Topic: Algebra

Faculty Name: Prof. Gopal Srinivasan, IITB

Department: Mathematics

Relevant Semester **:** Nil

Relevant Department : Mathematics

Pre-Requisite : Nil

Course Description & Outline : The course description, outline and other details for this course will be decided at the Meet the Faculty Session to be scheduled by the 2nd/3rd week of June.

Topic: Application of Principle of Virtual Work in Finding Unknown Forces

Faculty Name: Prof. Devdas Menon

Department: Civil Engineering, IITM

Relevant Semester: 3rd

Relevant Course : Structural Analysis - 1

Pre-Requisite : Knowledge of Engineering Mechanics and Strength of Materials is preferable

Course Description & Outline :

- Introduction to Principle of virtual work, Validation of principle of virtual work. Derivation of expressions for external virtual work and internal virtual work for members subject to axial forces/deformations, bending moments/curvatures, shear forces/distortions and twisting moments/rotations.
- Demonstration of Principle of Virtual Displacements (PVD) to finding unknown reactions and internal forces in trusses and beams, and also collapse load in beams and frames (mechanism method).
- Demonstration of Principle of Virtual Forces (PVF) in finding unknown displacements for trusses beams and frames. Simplification of calculations of internal virtual work using area multiplication method. Application to finding deflections in statically indeterminate beams and frames.

Topic: Basics of Design of Machine Elements

Faculty Name: Prof. Narasimhan Swaminathan

Department: Mechanical Engineering, IITM

Relevant Semester: 5^{th}

Relevant Course : Design of Machine Elements.

Pre-Requisite : Knowledge of Strength of Materials is preferable

Course Description & Outline :

- Introduction to design, Stress based design, Stress Tensor, Principal stresses, stress invariants, Static Failure theories.
- Also covers Static Failure theories for ductile, brittle materials. Von-mises, tresca, mohr-coulomb and modified mohr theories. Some problems around static failure theories will be solved.
- Concept of SN diagram, endurance limit, correction to endurance limit. Effect of mean stresses and finite and infinite life based designs and associated safety factors. Problems will be discussed.

Topic: Chemical Reaction Engineering

Faculty Name: Prof. K Krishnaiah

Department: Chemical Engineering, IITM

Relevant Semester: 5th

Relevant Course & Department : Nil

Pre-Requisite : Nil

Course Description & Outline :

The information required for the design and operation of Chemical Reactors, which are the heart of any chemical process, will be presented. Background theory and applications will be discussed.

Topic: The topic will be decided at the Meet the Faculty Session to be scheduled by the 2nd/3rd week of June.

Faculty Name: Prof. Supratim Biswas

Department: Computer Science and Engineering.

Relevant Semester : Nil

Relevant Course : Compiler Design

Pre-Requisite : Nil

Course Description & Outline : The course description, outline and other details for this course will be decided at the Meet the Faculty Session to be scheduled by the 2nd/3rd week of June.

Topic: Computational Tools in Materials Technology

Faculty Name: Prof. MP Gururajan, IITB

Department: Metallurgical Engineering and Materials Science

Relevant Semester : 3rd

Relevant Course : Numerical methods or computational methods or computational tools course

Pre-Requisite : Knowledge in Engineering Mathematics and Introductory Materials Science is preferable and it's mandatory to bring a calculator.

Course Description & Outline :

- Data Analysis
- Eigenvalues, solution of simultaneous linear equations
- Thermodynamics
- Newton's law of cooling, steady state heat / mass transfer

Topic: Construction Planning and Control

Faculty Name: Prof. Koshy Varghese

Department: Civil Engineering, IITM

Relevant Semester: 6^{th} or 7^{th}

Relevant Course : Project Management

Pre-Requisite : Basic courses in Building Materials & Building Construction

Course Description & Outline :

Lectures will cover basic concepts required to develop a resource loaded plan based on the Critical Path Methodology.

Topic: Control Systems

Faculty Name: Prof. Anil Kumar, IIT Mandi

Department: Electrical Engineering

Relevant Semester : 3rd

Relevant Course : Control Systems

Pre-Requisite : Knowledge of Transfer function and Laplace transform and basic component of control system is preferable

Course Description & Outline :

- The focus of lecture will be in Time domain analysis of control system. It will cover time domain performance criteria and transient response, steady state response of first order and higher order system. How these quantive will vary under the influence of different controller, such as P, PI and PID controller.

Topic: Earth Pressure on Retaining Structure

Faculty Name: Prof. Deepankar Choudhury, IITB

Department: Civil Engineering

Relevant Semester: Nil

Relevant Course : Nil

Pre-Requisite : Nil

Course Description & Outline : The description, outline and other details for this course will be decided at the Meet the Faculty Session to be scheduled by the 2nd/3rd week of June.

Topic: Electromagnetic Waves

Faculty Name: Prof. Deepa Venkitesh, IITM

Department: Electrical Engineering

Relevant Semester: Nil

Relevant Course : Electromagnetic Fields

Pre-Requisite : Knowledge of Electrostatics and Magnetostatics is preferable.

Course Description & Outline :

- Review of Maxwells Equation
- Wave Equation and Plane wave solution will be covered.
- Wave Propagation in lossy dielectrics.
- Plane waves in losses dielectrics
- Plane waves in good conductors –Skin effect
- Power and Poynting vector

Topic: Engineering Drawing (Machine Drawing)

Faculty Name: Prof. S.R Kale, IITD

Department: Mechanical Engineering

Relevant Semester **:** Any Semester

Relevant Course : The topics are relevant to all branches of engineering

Pre-Requisite : Basic drawing capabilities, knowledge of projections, view etc (typical 1st year) would be preferable.

Course Description & Outline for Each Topic :

Drawing basics

- Importance of drawings in design and manufacturing.
- Drawing life cycle and product life cycle.
- Examples from engineering.
- Size, border, title block, instructions.
- Line types.
- Views and Projections

Dimensioning

- Basics
- Tolerances
- Fits
- Geometrical Dimensioning & Tolerancing GDT
- Features (fillet, undercut, boss, chamfer etc)

General Arrangement and Assembly

- Information and use of GA drawings
- Part numbering and BoM
- Planning of assembly drawings

Common Symbols for Components

- Fasteners, anti friction bearings, springs, gears etc.

Drawing use and Preparation

- Reading drawings-Correctness and Completeness
- Mark up and version control
- Planning the making of a drawing (Number of views and which ones? Sectioning? Etc)

Practice and Case Studies

- Case studies and examples of drawings and typical shortcomings
- Examples of best practices

Topic: Engineering Drawing: Plant Engineering

Faculty Name: Prof. S.R Kale, IITD

Department: Mechanical Engineering

Relevant Semester **:** Any Semester

Relevant Course : These drawings are cross disciplinary and relevant to all branches of engineering.

Pre-Requisite : Basic drawing capabilities would be preferable.

Course Description & Outline for Each Topic :

Overview

- Plant Engineering – Integrations of Equipment.
- I & C, Civil layouts, Electrical Cables.
- Types of drawings generated
- Examples process industries-power plants, refineries, services+

Schematic drawing/Flow Diagram/Process flow diagram

- Symbols of Equipment
- Lines.
- Integration to attain performance
- Stand by capacity
- Redundancy,+
- Bill of Materials

Process Instrumentation & Control (PIC) drawing

- Symbols of Instruments
- Requirement assessment
- Placing and integrating on a schematic drawing
- Redundancy
- Lines for Instrumentation signals and controls
- Bill of Materials

Layout Drawings

- Basics of architectural & structural drawings
- Placing equipment
- Mounting requirements-Example-foundation, pipe and cable trenches & trays/racks.
- Access. Lifting. Safety

Piping Drawing

- Pipe layout design with information from schematic, GA and layout drawings
- Isometric plan and elevation representation of piping
- Insulation, slopes, support etc.
- Bill of Materials

Line diagrams (Wiring Diagrams)

- Basic symbols of electrical equipment and their connections.
- Cable layout on drawings
- Bill of Materials

Topic Name: English for Employability

Faculty Name: Dr. Vineeta Prasad

Department: Bridge Program

Relevant Semester **:** 5th and 7th preferred but open to all.

Relevant Course : Spoken English

Pre-Requisite : Nil

Course Description & Outline :

- Help learners significantly improve their communication skills
- Enable the students to join the realm of people who speak polished English. It will act as a catalyst and help learners make significant, positive changes in the way they conduct and present themselves, both in the work place and in social interaction
- This course which has been carefully crafted to strike a balance between "how we speak" and "what we say" will help students develop their social skills and improve their employability.

Session Dates

Module Name- English for Employability

- Session 1 – 21st August, Friday- 10 to 12 noon
- Session 2 – 28th August, Friday- 2 to 4pm
- Session 3 – 2nd September, Wednesday- 10 to 12 pm
- Session 4 – 4th September, Friday- 10 to 12 pm
- Session 5 – 11th September, Friday- 2 to 4 pm
- Session 6 – 16 September, Wednesday- 2 to 4 pm
- Session 7 – 18th September, Friday- 10 to 12 pm
- Session 8 – 23rd September, Wednesday- 10 to 12 pm
- Session 9 – 29th September, Tuesday- 2 to 4 pm
- Session 10 – 1st October, Thursday- 10 to 12 pm
- Session 11 – 7th October, Tuesday- 2 to 4pm
- Session 12 – 9th October, Friday- 2 to 4 pm
- Session 13 – 14th October, Wednesday- 10 to 12 pm

Topic: Fluid Mechanics: Physical and Mathematical Foundations

Faculty Name: Dr.Suman Chakraborty, IIT Kharagpur

Department: Mechanical Engineering.

Relevant Semester : 3rd

Relevant Course : Fluid Mechanics

Pre-Requisite : Knowledge of Engineering Mathematics with integral calculus, differential calculus and vector calculus is preferable.

Course Description & Outline :

- 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
- Reynolds transport theorem - conservation of mass, linear and angular momentum
- Continuity equation, Navier-Stokes equations – derivations and some exact solutions

Topic: Foundation of Machine Learning.

Faculty Name: Sudeshna Sarkar, IIT-Kharagpur

Department: Computer Science & Engineering Department

Relevant Semester : 3rd & higher

Relevant Course : Machine Learning

Pre-Requisite : A course on probability and Statistics is preferable.

Course Description & Outline :

- Introduction to supervised learning -- classification and regression.
- Features, Hypothesis space.
- Underfitting and overfitting
- Inductive Bias, The Bias-Variance tradeoff and decomposition
- Feature Selection, Dimensionality Reduction
- Learnability: Basic introduction to Computational Learning Theory, VC dimension.

Topic: Fundamentals of Small Signal Analysis

Faculty Name: Prof. Shanthi Pavan

Department: Electrical Engineering, IITM

Relevant Semester: 5th but can be done in any sememster

Relevant Course : Analog Circuits, Electronic Circuits.

Pre-Requisite : Knowledge in Taylor Series.

Course Description & Outline :

This Module will introduce the principle behind small signal analysis of analog electronic circuits.

Topic: Graphs and Strings

Faculty Name: Prof. G. Venkitesh, IITM

Department: Electrical Engineering

Relevant Semester: 5th

Relevant Course : Advanced Data Structures and Algorithms

Pre-Requisite : Knowledge of Data Structures and Algorithm is preferable.

Course Description & Outline :

- Elementary Graph Algorithms: Representations of Graphs – Breadth-First
- Search – Depth-First Search – Topological Sort – Strongly Connected Components- Minimum Spanning
- Trees: Growing a Minimum Spanning Tree – Kruskal and Prim- Single-Source Shortest Paths: The
- Bellman-Ford algorithm – Single-Source Shortest paths in Directed Acyclic Graphs – Dijkstra's Algorithm;
- AllPairs Shortest Paths: Shortest Paths and Matrix Multiplication – The Floyd-Warshall Algorithm;
- Maximum Flow: Flow Networks – The Ford-Fulkerson method – Maximum Bipartite Matching; String
- Matching: The Native String-Matching Algorithm – The Knuth-Morris-Pratt Algorithm

Topic: Introduction to Slope Stability Analysis

Faculty Name: Dr. Santiram Chatterjee, IIT Bombay

Department: Civil Engineering.

Relevant Semester : 5th

Relevant Course : Geo technical Engineering.

Pre-Requisite : Knowledge of Shear Strength of Soil is preferable

Course Description & Outline :

- Types of slopes
- Factors inducing instability
- Types of instability
- Methods of slope stability analysis
    a) Finite Slope Analysis (Total and Effective Stress Analysis)
    b) Infinite Slope Analysis
- Common Methods of Slope Stabilization.

Topic: Machine Learning

Faculty Name: Prof. Balaraman Ravindran

Department: Computer Science Engineering, IITM

Relevant Semester: Nil

Relevant Course : Machine Learning

Pre-Requisite : Nil

Course Description & Outline :

Reinforcement Learning

- Introduction to the reinforcement learning problem; Elements of reinforcement learning; Immediate Reinforcement Learning: N-Armed Bandit
- Dynamic Programming based approaches: Value Iteration, Policy Iteration.
- Temporal Difference Learning: TD learning, Q learning and SARSA; Exploration Strategies; A brief introduction to Eligibility Traces and TD(lambda)
- Generalization: Linear function approximation
- Policy search based methods: REINFORCE and extensions.
- Partially Observable Problems: A brief introduction. RL and Deep Learning.

Topic: Manipulator Kinematics

Faculty Name: Dr. T. Asokan, IITM

Department: Engineering Design

Relevant Semester: 5th or 7th

Relevant Course : Robotics and Robot Applications

Pre-Requisite : Nil

Course Description & Outline : Mechanics - Kinematic parameters and modelling, direct and inverse kinematics.

Topic: MIMO and Massive MIMO

Faculty Name: Zafar Ali Khan

Department: Department of Electrical Engineering, IIT Hyderabad

Relevant Semester **:** Nil

Relevant Course **:** Wireless Communication

Pre-Requisite **:** Nil

Course Description and Outline :

The description, outline and other details for this course will be decided at the Meet the Faculty Session to be scheduled by the 2nd/3rd week of June.

Topic: Program Testing

Faculty Name: Prof. Rajib Mall, IIT Kharagpur

Department: Computer Science

Relevant Semester: 3rd year

Relevant Course : Software Enginnering

Pre-Requisite : Experience in C programming and object-oriented programming using languages such as C++ or Java. Knowledge of software requirements specification is preferable.

Course Description & Outline :

- The module will address testing a program at the levels of unit, integration, and system. For unit testing, both black-box and white-box techniques shall be discussed with the help of example test case design problems. For black box testing, besides equivalence partitioning and boundary value analysis, cause-effect graphing and combinatorial testing shall be discussed.
- For white-box testing, besides coverage-based testing techniques, Mutation testing shall be discussed.
- For system testing, both functional and performance testing techniques shall be discussed. Testing techniques for object-oriented programs shall be included. Automated testing will be covered and a few open source testing tools would be included in the discussions and participants would be encouraged to use these tools.

Topic: Site Investigation & Exploration

Faculty Name: V B Maji

Department: Department of Civil Engineering, IIT Madras

Relevant Semester **:** 5th and above

Relevant Course **:** Geotechnical Engineering

Pre-Requisite **:** Background in Soil Basics is preferable

Course Description and Outline :

To obtain information on the subsurface soil and rock to design earthworks and foundations for a proposed structure/ excavation. Module will mostly cover various topics on site investigation methodologies, drilling and subsurface exploration techniques, sampling methods and various insitu-field testing.

Topic: The topic for this course will be decided at the Meet the Faculty Session to be scheduled by the 2nd/3rd week of June.

Faculty Name: Prof. Niloy Ganguly, IIT-KGP

Department: Computer Science and Engineering

Relevant Semester: Nil

Relevant Course : Smart Phone Computing

Pre-Requisite :

Course Description & Outline :

The course description, outline and other details for this course will be decided at the Meet the Faculty Session to be scheduled by the 2nd/3rd week of June.

Topic: Solar DC power for Residential and Business Sectors

Faculty Name: Prof.Ashok Jhunjhunwala, IITM

Department: Electrical Engineering.

Relevant Semester/Year : 3rd /4th year

Relevant Course : Power Systems

Pre-Requisite : Knowledge of power electronics is preferable

Course Description & Outline :

- DC powering for appliances: Use of direct DC power rather than AC power to power appliances: Efficiencies, Availability, Costs
- Direct DC power from Solar PV: Use of solar PV power without DC – AC converter – efficiencies, implementation
- Integrating batteries on DC power lines.
- Concept of Uninterrupted DC Power for residential sector; load-management to bridge Demand – Supply Gap

Topic: Solid State Devices

Faculty Name: Prof. Shreepad Karmalkar, IITM

Department: Electrical Department.

Relevant Semester **:** Nil

Relevant Course & Department : Nil

Pre-Requisite : Nil

Course Description & Outline : The course description, outline and other details for this course will be decided at the Meet the Faculty Session to be scheduled by the 2nd/3rd week of June.

Topic: Space Time Codes

Faculty Name: Zafar Ali Khan

Department: Department of Electrical Engineering, IIT Hyderabad

Relevant Semester **:** Nil

Relevant Course **:** Wireless Communication

Pre-Requisite **:** Nil

Course Description and Outline :

The description, outline and other details for this course will be decided at the Meet the Faculty Session to be scheduled by the 2nd/3rd week of June.

Topic: Spectral Theorem

Faculty Name: Prof. Gopal Srinivasan, IITB

Department: Mathematics

Relevant Semester **:** Nil

Relevant Department : Mathematics

Pre-Requisite : Nil

Course Description & Outline : The course description, outline and other details for this course will be decided at the Meet the Faculty Session to be scheduled by the $2^{nd}/3^{rd}$ week of June.

Topic: Structure, Bonding in Organic Molecules and Structure and Reactivity

Faculty Name: Dr. P.C. Ravikumar, IIT Mandi

Department: Chemistry

Relevant Semester **:** Nil

Relevant Course & Department : Organic Chemistry

Pre-Requisite : Chemistry as a subject at higher secondary level

Course Description & Outline :

- Coulomb forces, ionic and covalent bonds, electron dot model of bonding. A quantum mechanical description of electrons around nucleus, molecular orbital and covalent bonding, hybrid orbital. Chapter integration problems.
- Kinetics and thermodynamics of simple chemical processes, acids and bases, electrophiles and nucleophiles, functional groups, rotation around single bonds, conformations, chapter integration problems.

Topic: The Nitty-Gritty of Logic Gates to Processor Design

Faculty Name: Prof.Ashok Jhunjhunwala, IITM

Department: Electrical Engineering.

Relevant Semester/Year : 3rd year

Relevant Course : Computer Organization & Architecture

Pre-Requisite : Digital Circuits (1st Course) and some programming is required.

Course Description & Outline :

- 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)**