | | | ✓ | ✓ |
| 4. Essay assignment | 10% | ✓ | | | ✓ | ✓ |
| Total | 100% | | | | | |

The outcomes on concepts, design and applications are assessed by the usual means of examination and test Experiments and written reports assess those on analytical skills, problem-solving techniques and practical considerations of power system stability and control design as well as technical reporting.

**Student Study Effort Expected**

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| Class contact: | |
| ▪ Lecture/Tutorial | 39 Hrs. |
| Other student study effort: | |
| ▪ Mini-project and report | 15 Hrs. |
| ▪ Essay assignment/Self-study | 51 Hrs. |
| Total student study effort | 105 Hrs. |

**Reading List and References**

**Reference Books:**


1. P. Kundur, Power System Stability and Control, McGraw Hill, 1994
2. P.M. Anderson and A.A. Fouad, Power System Control and Stability, Wiley-IEEE Press, 2nd Edition, 2002
3. G. Rogers, Power System Oscillations, Springer, 1999
4. Voltage Stability of Power Systems: Concepts, Analytical Tools and Industry Experience, IEEE Publication 90th 0358-2-PWR, 1990
5. Y.H. Song, and A.T. Johns, Flexible AC Transmission Systems, IEE, 1999
6. T.V. Cutsem, and C. Vournas, Voltage Stability of Electric Power Systems, Springer, 2nd Edition, 2007