

**Course : Analysis and Design of Algorithms**  
**Topic: Algorithms for comparison problems**

**Prof :** Sandeep Sen

**Email Id:** ssen@cse.iitd.ernet.in,  
ssen@ce.iitd.ac.in

- Sorting: Heapsort, randomized quicksort
  - Selection: linear time and randomized
  - optimality: worst case and random input
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**Course : Theory of machines**

**Topic: Balancing of rotating machines**

**Prof:** Abhiji Sarkar

**Email Id :** asarkar@iitm.ac.in

Static & Dynamic Balancing, Two plane Balancing Analytical approach.

Balancing of reciprocating machines - Free body diagram of moving links of an IC engine mechanism, Approximate Kinematics, Dynamic Equivalent model for connecting rod, Unbalance force due to reciprocating slider, Lanchester balancing.

Reference: Theory of Mechanisms and Machines by A. Ghosh & A. K. Mallik

Proposed Schedule: 23rd Feb 10 am to 12 noon, 24th Feb 10 am to 12 noon, 1st March 10 am to 11 am (lecture) 11 am to 12 noon (Assignment solution)

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**Course : Design of Steel structures**

**Topic: Basic Design of Steel Structures**

**Prof :** Sathish Kumar S R

**Email Id :** kim@iitm.ac.in

The Code of Practice for General Construction in Steel in India IS 800:2007 has been revised into Limit State Method. A thorough understanding of the new provisions and their background is required to use the Standard efficiently and effectively. Design of members in tension, compression and flexure will be covered in this module on Basic Design of Steel Structures.

1. Limit State Method
  2. Design of tension members
  3. Design of compression members
  4. Local Buckling and section classification
  5. Design of beams
  6. Tutorial
-

**Course : Analog Electronic Circuits**

**Topic: BJT, MOSFET And Amplifiers; frequency response**

**Prof :** Hitesh Shrimali

**Email Id :** hitesh@iitmandi.ac.in

- device understanding of BJT, MOS
- operation of devices
- small signal model derivations using two port network analysis
- single stage amplifiers such as CE, CB and CC for BJT
- single stage amplifiers: CS, CD, CG for MOSFET
- finding poles and zeros in the system
- drawing frequency response

Pre-requisite for the course is basic network analysis.

**Course : Automobile Engineering**

**Topic: Braking System**

**Prof : C. S. SHANKAR RAM**

**Email Id : shankarram@iitm.ac.in**

Evolution and Requirements of a Braking System; Components and Classification; Drum and Disc Brakes; Hydraulic Brake System; Air Brake System; Antilock Brake System; Analysis of Vehicle Braking - Brake Force Distribution, Vehicle Stability during Braking, Stopping Distance.

Pre-requisites: I expect a background on Engineering Mechanics, which is mostly taught to all Engineering students in their first year.

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**Relevant Course: Concrete Technology**

**Relevant Department: Civil Engineering**

**Relevant Semester: 7<sup>th</sup> or 8<sup>th</sup> for BE students, or 1<sup>st</sup> year ME students**

**Pre- requisite : Basic course in Construction Materials**

**Course Description and Outline:** The module will cover the following aspects: (i) Selection of raw materials for cement manufacture, (ii) Processing of the raw materials, (iii) Reactions in cement production process, (iv) Composition and appearance of cement clinker, (v) Types of cements, (vi) Reactions of cement hydration, and (vii) Development of hydrated cement paste structure. The emphasis will be on how the basic cement characteristics are related to concrete properties.

**Finalized topic name: Cement Production, Composition and Chemistry**

**Course : Geotechnical Engineering**  
**Topic: Principle of soil compaction**

**Prof :** Ashish Juneja  
**Email Id :** ajuneja@iitb.ac.in

- Factors affecting compaction,
  - structure and engineering behaviour of compacted-cohesive soils,
  - laboratory tests,
  - compaction in field,
  - compaction specifications and field control
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**Course : Signals & Systems**

**Topic: Introduction to Signal & Systems**

**Prof :** Devendra Jalihal

**Email Id :** [dj@iitm.ac.in](mailto:dj@iitm.ac.in)

Classification of signals and classification of systems, their properties.

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**Course : Signals & Systems**

**Topic: Convolution**

**Prof :** Devendra Jalihal

**Email Id :** [dj@iitm.ac.in](mailto:dj@iitm.ac.in)

Linear time-invariant systems and their processing by convolution.

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**Course : Structural analysis**  
**Topic: Deflections of Structures**

**Prof : ARGHADEEP LASKAR**

**Email Id: [laskar@civil.iitb.ac.in](mailto:laskar@civil.iitb.ac.in)**

This cover the various methods used to calculate the elastic deformations (slope and deflection) of structures as listed below:

- 1) Double Integration Method
- 2) Moment Area Method
- 3) Conjugate Beam Method
- 4) Virtual Work Method
- 5) Castigliano's Theorem

Prerequisites: Students should be familiar with the analysis of statically determinate structures such as beams, frames and trusses i.e. they should be able to:

- (i) draw shear force and bending moment diagrams of statically determinate beams and frames,
- (ii) calculate member forces of statically determinate truss members.

## **QEEE**

### **Design of Concrete structures**

Based on the discussion on December 14, 2015 (10-00 to 10-50am) , I shall take a different topic. Therefore, it may be in the second part of the semester.

*Content of this document*

- (a) The syllabus given on “Design of concrete structure”*
- (b) Proposed sequence of lectures – topic wise*
- (c) Module on design of earthquake resistant design of RCC multi-storeyed frames which will be taken by Prof. Nirjhar Dhang, Department of Civil Engineering, IIT Kharagpur*

### **Design of Concrete structures**

#### **Syllabus given**

Staircases-Multi-Storey Frames-Foundations-Earth Retaining Structures-Liquid Retaining Structures-Miscellaneous Topics : Principles Of Prestressing – Ductile Detailing For Earthquake Resistant Structures-Objective And Fundamental Concepts Of Design Of Rc Members-Analysis And Design Of Singly Reinforced-Limit State Of Collapse In Shear-Limit State Of Collapse In Bond-Analysis And Design Of One Way And Two Way Slabs-Columns And Design Of Column Footings-Concrete Technology-Aggregates-Properties Of Concrete-Mix Design-Design Of Reinforced Concrete Elements-Cements & Admixtures-Stairs-Foundations-Compression Members-Design Of Continuous Beams And Curved Beam-Design Of Domes.-Design Of Retaining Walls-Introduction To Water Retaining Structures-Design For Flexure (Working Stress Method)-Design For Flexure (Limit State Method)-Shear And Development Length-Deflection And Cracking-Design By Working Stress Method

## **Proposed sequence of lectures**

**Part-A** *(This may be optional if there is a separate course on Concrete Technology)*

Concrete Technology-Aggregates-Properties of Concrete-Mix Design- Cements & Admixtures

**Part-B (Basic of design of reinforced concrete structures) (24 hours, 18 lectures and 6 tutorials)**

*Part-A will be covered within the introduction of concrete structures*

Objective and fundamental concepts of design of RC members

Limit state of collapse in flexure : Analysis and design of singly reinforced section

Limit state of collapse in shear

Development length

Deflection and cracking

Analysis and design of one way and two way slabs

Design of columns

Design of footings

**Part-C (Application )**

Design of staircases - 2 hours

Design of continuous beams and curved beams – 3 hours

Multi-storey frames 6 hours

Ductile detailing for earthquake resistant structures (included with the above topic)

Design for flexure (Working Stress Method) - 3 hours

Earth retaining structures : design of retaining walls - 2 hours

Design of domes – 2 hours

Liquid retaining structures : Introduction to water retaining structures – 4 hours

Miscellaneous Topics : Principles of Prestressing - 2 hours

## **Design of Concrete structures**

### **Module on design of earthquake resistant multi storeyed frames**

Sl No	Topic	Number of lectures proposed	Remarks
1	Buildings – different forms of buildings, residential, administrative, academic and industrial buildings, different loadings and load combination	2	
2	Structural modelling and analysis methodology Codal provisions, Earthquake resistant design	2	
3	Example problems and tutorial	2	

**Course : Control Systems**

**Topic: Design of feedback control systems**

**Prof :** Tushar Jain

**Email Id :** tushar@iitmandi.ac.in

Topics to be covered: Classical PID Control, Synthesis of SISO Controllers, Fundamental Limitations in SISO Control, Architectural Issues in SISO Control, Dealing with Constraints, SISO controller Parameterizations, Introduction to MIMO control loops.

The pre-requisite for the above topics is Network theory and analysis

# **DIGITAL SYSTEMS**

## **T G Venkatesh, EE Deptt, IIT Madras**

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### **Course Outline**

#### **Session 1 : Boolean Algebra, Reduction, and Combinational Circuits ( 2 hours)**

Basic logic operation and logic gates. Basic postulates and fundamental theorems of Boolean algebra; Canonical (SOP and POS) forms; Minterm and Maxterm expansions; - Karnaugh-maps, essential prime implicants, four and five variable maps; incompletely specified functions, NAND and NOR implementation, multiplexers, demultiplexers Adders.

#### **Session 2 Sequential Logic ( 2 hours)**

Latches and flip-flops: SR-latch, D-latch, D flip-flop, JK flip-flop, T flip-flop; timing diagram; Registers and counters; Ripple counter, BCD counter, Shift register; Synchronous counter design using D, SR, JK flip flops.

#### **Session 3 State Machine Design ( 2 hours)**

Moore and Mealy state machines; Derivation of state graph and tables; state table reduction using Implication table, logic realization; PLAs, Reduced PLA table; PALs and their applications.

Seperate Session : ( if need be) ASM chart, Asynchronous Sequential Machines

## **"Digital Signal Processor and Application (DSP) lab"**

**Relevant Semester:** 7<sup>th</sup>

**Pre-Requisite** : Familiarity with C programming and Microprocessors is preferable.

The lab needs to be taken by the students for Credit. Only a limited number of institutes will be allowed to register. The lab will be a remotelab.

Please make note of the following points towards your participation.

- Upon completion of training, the faculty will be required to complete delivering the module at the institute to the students using the material and chronology guidance for experiments provided on the course-pack.
- We expect up-to 60 students in a lab. The students will be paired and each student will have to have access to a windows desktop with internet connection (a minimum of 2 Mbps connection for the institute).
- The lab schedule can be decided by the institute (Monday to Friday) and pre-cleared by QEEE.
- There will be 8 experiments. Each experiment will have 90 to 120 minutes of video, consisting of theory as well as the procedure to be used for the lab. The experiment then would take between 60-90 minutes. Then each experiment would require a session of about 3.5 hours.
- The local faculty will play the theory and procedure video in the class and answer questions. The experiment will start then. The remote tutor will log in from IITM (QEEE) for about 60 minutes for each lab, while the lab is going on, to assist students. The local faculty will then get the experiment complete.
- The material ( video, experiment set up, procedure) will be provided in a course-pack, where each student can log in. Each student then have to submit the result of the experiment on the worksheet provided in the course-pack. The experiment will be graded by the local faculty.

- The final exam/Quiz will be given by IITM (QEEE) on a specific day. Students will have to answer Quiz, under the supervision of the local faculty, and also have to carry out an experiment and submit results in the course-pack. IITM (QEEE) will grade the exam and provide the marks to the local faculty.
- Qualified candidates will be issued certificates for completion of the module.

We request colleges to register for this module and take this up seriously. We also suggest that you consider crediting this as a formal course for improved student uptake and their proactive involvement. Your involvement will be a crucial step for us to understand how we can improve our program delivery modality.

We appreciate your immediate response on this and look forward to seeing your participation.



**Relevant Course:** Fluid Mechanics

**Relevant Department:** Mechanical Engineering, Civil Engineering, Aerospace Engineering, Chemical Engineering, Metallurgy and Materials Engineering, Biotechnology, Power Engineering, Energy Engineering, Physics, Applied Mathematics

**Relevant Semester:** 4th

**Pre- requisite :** Engineering Mathematics with integral calculus, differential calculus and vector calculus

**Course Description and Outline:**

Kinematics of Fluid Flow: Lagrangian and Eulerian description, streamline, streakline and pathline, acceleration of a fluid element, continuity equation, stream-function, rotation and angular deformation, irrotational flow, velocity potential.

Integral forms of Conservation Equations: Reynolds transport theorem - conservation of mass, linear and angular momentum

Differential form of Conservation Equations: Continuity equation, Navier-Stokes equations – derivations and some exact solutions

**Finalized topic name:** Fundamental Concepts in Fluid Mechanics

**Schedule:**

Session:1	Date: February 16, 2016	Time: 10 am -12 noon
Session:2	Date: February 17, 2016	Time: 10 am -12 noon
Session:3	Date: February 18, 2016	Time: 10 am -12 noon

**Course : Kinematics of machines**

**Topic: Gears**

**Prof:** Abhiji Sarkar

**Email Id :** asarkar@iitm.ac.in

Nomenclature for spur gears, Fundamental law of gearing, Conjugate action for Involute tooth profile, Simple & Compound Gear train, Planetary Gear train

Reference: Theory of Mechanisms and Machines by A. Ghosh & A. K. Mallik

Proposed Schedule: 22nd March 10 am to 12 noon, 23rd March 10 am to 12 noon, 29th March 10 am to 11 am (lecture) 11 am to 12 noon (Assignment Solution).

**Course : Heat Transfer**

**Topic: Heat Transfer**

**Prof : Arvind Pattamatta**

**Email Id : [arvindp@iitm.ac.in](mailto:arvindp@iitm.ac.in)**

- 1) Radiation: Fundamental concepts
  - 2) Radiation: View factor and calculation
  - 3) Radiation exchange between surfaces and enclosures
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**Course : Engineering mathematics**

**Topic: INFINITE SERIES**

**Prof : Niranjan Balachandran**

**Email Id : [niranj@math.iitb.ac.in](mailto:niranj@math.iitb.ac.in)**

Summation of Series, Non-negative series, Absolute convergence, Tests for convergence including Root test, Ratio test, Integral test, Leibniz test, Dirichlet and Abel test, Cauchy product of infinite series, Rearrangement of series, Double series, Infinite products.

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**Course : Information Security and Cryptography**  
**Topic: Information Security and Cryptography**

**Prof :** Chester Rebeiro  
**Email Id :** chester@iitm.ac.in

Classical cryptography, block ciphers, DES, AES, and their attacks

**Course : Signals & Systems**

**Topic: Introduction to Signal & Systems**

**Prof :** Devendra Jalihal

**Email Id :** [dj@iitm.ac.in](mailto:dj@iitm.ac.in)

Classification of signals and classification of systems, their properties.

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**Course : Signals & Systems**

**Topic: Convolution**

**Prof :** Devendra Jalihal

**Email Id :** [dj@iitm.ac.in](mailto:dj@iitm.ac.in)

Linear time-invariant systems and their processing by convolution.

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**Course : Engineering Mechanics**

**Topic: Kinematics of particle:**

**Prof:** Abhiji Sarkar

**Email Id :** asarkar@iitm.ac.in

Idealization of particle, Kinematics of rectilinear motion, Kinematics of plane curvilinear motion, Kinematics of space curvilinear motion in rectangular and cylindrical coordinates.

Reference: (1) Engineering Mechanics by Irving Shames (2) Engineering Mechanics Dynamics by J. L. Meriam and L. G. Kraige.

Proposed schedule: 2nd Feb 10 am to 12 noon, 3rd Feb 10 am to 12 noon , 9th Feb 10 am to 11 am (lecture), 9th Feb 11 am to 12noon tutorial / assignment solutions.

**Course : Embedded systems and Applications**  
**Topic: Low Power Design Issues in Embedded Systems**

**Prof : M. Balakrishnan**

**Email Id : mbala@cse.iitd.ernet.in**

We would consider case studies related to power consumption in real-life embedded systems.

In many cases such design involves trade-off with performance - where

performance may be related to application specific performance (quality of service) or throughput. We would illustrate this through two specific case studies.

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**Faculty Name: Devdas Menon**

**Department: Civil Engineering**

(email: [dmenon@iitm.ac.in](mailto:dmenon@iitm.ac.in), phone: 22574253)

Topic (s) name	Description/Outline	Relevant Course & Dept.	Relevant Semester	Pre – requisite	Preferred slot for delivery	
					Date	Time Slot
Moment distribution method	<p>1. <b>Introduction</b> to <i>displacement methods</i> (as different from <i>force methods</i>); <i>Kinematic indeterminacy</i>: degree of freedom (as different from static indeterminacy); Basic Concept of moment distribution: <i>distribution factor</i> and <i>carry-over factor</i>; Concept of kinematically determinate primary structure (fixed beam) and use of Principle of Superposition; <i>Fixed end moments</i> in prismatic beams.</p> <p>2. <b>Problems (beams and frames) involving single cycle moment distribution</b>: direct loading, support movements; Taking advantage of <i>hinged supports</i> at far ends: reducing two cycles to single cycle moment distribution, modified flexural stiffness, fixed end moments for propped cantilevers; Taking advantage of <i>symmetry</i>; modified flexural stiffness of beam with <i>guided-fixed support</i> at one end.</p> <p>3. <b>Problems (beams and frames) involving multiple cycles of moment distribution</b>: direct loading, support settlements; Dealing with <i>sway</i> degrees of freedom; Simplified analysis of <i>single bay symmetric multi-storey frames</i> subject to lateral loading.</p>	Structural Analysis – 2, Civil Engineering	Sixth	Structural Analysis - 1	Feb 26 <sup>th</sup> , Feb 29 <sup>th</sup> March 2 <sup>nd</sup> , 2016	10-12 hrs on all days

**TAs for the course: Adrija D** (CE15S001) (email: [adrija.dhananjayan@gmail.com](mailto:adrija.dhananjayan@gmail.com)) and **Bijily B** (CE12D036) (email: [ce12d036@smail.iitm.ac.in](mailto:ce12d036@smail.iitm.ac.in))

## Computer Organization

- Course Name: Computer Organization & Architecture.
- Topic name : The nitty-gritty of Logic Gates to Processor Design
- Summary of the topic: Logic Gates to Execution Unit Design; ALU design; The complete Execution Unit and control Signals; Control Machine Language (prelim to Assembly language); Control Unit Design; Full Processor; **Items like Interrupt Unit may not be delivered.**
- Semester possibility : 3rd year
- Pre-requisites : Digital Circuits (1<sup>st</sup> Course) and some programming

### Session I

1. Basic Logic gates in the context of microprocessor: Tristate gates, flip flops
2. Registers and Data bus
3. Understanding the working of MOV instruction (introduction to read-write control lines and their use to transfer data through bus)
4. ALU
  - a. The Functional components (combinational circuits for adder, sub tractor, comparator etc.)
  - b. Function Select lines
  - c. Flag Register
5. A small(3-4 line) machine language program to demonstrate ALU function selection

### Session II

1. Using single read and write line and the concept of address lines
2. Use of decoders to reduce the number of lines and the concept of Address Bus, Data Bus and Control Bus
3. Piano Control Analogy with inputs for selecting function lines and registers(memory) to use and output as LEDs (function output lines)
4. Indirect Addressing and Data loading
5. Basic of Execution Unit

### Session III

1. Program Counter
2. Program Flow Control Instruction (PFCI) and Execution Unit Control Instruction (EUCI)
3. End to End operation flow for completing an instruction using Program Counter, Program Memory, PFCI processing and EUCI State Machine
4. Demonstrating the working of Control Unit and Execution Unit as a whole through a machine language program

5. Concluding Discussion on the changes made to support addition of peripherals and external memory which would work with the internal registers

**Course : Object Oriented Programming**

**Topic: Object Oriented Concepts-Classes and Data Abstraction-Operator  
Overloading-Inheritance**

**Prof :** Rupesh Nasre

**Email Id :** rupesh0508@gmail.com

This module would introduce solving a problem by thinking about objects and the associated methods, rather than by merely splitting it into procedural steps. Students would learn about how to organize various objects into a common form of classes, how to define the interface to access its members, and how to hide unwanted details. To ease programmability, some languages support redefining an operator or a function; students would learn about this as operator overloading. Finally, reusing class definitions, we would learn about inheriting properties of an existing class to define a new one. Together, this would form a solid base in kickstarting OOP

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**Course :Software Engineering**

**Topic: Object-oriented design using UML.**

**Prof :** Rajib mal

**Email Id :** rajib@cse.iitkgp.ernet.in

Introduction; Evolution of UML; Types of diagrams and views; Use case diagram; Class and object diagrams; Sequence and collaboration diagrams; Package diagram; State chart diagram;

An object-oriented design methodology using UML

Tutorial problems: Open source CASE Tools

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**Relevant Course: Geotechnical Engineering/ Soil Mechanics**

**Relevant Department: Civil Engineering**

**Relevant Semester: Autumn/ Spring**

**Pre-requisite: None**

**Course Description and Outline:**

**Factors affecting compaction, structure and engineering behaviour of compacted-cohesive soils, laboratory tests, compaction in field, compaction specifications and field control**

**Finalized topic name: Compaction of soils**

## **Statistics and Probability Distribution - Engineering Mathematics**

**Prof : Prof.Sanjeev Sabnis**

**Relevant Course:**Statistics and Probability

**Relevant Department :** Engineering Departments

**Pre-requisite:** 1<sup>st</sup> course in Calculus

**Course Description & Outline :**

Basic Laws of Probability, Review of most commonly occurring discrete and continuous distributions and their applications.

### **Schedule for Lecture Delivery**

**Session 1 :**22 - Feb - 2016 ( 10 am to 12 noon)

**Session 2 :**24 - Feb - 2016 ( 10 am to 12 noon)

**Session 3 :**26- Feb - 2016 ( 10 am to 12 noon)

# Syntax Directed Translation

**Relevant Course:** Compiler Design

**Relevant Department:** Computer Science

**Relevant Semester:** 5th/6th

**Pre- requisite :** Data Structures, Formal Methods, Programming, C programming, Computer Organization.



**Course : Thermodynamics**

**Topic: Thermodynamics**

**Prof : Arvind Pattamatta**

**Email Id : [arvindp@iitm.ac.in](mailto:arvindp@iitm.ac.in)**

- 1) Vapor Power Cycles
  - 2) Boilers and Steam Generators
  - 3) Availability (Exergy) Analysis
-

### Topics for the course “Control Systems”

**Instructor:** Dr. Tushar JAIN (Assistant Professor, IIT Mandi)

**Total contact hours:** 10 hours

**Prerequisites:** Network analysis / Signals and systems

**Intended for:** B.Tech (EE/ECE/ME)

**Preamble:** Control Systems Engineering plays an important part in modern technological systems. The scope and benefits of an improved control strategy in the industry can be immense. However, a difficulty with this subject is perhaps that some of the more advanced aspects depend on sophisticated mathematical background. I intend to keep the mathematics at a reasonable basic level, thereby focusing on an application of the control theoretic tools. This short course covers two topics, which comprise a total of 8 hours of lectures and 2 hours of tutorials.

#### Topic - 1: Time domain analysis of first and second order system

##### **Course Outline:**

##### **Module 1:** [2 hours]

- Transfer function and state-space model
- Standard process inputs
- Response of first-order systems
- Response of integrating systems

##### **Module 2:** [2 hours]

- Response of second-order systems
- Poles and zeros and their effects on system response
- Systems with time-delays
- Approximation of higher-order transfer functions

##### **Textbook:**

1. D.E. Seborg, T.E. Edgar, D.A. Mellichamp, Process Dynamics and Control, John Wiley & sons, second edition, 2004.

#### Topic - 2: Design of feedback control systems

##### **Course Outline:**

##### **Module 1:** [2 hours]

- Feedback structures

- Nominal sensitivity functions
- Closed-loop stability based on the characteristics polynomial
- Root locus
- Nominal and relative stability

**Module 2:**

[2 hours]

- PID structure and Empirical tuning
- Ziegler-Nichols (Z-N) Oscillation Method
- Reaction Curve Based Methods
- PI and PID Synthesis Revisited using Pole Assignment
- Smith Predictor

**Textbook:**

1. G.C. Goodwin, S.F. Graebe, M.E. Salgado, Control system design, Prentice Hall, 2001.