

Lecture 1 - Introduction

Lecture 2 - Flow Classifications

Lecture 3 - Laws of Convection

Lecture 4 - Scalar Transport Equations

Lecture 5 - Laminar Boundary Layers

Lecture 6 - Similarity Method

Lecture 7 - Similarity Solns Velocity BL

Lecture 8 - Similarity Solns Temperature BL - I

Lecture 9 - Similarity Solns Temperature BL - II

Lecture 10 - Integral BL Equations

Lecture 11 - Integral Solns Laminar Velocity BL

Lecture 12 - Integral Solns Laminar Temperature BL

Lecture 13 - Superposition Theory

Lecture 14 - Laminar Internal Flows

Lecture 15 - Fully-Developed Laminar Flows - 1

Lecture 16 - Fully-Developed Laminar Flows - 2

Lecture 17 - Fully-Developed Laminar Flows Heat Transfer - 1

Lecture 18 - Fully-Developed Laminar Flows Heat Transfer - 2

Lecture 19 - Laminar Internal Developing Flows Heat Transfer

Lecture 20 - Superposition Technique

Lecture 21 - Nature of Turbulent Flows

Lecture 22 - Sustaining Mechanism of Turbulence - 1

Lecture 23 - Sustaining Mechanism of Turbulence - 1

Lecture 24 - Sustaining Mechanism of Turbulence - 2

Lecture 25 - Near-Wall Turbulent Flows - 1

Lecture 26 - Near-Wall Turbulent Flows - 2

Lecture 27 - Turbulence Models - 1

Lecture 28 - Turbulence Models - 2

Lecture 29 - Turbulence Models - 3

Lecture 30 - Prediction of Turbulent Flows

Lecture 31 - Prediction of Turbulent Heat Transfer

[Lecture 32 - Convective Mass Transfer](#)

[Lecture 33 - Stefan Flow Model](#)

[Lecture 34 - Couette Flow Model](#)

[Lecture 35 - Reynolds Flow Model](#)

[Lecture 36 - Boundary Layer Flow Model](#)

[Lecture 37 - Evaluation of  \$g\$  and  \$Nw\$](#)

[Lecture 38 - Diffusion Mass Transfer Problems](#)

[Lecture 39 - Convective MT Couette Flow](#)

[Lecture 40 - Convective MT Reynolds Flow Model - 1](#)

[Lecture 41 - Convective MT Reynolds Flow Model - 2](#)

[Lecture 42 - Natural Convection](#)

[Lecture 43 - Diffusion Jet Flames](#)

- Lecture 1 - Introduction to Cryogenic Engineering
- Lecture 2 - Properties of Cryogenic Fluids - I
- Lecture 3 - Properties of Cryogenic Fluids - II
- Lecture 4 - Properties of Cryogenic
- Lecture 5 - Material Properties at Low Temperature - I
- Lecture 6 - Material Properties at Low Temperature - II
- Lecture 7 - Material Properties at Low Temperature - III
- Lecture 8 - Gas Liquefaction and Refrigeration Systems - I
- Lecture 9 - Gas Liquefaction and Refrigeration Systems - II
- Lecture 10 - Gas Liquefaction and Refrigeration Systems - III
- Lecture 11 - Gas Liquefaction and Refrigeration Systems - IV
- Lecture 12 - Gas Liquefaction and Refrigeration Systems - V
- Lecture 13 - Gas Liquefaction and Refrigeration Systems - VI
- Lecture 14 - Gas Liquefaction and Refrigeration Systems - VII
- Lecture 15 - Gas Liquefaction and Refrigeration Systems - VIII
- Lecture 16 - Gas Liquefaction and Refrigeration Systems - IX
- Lecture 17 - Gas Liquefaction and Refrigeration Systems - X
- Lecture 18 - Gas Separation - I
- Lecture 19 - Gas Separation - II
- Lecture 20 - Gas Separation - III
- Lecture 21 - Gas Separation - IV
- Lecture 22 - Gas Separation - V
- Lecture 23 - Gas Separation - VI
- Lecture 24 - Gas Separation - VII
- Lecture 25 - Gas Separation - VIII
- Lecture 26 - Cryocoolers
- Lecture 27 - Cryocoolers Ideal Stirling Cycle - I
- Lecture 28 - Cryocoolers Ideal Stirling Cycle - II
- Lecture 29 - Cryocoolers Ideal Stirling Cycle - III
- Lecture 30 - Cryocoolers Ideal Stirling Cycle - IV
- Lecture 31 - Cryocoolers Ideal Stirling Cycle - V

[Lecture 32 - Cryocoolers](#)

[Lecture 33 - Cryogenic Insulation - I](#)

[Lecture 34 - Cryogenic Insulation - II](#)

[Lecture 35 - Cryogenic Insulation - III](#)

[Lecture 36 - Vacuum Technology - I](#)

[Lecture 37 - Vacuum Technology - II](#)

[Lecture 38 - Vacuum Technology - III](#)

[Lecture 39 - Instrumentation in Cryogenics - I](#)

[Lecture 40 - Instrumentation in Cryogenics - II](#)

[Lecture 41 - Instrumentation in Cryogenics - III](#)

[Lecture 42 - Safety in Cryogenics](#)

Lecture 1 - Stress and Strain Tensor

Lecture 2 - Stress and Strain Tensor (Continued) and Cauchy Formula for Traction

Lecture 3 - Examples on Calculation of Strains and Tractions, Principal Stresses and Directions

Lecture 4 - Example on Calculation of Principal Stresses and Directions, Orthogonality of Principal Directions, Principal Stresses are all Real

Lecture 5 - Maximum Shear Stress and Octahedral Shear Stress, Deviatoric and Hydrostatic Stresses

Lecture 6 - Transformation of Stresses and Mohr Circle in 3-D

Lecture 7 - Mohr Circle (Continued)

Lecture 8 - Deformation, Rotation and Strain Tensors, Principal Strains, Deviatoric and Hydrostatic Strains

Lecture 9 - Strain Transformations, Strains in Polar Coordinates, Equilibrium Equations in 2-D

Lecture 10 - Equilibrium Equations in 2-D Polar Coordinates Plane Stress and Plane Strain Conditions

Lecture 11 - Stress-Strain Relations for Isotropic, Orthotropic and Anisotropic Materials Stress-Strain-Temperature Relations

Lecture 12 - Relation between Elastic Constants and Strain Energy Densities Recap of Lectures 1 to 11

Lecture 13 - Stress Distribution in Thick Cylinder

Lecture 14 - Stresses due to Shrink Fitting

Lecture 15 - Stresses in Rotating Disc

Lecture 16 - Examples on Shrink Fitting and Rotating Disc

Lecture 17 - Torsion of Non-Circular Shaft

Lecture 18 - Torsion of Non-Circular Shaft (Continued)

Lecture 19 - Membrane Analogy for Torsion

Lecture 20 - Torsion of Thin Box Sections

Lecture 21 - Torsion of Box and Open Sections

Lecture 22 - Bending of Curved Bars

Lecture 23 - Bending of Curved Bars (Continued)

Lecture 24 - Theories of Failure

Lecture 25 - Theories of Failure (Continued)

Lecture 26 - Theories of Failure (Continued) and Their Applications, Griffith Theory of Brittle Fracture

Lecture 27 - Application of Griffith Theory, Irwin-Orowan Modification of Griffith Theory, Assessment of Effect of Dynamic Loading

Lecture 28 - Theorems of Elasticity

Lecture 29 - Theorems of Elasticity (Continued)

Lecture 30 - Thermal Stress Distribution in Rectangular Sheet due to Symmetric and Asymmetric Temperature Fields

[Lecture 31 - Thermal Stress Distribution in Cylinders](#)

[Lecture 32 - Unsymmetrical Bending](#)

[Lecture 33 - Shear Centre](#)

[Lecture 34 - Plate Bending](#)

[Lecture 35 - Plate Bending \(Continued\)](#)

[Lecture 36 - Examples on Plate Bending](#)

[Lecture 37 - Approximate Solutions for Bending of Rectangular and Circular Plates](#)

[Lecture 38 - Thin Shells of Revolution](#)

[Lecture 39 - Beam on Elastic Foundation](#)

[Lecture 40 - Application of Beam on Elastic Foundation Analysis to Pressure Vessels for Calculation of Discontinuity Stresses](#)

Lecture 1 - Introduction to Heat and Mass Transfer

Lecture 2 - Introduction

Lecture 3 - Introduction

Lecture 4 - Heat Conduction - 1

Lecture 5 - Heat Conduction - 2

Lecture 6 - Heat Conduction - 3

Lecture 7 - Heat Conduction - 4

Lecture 8 - Heat Conduction - 5

Lecture 9 - Heat Conduction - 6

Lecture 10 - Thermal Radiation - 1

Lecture 11 - Thermal Radiation - 2

Lecture 12 - Thermal Radiation - 3

Lecture 13 - Thermal Radiation - 4

Lecture 14 - Thermal Radiation - 5

Lecture 15 - Thermal Radiation - 6

Lecture 16 - Review Of Fluid Mechanics - 1

Lecture 17 - Review Of Fluid Mechanics - 2

Lecture 18 - Forced Convection - 1

Lecture 19 - Forced Convection - 2

Lecture 20 - Forced Convection - 3

Lecture 21 - Forced Convection - 4

Lecture 22 - Natural Convection - 1

Lecture 23 - Natural Convection - 2

Lecture 24 - Natural Convection - 3

Lecture 25 - Heat Exchangers - 1

Lecture 26 - Heat Exchangers - 2

Lecture 27 - Heat Exchangers - 3

Lecture 28 - Heat Exchangers - 4

Lecture 29 - Boiling and Condensation - 1

Lecture 30 - Boiling and Condensation - 2

Lecture 31 - Boiling and Condensation - 3

[Lecture 32 - Boiling and Condensation - 4](#)

[Lecture 33 - Introduction to Mass Transfer - 1](#)

[Lecture 34 - Introduction to Mass Transfer - 2](#)

[Lecture 35 - Introduction to Mass Transfer - 3](#)



Lecture 1 - Introduction to Robotics

Lecture 2 - Technologies in Robots

Lecture 3 - Industrial Robots

Lecture 4 - Industrial Manipulators and its Kinematics

Lecture 5 - Parallel Manipulators

Lecture 6 - Grippers manipulators

Lecture 7 - Electric Actuators

Lecture 8 - Actuators - Electric, Hydraulic, Pneumatic

Lecture 9 - Internal State Sensors

Lecture 10 - Internal State Sensors

Lecture 11 - External State Sensors

Lecture 12 - Trajectory planning

Lecture 13 - Trajectory planning

Lecture 14 - Trajectory planning

Lecture 15 - Trajectory planning

Lecture 16 - Trajectory planning

Lecture 17 - Trajectory planning

Lecture 18 - Trajectory planning

Lecture 19 - Trajectory planning

Lecture 20 - Forward Position Control

Lecture 21 - Inverse Problem

Lecture 22 - Velocity Analysis

Lecture 23 - Velocity Analysis

Lecture 24 - Dynamic Analysis

Lecture 25 - Image Processing

Lecture 26 - Image Processing

Lecture 27 - Image Processing

Lecture 28 - Image Processing

Lecture 29 - Image Processing

Lecture 30 - Image Processing

Lecture 31 - Robot Dynamics and Control

[Lecture 32 - Robot Dynamics and Control](#)

[Lecture 33 - Robot Dynamics and Control](#)

[Lecture 34 - Robot Dynamics and Control](#)

[Lecture 35 - Robot Dynamics and Control](#)

[Lecture 36 - Robot Dynamics and Control](#)

[Lecture 37 - Futuristic Topics in Robotics](#)

[Lecture 38 - Robot Dynamic and Control-Case Studies](#)

[Lecture 39 - Robot Dynamic and Control-Case Studies](#)

[Lecture 40 - Futuristic Topics in Robotics](#)

Lecture 1 - Introduction

Lecture 2 - Isoperimetric problem

Lecture 3 - Review of real analysis (sequences and convergence)

Lecture 4 - Bolzano-Weierstrass theorem and completeness axiom

Lecture 5 - Open sets, closed sets and compact sets

Lecture 6 - Continuity and Weierstrass theorem

Lecture 7 - Weierstrass theorem

Lecture 8 - Different solution concepts

Lecture 9 - Different types of constraints

Lecture 10 - Taylor's theorem

Lecture 11 - First order sufficient condition

Lecture 12 - Second order necessary condition

Lecture 13 - Least square regression

Lecture 14 - Least square regression (Continued...)

Lecture 15 - Implicit function theorem

Lecture 16 - Optimization with equality constraints and introduction to Lagrange multipliers - I

Lecture 17 - Optimization with equality constraints and introduction to Lagrange multipliers - II

Lecture 18 - Least norm solution of underdetermined linear system

Lecture 19 - Transformation of optimization problems - I

Lecture 20 - Transformation of optimization problems - II

Lecture 21 - Transformation of optimization problems - III

Lecture 22 - Convex Analysis - I

Lecture 23 - Convex Analysis - II

Lecture 24 - Convex Analysis - III

Lecture 25 - Polyhedrons

Lecture 26 - Minkowski-Weyl Theorem

Lecture 27 - Linear Programming Problems

Lecture 28 - Extreme points and optimal solution of an LP

Lecture 29 - Extreme points and optimal solution of an LP (Continued...)

Lecture 30 - Extreme points and basic feasible solutions

Lecture 31 - Equivalence of extreme point and BFS

[Lecture 32 - Equivalence of extreme point and BFS \(Continued...\)](#)

[Lecture 33 - Examples of Linear Programming](#)

[Lecture 34 - Weak and Strong duality](#)

[Lecture 35 - Proof of strong duality](#)

[Lecture 36 - Proof of strong duality \(Continued...\)](#)

[Lecture 37 - Farkas' lemma](#)

[Lecture 38 - Max-flow Min-cut problem](#)

[Lecture 39 - Shortest path problem](#)

[Lecture 40 - Complementary Slackness](#)

[Lecture 41 - Proof of complementary slackness](#)

[Lecture 42 - Tangent cones](#)

[Lecture 43 - Tangent cones \(Continued...\)](#)

[Lecture 44 - Constraint qualifications, Farkas' lemma and KKT](#)

[Lecture 45 - KKT conditions](#)

[Lecture 46 - Convex optimization and KKT conditions](#)

[Lecture 47 - Slater condition and Lagrangian Dual](#)

[Lecture 48 - Weak duality in convex optimization and Fenchel dual](#)

[Lecture 49 - Geometry of the Lagrangian](#)

[Lecture 50 - Strong duality in convex optimization - I](#)

[Lecture 51 - Strong duality in convex optimization - II](#)

[Lecture 52 - Strong duality in convex optimization - III](#)

[Lecture 53 - Line search methods for unconstrained optimization](#)

[Lecture 54 - Wolfe conditions](#)

[Lecture 55 - Line search algorithm and convergence](#)

[Lecture 56 - Steepest descent method and rate of convergence](#)

[Lecture 57 - Newton's method](#)

[Lecture 58 - Penalty methods](#)

[Lecture 59 - L1 and L2 Penalty methods](#)

[Lecture 60 - Augmented Lagrangian methods](#)

[Lecture 61 - Cutting plane methods](#)

[Lecture 62 - Interior point methods for linear programming](#)

[Lecture 63 - Dynamic programming: Inventory control problem](#)

[Lecture 64 - Policy and value function](#)

[Lecture 65 - Principle of optimality in dynamic programming](#)

[Lecture 66 - Principle of optimality applied to inventory control problem](#)

[Lecture 67 - Optimal control for a system with linear state dynamics and quadratic cost](#)

Lecture 1 - Introduction

Lecture 2 - Elements of Mechatronic Systems - Part I

Lecture 3 - Elements of Mechatronic Systems - Part II

Lecture 4 - Elements of Mechatronic Systems - Part III

Lecture 5 - CD-ROM - Part I

Lecture 6 - CD-ROM - Part II

Lecture 7 - CD-ROM - Part III

Lecture 8 - Scanner

Lecture 9 - Integrated Mechanical-Electronics Philosophy - Part I

Lecture 10 - Integrated Mechanical-Electronics Philosophy - Part II

Lecture 11 - Smart Sensors Concept

Lecture 12 - Compliant Mechanisms

Lecture 13 - Microprocessor Building Blocks I - Combinational Circuits

Lecture 14 - Microprocessor Building Blocks II - Sequential Circuits

Lecture 15 - Microprocessor Memory and Addressing

Lecture 16 - Timing and control unit: Primitive Microprocessor

Lecture 17 - Microcontroller Architecture - I

Lecture 18 - Microcontroller Architecture - II

Lecture 19 - Microcontroller Programming Philosophy

Lecture 20 - Hardware Interfaces

Lecture 21 - Interfacing Actuator using PWM in Tiva Microcontroller

Lecture 22 - Interfacing Encoder using QEI in Tiva Launchpad + ISR

Lecture 23 - Mathematical Modelling: Overview and Context

Lecture 24 - Modelling Friction in a System

Lecture 25 - Modelling DC Motor with loads

Lecture 26 - Lagrange formulation fundamentals

Lecture 27 - Lagrange formulation examples

Lecture 28 - Dynamics: 2-R Manipulator

Lecture 29 - Control formulation: Regulation and Tracking

Lecture 30 - Fundamentals of Simulation of dynamics using MATLAB

Lecture 31 - Selection of Sensors and Actuators - Part I

- Lecture 32 - Selection of Sensors and Actuators - Part II
- Lecture 33 - Concept of feedback
- Lecture 34 - Closed loop control implementation in microcontroller
- Lecture 35 - Mathematical representations of systems for control
- Lecture 36 - Control design for linear systems
- Lecture 37 - Application of control design for linear systems
- Lecture 38 - Mathematical Preliminaries- Nonlinear Control
- Lecture 39 - Fundamentals of Lyapunov theory
- Lecture 40 - Application of Lyapunov stability analysis
- Lecture 41 - Trajectory tracking controller: Robotic system
- Lecture 42 - Fundamentals of sampling
- Lecture 43 - Shannon sampling theorem and signal reconstruction
- Lecture 44 - Signal processing
- Lecture 45 - Digital system representation and filters for mechatronics
- Lecture 46 - Case study: Development of 3D microprinting system
- Lecture 47 - Case study: 3D microprinting via Bulk lithography
- Lecture 48 - Case study: Hele-Shaw system for novel fabrication

Lecture 1 - Basic Concepts and Nomenclature

Lecture 2 - Preliminaries - Part 1

Lecture 3 - Preliminaries - Part 2

Lecture 4 - Preliminaries - Part 3

Lecture 5 - Preliminaries - Part 4

Lecture 6 - Preliminaries - Part 5

Lecture 7 - Barbalat's Lemma - Part 1

Lecture 8 - Barbalat's Lemma - Part 2

Lecture 9 - Convergence of Signals using Barbalat's Lemma - Part 1

Lecture 10 - Convergence of Signals using Barbalat's Lemma - Part 2

Lecture 11 - Notions of Stability - Part 1

Lecture 12 - Notions of Stability - Part 2

Lecture 13 - Stability Analysis with Examples - Part 1

Lecture 14 - Stability Analysis with Examples - Part 2

Lecture 15 - Stability Analysis with Examples - Part 3

Lecture 16 - Stability Analysis with Examples - Part 4

Lecture 17 - Stability Analysis in Linear Systems

Lecture 18 - Function Classes and Definiteness

Lecture 19 - Positive Definite Functions

Lecture 20 - Radially Unbounded Functions

Lecture 21 - Decrescent Functions

Lecture 22 - Lyapunov Stability Theorems - Part 1

Lecture 23 - Lyapunov Stability Theorems - Part 2

Lecture 24 - Lyapunov Stability Theorems - Part 3

Lecture 25 - Exponential Stability and Converse Lyapunov Theorems

Lecture 26 - Persistence of Excitation (PE): Introduction

Lecture 27 - Connection of PE to Stability, Uniform Complete Observability (UCO)

Lecture 28 - Exponential Stability of LTV systems, PE and Exponential Stability

Lecture 29 - Parameter Identifier Convergence under PE Condition

Lecture 30 - Analysis of Parameter Varying Systems using General Integral Lemma - Part 1

Lecture 31 - Analysis of Parameter Varying Systems using General Integral Lemma - Part 2



- Lecture 32 - Adaptive Control Design: First Order Scalar Systems
- Lecture 33 - Barbalat's Lemma and Signal Chasing Analysis
- Lecture 34 - Parameter Convergence in Adaptive Control Design
- Lecture 35 - Adaptive Control Design: Second-Order Systems
- Lecture 36 - Overcoming the Detectability Obstacle: Ortega Construction
- Lecture 37 - Backstepping in Adaptive Control: Introduction - Part 1
- Lecture 38 - Backstepping in Adaptive Control: Introduction - Part 2
- Lecture 39 - Backstepping in Adaptive Control: Parameters Unmatched with Control - Part 1
- Lecture 40 - Backstepping in Adaptive Control: Parameters Unmatched with Control - Part 2
- Lecture 41 - How to Deal with Unknown Gains in Control
- Lecture 42 - Setup of Model Reference Adaptive Control (MRAC) Problem
- Lecture 43 - Model Reference Adaptive control: For Known and Unknown Parameters
- Lecture 44 - Model Reference Adaptive control: Lyapunov Stability Analysis
- Lecture 45 - Generalization of Adaptive Integrator Backstepping Method - Part 1
- Lecture 46 - Generalization of Adaptive Integrator Backstepping Method - Part 2
- Lecture 47 - Extended Matching Design for Avoiding Overparameterization
- Lecture 48 - Adaptive Integrator Backstepping Method: An Example - Part 1
- Lecture 49 - Adaptive Integrator Backstepping Method: An Example - Part 2
- Lecture 50 - Extended Matching Design: An Example
- Lecture 51 - Control Lyapunov Function
- Lecture 52 - Tuning Function Adaptive Method
- Lecture 53 - Adaptive Backstepping via Control Lyapunov Function (CLF)
- Lecture 54 - Adaptive Backstepping via CLF: An Example
- Lecture 55 - Robustness in Adaptive Control - Part 1
- Lecture 56 - Robustness in Adaptive Control - Part 2
- Lecture 57 - Parameter Projection in Adaptive Control - Part 1
- Lecture 58 - Parameter Projection in Adaptive Control - Part 2
- Lecture 59 - Parameter Projection in Adaptive Control - Part 3
- Lecture 60 - Sigma- Modification and Epsilon-Modification in Adaptive Control
- Lecture 61 - Initial Excitation in Adaptive Control - Part 1
- Lecture 62 - Initial Excitation in Adaptive Control - Part 2
- Lecture 63 - Initial Excitation in Adaptive Control - Part 3
- Lecture 64 - Initial Excitation in Adaptive Control - Part 4

[Lecture 65 - Initial Excitation in Adaptive Control - Part 5](#)

[Lecture 66 - Discussion on Historical Developments in Adaptive Control and Learning](#)

[Lecture 67 - Real Time Neural Network Based Control of a Robotic Manipulator - Part 1](#)

[Lecture 68 - Real Time Neural Network Based Control of a Robotic Manipulator - Part 2](#)

[Lecture 69 - Real Time Neural Network Based Control of a Robotic Manipulator - Part 3](#)

[Lecture 70 - Real Time Neural Network Based Control of a Robotic Manipulator - Part 4](#)

[Lecture 71 - Real Time Neural Network Based Control of a Robotic Manipulator - Part 5](#)

Lecture 1 - Introduction

Lecture 2 - Interdisciplinary Approach and Economic Benefits

Lecture 3 - Friction

Lecture 4 - Friction Estimation

Lecture 5 - Friction Instability

Lecture 6 - Wear

Lecture 7 - Adhesive Wear

Lecture 8 - Wear Mechanisms

Lecture 9 - Wear Mechanisms - 2

Lecture 10 - Wear Analysis

Lecture 11 - Lubrication and Lubricants

Lecture 12 - Boundary Lubrication

Lecture 13 - Lubrication Mechanisms

Lecture 14 - Hydrodynamic Lubrication

Lecture 15 - Lubricant Classifications

Lecture 16 - Solid and Semi Solid Lubricants

Lecture 17 - Liquid Lubricants

Lecture 18 - Lubricant Additives

Lecture 19 - Fluid Film Lubrication

Lecture 20 - Reynolds Equation

Lecture 21 - Solution of Reynolds Equation

Lecture 22 - Hybrid Solution Approach (to solve Reynolds Equation)

Lecture 23 - Finite Difference Method to Solve Reynolds Equation

Lecture 24 - Viscosity Variation

Lecture 25 - Estimating Elastic Deformation

Lecture 26 - Thermo Hydrodynamic Lubrication

Lecture 27 - Application of Tribology

Lecture 28 - Rolling Element Bearings

Lecture 29 - Rolling Element Bearings (Continued...)

Lecture 30 - Rolling Element Bearings (Continued...)

Lecture 31 - Selection of Rolling Element Bearings

[Lecture 32 - Friction of Rolling Element Bearing](#)

[Lecture 33 - Bearing Clearance](#)

[Lecture 34 - Bearing Lubrication](#)

[Lecture 35 - Tribology of Gears](#)

[Lecture 36 - Friction and Lubrication of Gears](#)

[Lecture 37 - Friction and Lubrication of Gears \(Continued...\)](#)

[Lecture 38 - Surface Fatigue of Spur Gears](#)

[Lecture 39 - Journal Bearings](#)

[Lecture 40 - Hydrostatic Bearings](#)

[Lecture 41 - Hydrodynamic Journal Bearings](#)

[Lecture 42 - Design of Hydrodynamic Journal Bearings](#)

Lecture 1 - An Introduction to CAD

Lecture 2 - Input Output Devices, Raster Graphics

Lecture 3 - Raster Graphics - I

Lecture 4 - Raster Graphics - II

Lecture 5 - Polygon Filling

Lecture 6 - Windowing and Clipping

Lecture 7 - Clipping of Polygons

Lecture 8 - 2D Transformations

Lecture 9 - 3D Transformations and Projection

Lecture 10 - Perspective Projections

Lecture 11 - Projections and Hidden Surface Removal

Lecture 12 - Hidden Surface Removal

Lecture 13 - Hidden Surface Removal

Lecture 14 - Hidden Surface Removal

Lecture 15 - Finite Element Method : An Introduction

Lecture 16 - Galerkin's Approach

Lecture 17 - Galerkin's Method : 1D Finite Element Method

Lecture 18 - 1D Finite Element Problems

Lecture 19 - 1D Finite Element Problems

Lecture 20 - FE Problems : Solving for Q

Lecture 21 - 1D - FE Problems : Galerkin's Approach

Lecture 22 - Penalty Approach and Multi Point Boundary

Lecture 23 - Quadratic Shape Functions

Lecture 24 - 2D - FE Problems

Lecture 25 - 2D - FE Problems (Continued.)

Lecture 26 - 3D - FE Problems

Lecture 27 - 3D - Tetrahedral and 2D - Quadrilateral Element

Lecture 28 - Mesh Preparation

Lecture 29 - Modeling of Curves

Lecture 30 - Modeling of Curves

Lecture 31 - Modeling of Curves

[Lecture 32 - Modeling of B-Spline Curves](#)

[Lecture 33 - Modeling of B-spline Curves](#)

[Lecture 34 - Surface Modeling](#)

[Lecture 35 - Surface Modeling](#)

[Lecture 36 - Display of Curves and Surfaces](#)

[Lecture 37 - Solid Modeling](#)

[Lecture 38 - Solid Modeling](#)

[Lecture 39 - Solid Modeling Using Octrees](#)

[Lecture 40 - \(Lecture Missing\)](#)

[Lecture 41 - Computer Aided Design](#)

[Lecture 42 - Computer Aided Manufacturing](#)

[Lecture 43 - What is CAD/CAM](#)

[Lecture 44 - An Overview of Geometric Modeling](#)

[Lecture 45 - Parametric Cubic Curve](#)

[Lecture 46 - Parametric Bezier Curve](#)

[Lecture 47 - B-Spline Curve](#)

[Lecture 48 - Parametric Surfaces - Part-1](#)

[Lecture 49 - Parametric Surfaces - Part-2](#)

[Lecture 50 - Solid Modeling](#)

[Lecture 51 - Geometric & Product Data Exchange](#)

[Lecture 52 - Reverse Engineering](#)

**NPTEL : Project and Production Management (Mechanical Engineering)**

**Co-ordinators : Prof. Arun Kanda**

Lecture 1 - Project and Production Management - An Overview

Lecture 2 - Project Management: An Overview

Lecture 3 - Project Identification and Screening

Lecture 4 - Project Appraisal - Part I

Lecture 5 - Project Appraisal - Part II

Lecture 6 - Project Selection

Lecture 7 - Project Representation

Lecture 8 - Consistency and Redundancy in Project Networks

Lecture 9 - Basic scheduling with A-O-A Networks

Lecture 10 - Basic Scheduling with A-O-N Networks

Lecture 11 - Project Scheduling with Probabilistic Activity

Lecture 12 - Linear Time-Cost Tradeoffs in Projects

Lecture 13 - Project Crashing with Multiple Objectives

Lecture 14 - Resource Profiles and Leveling

Lecture 15 - Limited Resource Allocation

Lecture 16 - Project Monitoring and Control with PERT/Cost

Lecture 17 - Team Building and Leadership in Projects

Lecture 18 - Organizational and Behavioral Issues

Lecture 19 - Computers in Project Management

Lecture 20 - Project Completion and Review

Lecture 21 - Life Cycle of a Production System

Lecture 22 - Role of Models in Production Management

Lecture 23 - Financial Evaluation of capital Decisions

Lecture 24 - Decision Trees and Risk Evaluation

Lecture 25 - Introducing New Products & Services

Lecture 26 - Economic Evaluation of New Products & Services

Lecture 27 - Product Mix Decisions

Lecture 28 - Product & Process Design

Lecture 29 - Issues in Location of Facilities

Lecture 30 - Mathematical Models for Facility Location

Lecture 31 - Layout planning

[Lecture 32 - Computerised Layout Planning](#)

[Lecture 33 - Product Layouts and Assembly Line Balancing](#)

[Lecture 34 - Forecasting](#)

[Lecture 35 - The Analysis of Time Series](#)

[Lecture 36 - Aggregate Production Planning: Basic Concepts](#)

[Lecture 37 - Modelling Approaches](#)

[Lecture 38 - Basic Inventory Principles](#)

[Lecture 39 - Inventory Modelling](#)

[Lecture 40 - Material Requirements Planning](#)

[Lecture 41 - Scheduling of Job Shops](#)



Lecture 1 - Introduction to Design

Lecture 2 - Design Considerations

Lecture 3 - Basic Concepts Psychrometry and Air-Conditioning

Lecture 4 - Refrigerants

Lecture 5 - Refrigerant Properties and Applications

Lecture 6 - Refrigeration Cycle and Components

Lecture 7 - Compressor Selection

Lecture 8 - Expansion Devices

Lecture 9 - Condensers and Evaporators

Lecture 10 - Types of Heat Exchangers and Air Conditioning Systems

Lecture 11 - Selection of Air Conditioning Systems for Hostels

Lecture 12 - Case Study on a Railway Air Conditioning System

Lecture 13 - Vibration and noise issues in railway AC systems

Lecture 14 - New product launch process

Lecture 15 - Case study on a telecom cooling system and Emerging technologies

Lecture 1 - Thermodynamic Concepts: Applications of thermodynamics

Lecture 2 - Thermodynamic Concepts: System definition, Heat, Work and Mass Flow

Lecture 3 - Thermodynamic Concepts: Questions and Answers

Lecture 4 - Thermodynamic Concepts: Properties, State and Equilibrium

Lecture 5 - Thermodynamic Concepts: Process, Cycles and Applications

Lecture 6 - Thermodynamic Concepts: Steady state, Reversible and Irreversible processes

Lecture 7 - Thermodynamic Concepts: Causes of irreversibility

Lecture 8 - Thermodynamic Concepts: Thermal reservoirs

Lecture 9 - Thermodynamic Concepts: Pressure and temperature

Lecture 10 - Thermodynamic Concepts: Revision and Summary

Lecture 11 - Laws Of Thermodynamics: Mass flow rate, Conservation of mass, Flow work

Lecture 12 - Laws Of Thermodynamics: Zeroth Law

Lecture 13 - Laws Of Thermodynamics: First Laws Of Thermodynamics, 1st law for Control Mass, Internal Energy, enthalpy

Lecture 14 - Laws Of Thermodynamics: 1st law for Control Volume

Lecture 15 - Laws Of Thermodynamics: Revision, Cycles, Second Law statements, Clausius inequality

Lecture 16 - Laws Of Thermodynamics: Introduction to Carnot Cycle

Lecture 17 - Laws Of Thermodynamics: Entropy, Entropy change for a system

Lecture 18 - Laws Of Thermodynamics: Thermodynamics relations, Bernoulli's equation

Lecture 19 - Laws Of Thermodynamics: Devices, Cycles

Lecture 20 - Properties of a Pure Substance: Thermodynamic behaviour of a pure substance

Lecture 21 - Properties of a Pure Substance: Saturated states, Subcooled liquid, Superheated vapour

Lecture 22 - Properties of a Pure Substance: Vapour pressure curve, Reference state

Lecture 23 - Properties of a Pure Substance: Saturated states

Lecture 24 - Properties of a Pure Substance: p-h diagram

Lecture 25 - Properties of a Pure Substance: T-s diagram, h-s diagram

Lecture 26 - Properties of a Pure Substance: Critical state, Compressibility factor

Lecture 27 - Properties of a Pure Substance: Ideal gas behaviour, Equations of state, Specific heat

Lecture 28 - Properties of a Pure Substance: Ideal gas processes

Lecture 29 - Properties of a Pure Substance: Gibbs energy, Helmholtz function, Property relations

Lecture 30 - Properties of a Pure Substance: Process analysis, Summary

Lecture 31 - Laws of Thermodynamics: Carnot Cycle Realization

Lecture 32 - Applications, Problem Solving: Devices, Schematic/Flow Diagrams

Lecture 33 - Applications, Problem Solving: Positive Displacement Devices

Lecture 34 - Applications, Problem Solving: Heat Exchangers

Lecture 35 - Applications, Problem Solving: Compressors, Fans and Blowers, Pumps

Lecture 36 - Applications, Problem Solving: Turbines

Lecture 37 - Applications, Problem Solving: Nozzle, Diffuser, Expansion Valve, Pipe/duct flow

Lecture 38 - Applications, Problem Solving: De-Superheater, Deaerator, Separation

Lecture 39 - Applications, Problem Solving: Unsteady processes, Filling, Evacuation

Lecture 40 - Applications, Problem Solving: Realization of Carnot cycle, Practical cycles, Air-standard cycles

Lecture 41 - Applications, Problem Solving: Materials, Compressible flow

Lecture 42 - Applications, Problem Solving: Otto cycle, Diesel cycle

Lecture 43 - Applications, Problem Solving: Closed system

Lecture 44 - Applications, Problem Solving: Open System

Lecture 45 - Properties of Ideal Gas Mixtures: Introduction to mixtures properties

Lecture 46 - Properties of Ideal Gas Mixtures: Equation of state, Conservation equations

Lecture 47 - Gas-Vapour Mixtures: Psychrometry, Moist air Properties,

Lecture 48 - Gas-Vapour Mixtures: Properties, Conservation of Mass and Energy

Lecture 49 - Gas-Vapour Mixtures: Psychrometric chart, Applications

Lecture 50 - Thermodynamics of Reacting systems: Introduction to reacting systems and combustion

Lecture 51 - Thermodynamics of Reacting systems: Flames, Stoichiometry

Lecture 52 - Thermodynamics of Reacting systems: Analysis of Closed and Open Systems, Enthalpy of Formation

Lecture 53 - Phase and Chemical Equilibrium: Introduction. Chemical equilibrium. Gibbs function

Lecture 54 - Phase and Chemical Equilibrium: Equilibrium constant. Phase equilibrium

- Lecture 1 - Mathematical Concepts: Working with Vectors and Tensors
- Lecture 2 - Traction Vector
- Lecture 3 - Stress Tensor and its Matrix Representation
- Lecture 4 - Transformation of Stress Matrix
- Lecture 5 - Stress Equilibrium Equations : Balance of Linear and Angular Momentum
- Lecture 6 - Balance of Angular Momentum (Continued...)
- Lecture 7 - Principal Planes and Principal stress components
- Lecture 8 - Maximizing the Shear Component of Traction
- Lecture 9 - Mohr's Circle
- Lecture 10 - Mohr's Circle (Continued...), Stress Invariants, Decomposition of the Stress Tensor
- Lecture 11 - Concept of Strain Tensor
- Lecture 12 - Longitudinal and Shear Strains
- Lecture 13 - Local Volumetric Strain and Local Infinitesimal Rotation
- Lecture 14 - Similarity in Properties of Stress and Strain Tensors
- Lecture 15 - Stress-Strain Relation
- Lecture 16 - Stress-Strain Relation for Isotropic Materials
- Lecture 17 - Linear Momentum Balance in Cylindrical Coordinate System
- Lecture 18 - Linear Momentum Balance in Cylindrical Coordinate System (Continued...)
- Lecture 19 - Strain Matrix Cylindrical Coordinate System
- Lecture 20 - Extension-Torsion-Inflation in a Hollow Cylinder
- Lecture 21 - Extension-Torsion-Inflation in a Hollow Cylinder (Continued...)
- Lecture 22 - Solving Problems Involving Torsion of Shafts
- Lecture 23 - Pure Bending of Rectangular Beams
- Lecture 24 - Bending of Beams (Continued...)
- Lecture 25 - Bending of Unsymmetrical Beams
- Lecture 26 - Concept of Shear Center
- Lecture 27 - Theory of Beams
- Lecture 28 - Theory of Beams (Continued...) and Beam Buckling
- Lecture 29 - Energy Methods
- Lecture 30 - Energy Methods (Continued...)
- Lecture 31 - Theories of Failure

[Lecture 32 - Theories of Failure \(Continued...\)](#)

- Lecture 1 - Course Outline, Introduction
- Lecture 2 - Experimentation Processes and Applications Overview
- Lecture 3 - Developments in Uncertainty Analysis, Approach
- Lecture 4 - Errors, Their Causes and Classification
- Lecture 5 - Errors to Uncertainty via Statistics
- Lecture 6 - Sources of Errors, Uncertainty Definitions
- Lecture 7 - Experimentation - I
- Lecture 8 - Experimentation Stages / Phases I
- Lecture 9 - Experimentation Stages / Phases II
- Lecture 10 - Uncertainty Analysis Processes
- Lecture 11 - Instrument ans DAS
- Lecture 12 - Basic procedure - I
- Lecture 13 - Basic procedure - II
- Lecture 14 - Evaluating systematic uncertainties
- Lecture 15 - Worksheets for uncertainty in a measurement, Examples
- Lecture 16 - Examples of uncertainty in a measurement
- Lecture 17 - Methodologies, Multiple tests method
- Lecture 18 - Single test, Basics of Taylor Series Method
- Lecture 19 - Sensitivity coefficient, Result uncertainty from TSM
- Lecture 20 - Result uncertainty TSM: Special cases
- Lecture 21 - Method selection, Worksheets for result uncertainty
- Lecture 22 - Examples for result uncertainty - 1
- Lecture 23 - Examples for result uncertainty - 2
- Lecture 24 - Regression Introduction
- Lecture 25 - Regression analysis - Linear, single variable
- Lecture 26 - Correlation, Related topics
- Lecture 27 - Reporting uncertainties
- Lecture 28 - Validation and verification aspects, Data archiving
- Lecture 29 - Course overview

Lecture 1 - Introduction

Lecture 2 - Examples of visualization - 1

Lecture 3 - Examples of visualization - 2

Lecture 4 - Visualization and drawing

Lecture 5 - Sketch to engineering drawing

Lecture 6 - Types of projections

Lecture 7 - Multiview projections

Lecture 8 - 1st and 3rd angle projections

Lecture 9 - Sketching

Lecture 10 - Visualization

Lecture 11 - Drawing sheet

Lecture 12 - Lines

Lecture 13 - Dimensioning

Lecture 14 - Projection of a point line and plane

Lecture 15 - Projection of simple objects

Lecture 16 - Example Projection of a solid

Lecture 17 - Example Projection of an object

Lecture 18 - Types of Solids

Lecture 19 - Polygons Construction and Projections

Lecture 20 - Rotation of Solids

Lecture 21 - Example Rotation of Solids

Lecture 22 - Section views

Lecture 23 - Sectioning practices

Lecture 24 - Auxiliary views

Lecture 25 - Example Section View

Lecture 26 - Example Auxiliary View

Lecture 27 - Pictorial Drawings

Lecture 28 - Construction of Isometric Drawings

Lecture 29 - Example Isometric drawings

Lecture 30 - Working Drawing

Lecture 31 - Example Sectional View of Assembly

[Lecture 32 - Computer Aided Design](#)

[Lecture 33 - Autodesk Inventor Environment](#)

[Lecture 34 - Sketching for Solid Modelling](#)

[Lecture 35 - Example 1 Extrude Hole Fillet Chamfer](#)

[Lecture 36 - Example 2 Rib Mirror](#)

[Lecture 37 - Example 3](#)

[Lecture 38 - Revolve Loft Pattern](#)

[Lecture 39 - Example 4](#)

[Lecture 40 - Example 5](#)

[Lecture 41 - Spline Sweep Shell](#)

[Lecture 42 - Example 6](#)

[Lecture 43 - Example 7](#)

[Lecture 44 - Drawing from Solid Model](#)

[Lecture 45 - Assembly with constraints](#)

[Lecture 46 - Example 8](#)

[Lecture 47 - Example 9](#)

[Lecture 48 - Example 10](#)

[Lecture 49 - Example 11](#)

[Lecture 50 - Civil and architectural drawings](#)



Lecture 1 - Ideal fluids, Velocity potential, Potential flows

Lecture 2 - Stream function, Orthogonality of streamlines and equipotential lines

Lecture 3 - Complex variables, Analyticity, Cauchy - Riemann equations, Complex potential, Complex velocity

Lecture 4 - Elementary flows : Uniform flow, Source and Sink, Free vortex

Lecture 5 - Flow in a bend, Flow around a sharp edge

Lecture 6 - Superposition of source and sink : doublet flow

Lecture 7 - Superposition of uniform flow and doublet

Lecture 8 - Superposition of uniform flow, doublet and free vortex

Lecture 9 - Superposition of source and uniform flow

Lecture 10 - Problem solving session - 1

Lecture 11 - Problem solving session - 2

Lecture 12 - Method of images, Forces on a body, Blasius theorem

Lecture 13 - Calculation of forces using derived flow field

Lecture 14 - Introduction to conformal transformation

Lecture 15 - Singularities and their transformations

[Lecture 1](#)

[Lecture 2](#)

[Lecture 3](#)

[Lecture 4](#)

[Lecture 5](#)

[Lecture 6](#)

[Lecture 7](#)

[Lecture 8](#)

[Lecture 9](#)

[Lecture 10](#)

[Lecture 11](#)

[Lecture 12](#)

[Lecture 13](#)

[Lecture 14](#)

[Lecture 15](#)

[Lecture 16](#)

[Lecture 17](#)

[Lecture 18](#)

[Lecture 19](#)

[Lecture 20](#)

[Lecture 21](#)

[Lecture 22](#)

[Lecture 23](#)

[Lecture 24](#)

[Lecture 25](#)

[Lecture 26](#)

[Lecture 27](#)

[Lecture 28](#)

[Lecture 29](#)

[Lecture 30](#)

[Lecture 31](#)

[Lecture 32](#)

[Lecture 33](#)

[Lecture 34](#)

[Lecture 35](#)

[Lecture 36](#)

[Lecture 37](#)

[Lecture 38](#)

[Lecture 39](#)

[Lecture 40](#)

- Lecture 1 - Introduction to polymers
- Lecture 2 - Polymer structure
- Lecture 3 - Polymer classification
- Lecture 4 - Polymer length, packing and tacticity
- Lecture 5 - Glass transition temperature
- Lecture 6 - Temperature effects, glassy regime
- Lecture 7 - Viscoelastic, rubbery, viscous, decomposition
- Lecture 8 - Relaxation and creep tests
- Lecture 9 - Failure of polymers
- Lecture 10 - Heaviside, Dirac delta, Laplace
- Lecture 11 - Introduction to linear viscoelasticity
- Lecture 12 - Phenomenological models for linear viscoelasticity
- Lecture 13 - Maxwell model
- Lecture 14 - Kelvin model
- Lecture 15 - Three and four parameter models
- Lecture 16 - Generalized Maxwell and Kelvin models
- Lecture 17 - Boltzman superposition principle
- Lecture 18 - Alfrey's correspondence principle
- Lecture 19 - Analysis of viscoelastic bars
- Lecture 20 - Analysis of viscoelastic beams
- Lecture 21 - Dynamic mechanical analysis (DMA)
- Lecture 22 - Dynamic mechanical thermal analysis (DMTA)
- Lecture 23 - Time temperature superposition principle (TTSP)
- Lecture 24 - Plastic design consideration and practices
- Lecture 25 - What are composites?
- Lecture 26 - Composite materials and types
- Lecture 27 - Composite advantages and applications
- Lecture 28 - Fabrication and other aspects of composites
- Lecture 29 - 3D stress and strain components
- Lecture 30 - Symmetry in stress, strain and stiffness matrix
- Lecture 31 - Monoclinic, orthotropic and isotropic materials

- Lecture 32 - 3D stress strain relation for orthotropic material
- Lecture 33 - Plane stress: Specially orthotropic material
- Lecture 34 - Plane stress: Generally orthotropic material
- Lecture 35 - Lamina engineering constants
- Lecture 36 - Lamina hygrothermal effects
- Lecture 37 - Lamina fundamental strengths
- Lecture 38 - Lamina failure criteria
- Lecture 39 - Tsai-Hill and Hoffman failure criteria
- Lecture 40 - Micromechanics: Assumptions, RVE
- Lecture 41 - Micromechanics: Stiffness prediction
- Lecture 42 - Micromechanics: Stiffness and strength
- Lecture 43 - Macromechanics of laminate
- Lecture 44 - Classical laminate theory
- Lecture 45 - Classical laminate theory - II
- Lecture 46 - Symmetric laminates, orthotropic laminates
- Lecture 47 - Angle-ply, cross-ply and quasi-isotropic laminates
- Lecture 48 - Hygrothermal stresses in laminates
- Lecture 49 - Laminate failure
- Lecture 50 - Design practices with laminates
- Lecture 51 - Sandwich structures
- Lecture 52 - Composites testing
- Lecture 53 - Joining of composites

**NPTEL : Nonlinear Vibration (Mechanical Engineering)**

**Co-ordinators : Prof. S.K. Dwivedy**

Lecture 1 - Introduction of Nonlinear systems

Lecture 2 - Review of Linear vibrating systems

Lecture 3 - Phenomena associated with Nonlinear systems

Lecture 4 - Commonly observed Phenomena in Nonlinear systems

Lecture 5 - Force and Moment based Approach

Lecture 6 - Energy based approach Extended Hamilton's principle and Lagrange Principle

Lecture 7 - Derivation of Equation of motion of nonlinear discrete system (More examples)

Lecture 8 - Derivation of Equation of motion of nonlinear continuous system - 1

Lecture 9 - Derivation of Equation of motion of nonlinear continuous system - 2

Lecture 10 - Ordering of nonlinear Equation of motion

Lecture 11 - Qualitative Analysis Straight forward expansion

Lecture 12 - Numerical method Straight forward expansion

Lecture 13 - Lindstedt Poincaré technique

Lecture 14 - Method of multiple scales

Lecture 15 - Method of Harmonic balance

Lecture 16 - Method of averaging

Lecture 17 - Generalized Method of averaging

Lecture 18 - Krylov-Bogoliubov-Mitropolski technique

Lecture 19 - Incremental harmonic balance method and Intrinsic multiple scale harmonic balance method

Lecture 20 - Modified Lindstedt Poincaré technique

Lecture 21 - Stability and Bifurcation of Fixed-point response - 1

Lecture 22 - Stability and Bifurcation of Fixed-point response - 2

Lecture 23 - Stability and Bifurcation of Fixed-point response - 3

Lecture 24 - Stability and Bifurcation of Fixed-point response - 4

Lecture 25 - Stability Analysis of Periodic response

Lecture 26 - Bifurcation of Periodic response And Introduction to quasi-periodic and Chaotic response

Lecture 27 - Quasi-Periodic and Chaotic response

Lecture 28 - Numerical methods to obtain roots of characteristic equation and time response

Lecture 29 - Numerical methods to obtain time response

Lecture 30 - Numerical methods to obtain frequency response

Lecture 31 - Free Vibration of Single degree of freedom Nonlinear systems with Cubic and quadratic nonlinearities

[Lecture 32 - Free Vibration of Single degree of freedom Nonlinear systems with Cubic and quadratic nonlinearities: effect of damping](#)

[Lecture 33 - Free Vibration of multi- degree of freedom Nonlinear systems with Cubic and quadratic nonlinearities](#)

[Lecture 34 - Forced nonlinear Vibration Single degree of freedom Nonlinear systems with Cubic nonlinearities:](#)

[Lecture 35 - Forced nonlinear Vibration Single and multi- degree of freedom Nonlinear systems](#)

[Lecture 36 - Nonlinear Forced-Vibration of Single and Multi Degree-of-Freedom System](#)

[Lecture 37 - Analysis of Multi- degree of freedom system](#)

[Lecture 38 - Nonlinear Vibration of Parametrically excited system: Axially loaded sandwich beam](#)

[Lecture 39 - Nonlinear Vibration of Parametrically excited system: Elastic and Magneto-elastic beam](#)

[Lecture 40 - Nonlinear Vibration of Parametrically excited system with internal resonance](#)

Lecture 1 - Introduction

Lecture 2 - A Brief History of Rotor Dynamics

Lecture 3 - The State of the Art of Rotor Dynamics

Lecture 4 - Simple Rotor Models with Rigid Bearings

Lecture 5 - Jeffcott Rotor Model

Lecture 6 - Variant of Jeffcott Rotor Model

Lecture 7 - Rigid Rotor Mounted on Simple Anisotropic Springs as Bearings

Lecture 8 - Rigid Rotor Mounted on Complex Anisotropic Bearings

Lecture 9 - Flexible Shaft with a Rigid Disc Mounted on Anisotropic Supports

Lecture 10 - Gyroscopic Effects : Synchronous whirl of a Rotor Systems with a thin Disc

Lecture 11 - Gyroscopic Effects : Synchronous and Asynchronous pure wobbling motions

Lecture 12 - Gyroscopic Effects : Asynchronous whirl of a Rotor system with a thin Disc

Lecture 13 - Gyroscopic Effects : Asynchronous whirl analysis with Dynamic Approach

Lecture 14 - Torsional Vibrations: Simple Rotor Systems

Lecture 15 - Three Disc Rotor System

Lecture 16 - Transfer Matrix Approach - Part I

Lecture 17 - Transfer Matrix Approach - Part II

Lecture 18 - Transfer Matrix Approach - Part III

Lecture 19 - Geared and Branched Systems

Lecture 20 - Continuous System and Finite Element Method

Lecture 21 - Finite Element Method

Lecture 22 - Finite Element Analysis

Lecture 23 - Finite Element Analysis - Part III

Lecture 24 - Influence Coefficient Method

Lecture 25 - Transfer Matrix Method - Part I

Lecture 26 - Transfer Matrix Method - Part II

Lecture 27 - Transfer Matrix Method - Part III

Lecture 28 - Continuous System Approach

Lecture 29 - Finite Element Method - Part I

Lecture 30 - Finite Element Method - Part II

Lecture 31 - Finite Element Method - Part III



[Lecture 32 - Instability in Rotor Systems: Bearings](#)

[Lecture 33 - Fluid-Film Bearings](#)

[Lecture 34 - Internal Damping & Asymmetrical Shaft](#)

[Lecture 35 - Steam Whirl and Seals](#)

[Lecture 36 - Subcritical Speed Whirl](#)

[Lecture 37 - Introduction to Rigid Rotor Balancing](#)

[Lecture 38 - Dynamic Balancing of Rotors: Rigid Rotor Balancing](#)

[Lecture 39 - Dynamic Balancing of Rotors:Flexible Rotor Model Balancing](#)

[Lecture 40 - Dynamic Balancing of Rotors:Influence Coefficient Method for Flexible Rotor](#)

[Lecture 41 - Common Faults & Vibration signatures](#)

[Lecture 42 - Condition Based Monitoring](#)

Lecture 1 - Fundamentals Of Engineering Mechanics

Lecture 2 - Equations of Equilibrium

Lecture 3 - Truss Analysis - Part 1

Lecture 4 - Truss Analysis - Part 2

Lecture 5 - Analysis of Frames Machines

Lecture 6 - Internal Forces

Lecture 7 - Internal Forces in Beams

Lecture 8 - Cables

Lecture 9 - Friction

Lecture 10 - Application of Friction - Part 1

Lecture 11 - Application of Friction - Part 2

Lecture 12 - Application of Friction - Part 3

Lecture 13 - Centroids Center of Mass

Lecture 14 - Centroids Area of Moments

Lecture 15 - Product of Inertia, Rotation of Axis and Principle Moments of Inertia

Lecture 16 - Principle Mass Moments of Inertia

Lecture 17 - Second Moment of Mass

Lecture 18 - Virtual Work of Ideal System

Lecture 19 - Principle of Virtual Work

Lecture 20 - Systems with Friction

Lecture 21 - Potential Energy

Lecture 22 - Stability of Equilibrium

Lecture 23 - Kinematics of a Particles

Lecture 24 - Kinematics of a Particle Moving on a Curve

Lecture 25 - Relative Motion

Lecture 26 - Plane Kinematics of Rigid Bodies

Lecture 27 - Kinematics of a Particle

Lecture 28 - Work and Energy

Lecture 29 - Impulse and Momentum

Lecture 30 - Direct and Oblique Impulse

Lecture 31 - Plane Kinetics of Rigid Bodies

[Lecture 32 - Kinetics of a Body](#)

[Lecture 33 - Method of Momentum and Analysis of Robot Manipulator](#)

[Lecture 34 - Kinematics in 3D](#)

[Lecture 35 - Kinetics in 3D](#)

[Lecture 36 - Free Vibration](#)

[Lecture 37 - Forced Vibration Damped Undamped](#)

[Lecture 38 - Vibration of Rigid Bodies - Part 1](#)

[Lecture 39 - Vibration of Rigid Bodies - Part 2](#)

[Lecture 40 - Some Problems of Vibration](#)

- Lecture 1 - Overview of the Course, Practical and Research Trends
- Lecture 2 - Harmonic and Periodic Motions, Vibration Terminology
- Lecture 3 - Vibration Model, Equation of Motion-Natural Frequency
- Lecture 4 - Energy Method, Principle of Virtual Work
- Lecture 5 - Viscously Damped Free Vibration Special Cases: Oscillatory
- Lecture 6 - Logarithmic Decrement Experimental Determination of Damping Coefficient Hysteresis Loop
- Lecture 7 - Coulomb Damping other Damping Models
- Lecture 8 - Forced Harmonic Vibration, Magnification Factor
- Lecture 9 - Laplace Transform, Superposition Theorem
- Lecture 10 - Rotor Unbalance and Whirling of Shaft, Transmissibility
- Lecture 11 - Support Motion, Vibration Isolation
- Lecture 12 - Sharpness of Resonance, Vibration Measuring Instruments
- Lecture 13 - Generalized and Principle Coordinates, Derivation of Equation of Motion
- Lecture 14 - Lagranges's Equation
- Lecture 15 - Coordinate Coupling
- Lecture 16 - Forced Harmonic Vibration
- Lecture 17 - Tuned Absorber, Determination of Mass Ratio
- Lecture 18 - Tuned and Damped Absorber, Untuned Viscous Damper
- Lecture 19 - Derivation of Equations of Motion, Influence Coefficient Method
- Lecture 20 - Properties of Vibrating Systems: Flexibility & Stiffness Matrices, Reciprocity Theorem
- Lecture 21 - Modal Analysis: Undamped
- Lecture 22 - Modal Analysis: Damped
- Lecture 23 - Simple Systems With One Two or Three Discs Geared System
- Lecture 24 - Multi-Degree of Freedom Systems-Transfer Matrix Method Branched Systems
- Lecture 25 - Derivation of Equations of Motion Part 1 - Newton
- Lecture 26 - Derivation of Equations of Motion Part 2 - Newton
- Lecture 27 - Vibration of Strings
- Lecture 28 - Longitudinal and Torsional Vibration of Rods
- Lecture 29 - Transverse Vibration of Beams, Equations of Motion and Boundary Conditions
- Lecture 30 - Transverse Vibration of Beams: Natural Frequencies and Mode Shapes
- Lecture 31 - Rayleigh's Energy Method

[Lecture 32 - Matrix Iteration Method](#)

[Lecture 33 - Durkerley, Rayleigh-Ritz and Galerkin Method](#)

[Lecture 34 - Finite Element Formulation for Rods, Gear Train and Branched System](#)

[Lecture 35 - Finite Element Formulation for Beams: Galerkin](#)

[Lecture 36 - Global Finite Element Assembly and Imposition of Boundary Conditions](#)

[Lecture 37 - Vibration Testing Equipments: Signal Measurements](#)

[Lecture 38 - Vibration Testing Equipments: Signal Analysis](#)

[Lecture 39 - Field Balancing of Rotors](#)

[Lecture 40 - Condition Monitoring](#)

Lecture 1 - Introduction to advanced machining processes

Lecture 2 - Ultrasonic machining - Part I

Lecture 3 - Ultrasonic machining - Part II

Lecture 4 - Abrasive jet machining

Lecture 5 - Water jet cutting and Abrasive water jet machining

Lecture 6 - Magnetic abrasive finishing

Lecture 7 - Abrasive Flow Finishing

Lecture 8 - Magnetorheological Finishing

Lecture 9 - Magnetorheological Abrasive Flow Finishing - Part I

Lecture 10 - Magnetorheological Abrasive Flow Finishing - Part II

Lecture 11 - Magnetorheological Abrasive Flow Finishing - Part III

Lecture 12 - Electric discharge machining (EDM)

Lecture 13 - Electric Discharge Grinding, Electric Discharge Diamond Grinding and Wire Electric Discharge Machining

Lecture 14 - Electrochemical Machining (ECM)

Lecture 15 - Electrochemical Grinding, Electrostream Drilling, Shaped Tube Electrolytic Machining

Lecture 16 - Plasma Arc Machining (PAM)

Lecture 17 - Electron Beam Machining (EBM) Edit Lesson

Lecture 18 - Laser Beam Machining (LBM)

Lecture 19 - Chemical Machining (ChM)

- Lecture 1 - Introduction of nuclear energy
- Lecture 2 - Binding energy and mass defect
- Lecture 3 - Radioactivity and radioactive decay
- Lecture 4 - Different types of nuclear transmutation
- Lecture 5 - Artificial radioactivity and neutron-nucleus interactions
- Lecture 6 - Energy and momentum conservation
- Lecture 7 - Fission and role of neutron energy
- Lecture 8 - Theory of elastic scattering
- Lecture 9 - Neutron multiplication factor
- Lecture 10 - Neutron diffusion theory
- Lecture 11 - Solution of one-group diffusion equation
- Lecture 12 - Simple reactor theory
- Lecture 13 - Nuclear fuel and simple energy consideration
- Lecture 14 - Axial temperature distribution and heat transfer coefficient
- Lecture 15 - Prompt and delayed neutrons
- Lecture 16 - Delayed neutron kinetics
- Lecture 17 - Different control mechanisms and various effects
- Lecture 18 - Classical reactor designs
- Lecture 19 - Evolution of reactors from Gen-I to Gen-IV
- Lecture 20 - The concept of breeding
- Lecture 21 - Fuel cycles and FBR
- Lecture 22 - Gen-IV FBR designs
- Lecture 23 - Hydrogen fusion reactions
- Lecture 24 - Coulomb barrier and other critical factors
- Lecture 25 - Radiation dose and gross biological effects
- Lecture 26 - Stochastic and deterministic effects of human cells
- Lecture 27 - Lessons from TMI and Chernobyl
- Lecture 28 - Defence-in-depth Philosophy
- Lecture 29 - Waste classification and Disposal of Mill Tailings
- Lecture 30 - Disposal methodologies for HLW and IMW

- Lecture 1 - Fundamentals of Welding and Joining - Part I
- Lecture 2 - Fundamentals of Welding and Joining - Part II
- Lecture 3 - Fundamentals of Welding and Joining - Part III
- Lecture 4 - Fundamentals of Welding and Joining - Part IV
- Lecture 5 - Fundamentals of Welding and Joining - Part V
- Lecture 6 - Laser and Electron Beam Welding - Part I
- Lecture 7 - Laser and Electron Beam Welding - Part II
- Lecture 8 - Solid State Welding Processes - Part I
- Lecture 9 - Solid State Welding Processes - Part II
- Lecture 10 - Solid State Welding Processes - Part III
- Lecture 11 - Computational Welding Mechanics - Part I
- Lecture 12 - Computational Welding Mechanics - Part II
- Lecture 13 - Computational Welding Mechanics - Part III
- Lecture 14 - Micro and Nano Joining Processes - Part I
- Lecture 15 - Micro and Nano Joining Processes - Part II
- Lecture 16 - Micro and Nano Joining Processes - Part III
- Lecture 17 - Welding Metallurgy - Part I
- Lecture 18 - Welding Metallurgy - Part II
- Lecture 19 - Welding Metallurgy - Part III
- Lecture 20 - Welding Metallurgy - Part IV
- Lecture 21 - Welding and Joining of Non-Metals - Part I
- Lecture 22 - Welding and Joining of Non-Metals - Part II
- Lecture 23 - Metal Transfer in Welding and Metal Printing



Lecture 1 - Introduction

Lecture 2 - Introduction and Importance of Machining

Lecture 3 - Principles of Machining or Metal Cutting

Lecture 4 - Cutting Tools

Lecture 5 - Forces in Machining

Lecture 6 - Tribology in Machining

Lecture 7 - Lubrication surface roughness in Machining

Lecture 8 - Machinability and Thermal Aspects

Lecture 9 - Tool Wear and Tool life - Part 1

Lecture 10 - Tool Wear and Tool life - Part 2

Lecture 11 - Tool Wear and Tool life - Part 3

Lecture 12 - Tool Materials and Coatings

Lecture 13 - Machining Fluids / Cutting Fluids and its Additives - Part 1

Lecture 14 - Machining Fluids / Cutting Fluids and its Additives - Part 2

Lecture 15 - Machining Fluids / Cutting Fluids and its Emissions

Lecture 16 - Eco Friendly Cutting Fluids - Part 1

Lecture 17 - Eco Friendly Cutting Fluids - Part 2

Lecture 18 - Rheology and Thermal Characterization of Machining / Cutting Fluids

Lecture 19 - Bio-degradation Studies of Machining / Cutting Fluids

Lecture 20 - Cutting Fluid Application in Machining Region

Lecture 21 - Practical Machining Processes - 1

Lecture 22 - Practical Machining Processes - 2

Lecture 23 - Introduction to Abrasive Processes - Grinding

Lecture 24 - Cutting fluids in Grinding Process

Lecture 25 - Unbonded Conventional Abrasive Processes

Lecture 26 - Advances in Metal Cutting\_Machining Processes

Lecture 27 - Advances in Metal Cutting\_Machining Processes - 2

Lecture 1 - Deformation of Metals

Lecture 2 - Mechanism of Plastic Deformation

Lecture 3 - Machining Processes: Single Edge Tool, Types of Chips

Lecture 4 - Tool Geometry: Single Point Cutting Tool Specifications

Lecture 5 - Tool Specifications, Conversion Of Tool Angles, Multi-Point Cutting Tools

Lecture 6 - Mechanics of Orthogonal Cutting, Force Relationships

Lecture 7 - Determination of Stress, Strain, and Strain Rate

Lecture 8 - Measurement of Shear Angle

Lecture 9 - Other Analysis for Force Relationships

Lecture 10 - Mechanics of Oblique Cutting

Lecture 11 - Measurement of Cutting Forces

Lecture 12 - Thermal Aspects Of Machining: Temperatures in Orthogonal Cutting

Lecture 13 - Tool Wear and Tool Life and Tool Life Equations

Lecture 14 - Economics in Machining

Lecture 15 - Practical Machining Operations: Turning And Shaping and Planning Operation

Lecture 16 - Practical Machining Operations: Milling And Drilling

Lecture 17 - Grinding of Metals and Mechanics of Grinding Process

Lecture 18 - Abrasive Machining and Finishing Operations

Lecture 19 - CNC Machines and CNC Programming

Lecture 20 - Introduction to Advanced Machining Processes

Lecture 1 - Introduction to hydraulic machines: classifications and operational principles

Lecture 2 - Euler equation for turbomachines: net head developed by the pump/turbines

Lecture 3 - Velocity triangles of pumps, effect of inlet swirl on pump operation

Lecture 4 - Velocity triangles of pumps, effect of inlet swirl on pump operation

Lecture 5 - Pump casings, Efficiencies and Problems - I

Lecture 6 - Pump casings, Efficiencies and Problems - II

Lecture 7 - Pump casings, Efficiencies and Problems - III

Lecture 8 - Axial flow pump, HQ curve, System Resistance Curve - I

Lecture 9 - Axial flow pump, HQ curve, System Resistance Curve - II

Lecture 10 - HQ Curve, System Resistance Curve - I

Lecture 11 - HQ Curve, System Resistance Curve - II

Lecture 12 - Introduction to Cavitation

Lecture 13 - Condition for Cavitation and NPSH

Lecture 14 - Net Positive Suction Head (NPSH)

Lecture 15 - Suction number and Introduction to off design condition

Lecture 16 - Cavitation: The effect of off-design Conditions

Lecture 17 - Cavitation: Preventive Measures

Lecture 18 - Cavitation: Preventive Measures, Effect on Pump Characteristic

Lecture 19 - Problems on Cavitation

Lecture 20 - Introduction to Slip : Stodola Slip Model

Lecture 21 - Departure from Euler theory

Lecture 22 - Slip Velocity - I

Lecture 23 - Slip Velocity - II

Lecture 24 - Problem on slip

Lecture 25 - Degree of reaction of pump

Lecture 26 - Degree of reaction and axial pump design

Lecture 27 - Testing of radial flow pump - I

Lecture 28 - Testing of radial flow pump - II

Lecture 29 - Problem on radial flow pump testing

Lecture 30 - Radial equilibrium of axial flow pump - I

Lecture 31 - Radial equilibrium of axial flow pump - II

- Lecture 32 - Pump operation: series and parallel connection
- Lecture 33 - Series and parallel operation of dissimilar pumps
- Lecture 34 - Pumping system design
- Lecture 35 - Design of parallel pumping system
- Lecture 36 - Numerical problem on pumps - I
- Lecture 37 - Numerical problem on pumps - II
- Lecture 38 - Numerical problem on pumps - III
- Lecture 39 - Working principle and Indicator diagram of PD pump
- Lecture 40 - Working principle and Indicator diagram of PD pump (Continued...)
- Lecture 41 - Modified indicator diagram and Head-Discharge curve
- Lecture 42 - Analysis and Head-Discharge curve of PD pump
- Lecture 43 - Analysis and efficiencies of PD pump
- Lecture 44 - Requirement of air chamber in PD pump
- Lecture 45 - Numerical problem on PD pump with air chamber
- Lecture 46 - Similarity and dimensional analysis of hydraulic machines
- Lecture 47 - Dimensional analysis of hydraulic machines: Buckingham's theorem
- Lecture 48 - Buckingham's theorem: Specific speed of hydraulic machines
- Lecture 49 - Turbine Classification and Operational principle of Pelton wheel
- Lecture 50 - Velocity Triangles and analysis
- Lecture 51 - Operational Principle of Reaction turbine
- Lecture 52 - Degree of Reaction and Introduction to axial flow turbine
- Lecture 53 - Kaplan Turbine: Operational Principle, Turbine efficiencies
- Lecture 54 - Draft Tube for Reaction Turbine and Cavitation
- Lecture 55 - Energy Balance and NPSH
- Lecture 56 - Thoma Cavitation Factor
- Lecture 57 - Reaction Turbine: Design aspects and Characteristic Curves
- Lecture 58 - Problems on Impulse and Reaction Turbines

- Lecture 1 - Introduction to Abrasive Machining and Finishing Processes
- Lecture 2 - Grinding Process
- Lecture 3 - Grinding Fluids and Its Additives
- Lecture 4 - Grinding Fluids and its Emissions
- Lecture 5 - Sustainable Grinding Process: Biodegradation of Grinding Fluids
- Lecture 6 - Sustainable Grinding Process: MQL in Grinding Process
- Lecture 7 - Honing Process
- Lecture 8 - Lapping Process
- Lecture 9 - Super Finishing and Sand Blasting
- Lecture 10 - Vibratory Bowl Finishing, Rotary Barrel Finishing or Tumbling
- Lecture 11 - Drag Finishing, Ice-bonded Abrasive Finishing, Pitch Polishing, Pad Polishing
- Lecture 12 - Introduction to Surface Texture in abrasive Process
- Lecture 13 - Representation of Surface Roughness
- Lecture 14 - Abrasive Jet Machining (AJM)
- Lecture 15 - Abrasive Water Jet Machining (AWJM)
- Lecture 16 - Ultrasonic Machining (USM)
- Lecture 17 - EDM, Wire-EDM, EDG, EDDG, AW-EDG
- Lecture 18 - Elastic Emission Machining
- Lecture 19 - PMEDM and ECD and ELID, ECH
- Lecture 20 - Abrasive Flow Finishing: Part 1
- Lecture 21 - Abrasive Flow Finishing: Part 2
- Lecture 22 - Magnetic Field Assisted Abrasive Finishing: MAF, MADe, MFP
- Lecture 23 - Magneto Rheological Finishing and BE-MRF
- Lecture 24 - Magnetic Field Assisted Abrasive Finishing: CNP, CMMRF, MRAFF, R-MRAFF
- Lecture 25 - Summary of the Course

Lecture 1 - Basic of Solid Mechanics

Lecture 2 - Energy Principles

Lecture 3 - Classification of Plate Theories and Some Basics

Lecture 4 - Tutorial: Transformation of Tensors

Lecture 5 - Governing Equation for Plate - 1

Lecture 6 - Governing Equation for Plate - 2

Lecture 7 - Tutorial: Reduced Stiffness and Plate Stiffness

Lecture 8 - Navier Solution + Levy solution

Lecture 9 - Levy Solution

Lecture 10 - Tutorial: Load Matrices Calculation

Lecture 11 - EKM and buckling of plates

Lecture 12 - 3D Solutions

Lecture 13 - Matlab Coding + ABAQUS

Lecture 14 - Tutorial: Levy Solutions

Lecture 1 - Introduction to measurement

Lecture 2 - Generalized measurement system and static characteristics

Lecture 3 - Uncertainties in measurement

Lecture 4 - Statistical treatment of random errors

Lecture 5 - System response to periodic inputs

Lecture 6 - Zeroth and first order systems

Lecture 7 - First and second order systems

Lecture 8 - Basics of digitization and number systems

Lecture 9 - Binary logic gates and binary codes

Lecture 10 - Analog-to-digital conversion

Lecture 11 - Digital-to-analog conversion

Lecture 12 - Electromagnetic indicators

Lecture 13 - Electronic amplifiers and filters

Lecture 14 - Resistive devices

Lecture 15 - Inductive, capacitive and optical devices

Lecture 16 - Piezoelectric and nozzle-flapper transducers

Lecture 17 - Resistive strain gages and associated circuitry

Lecture 18 - Strain gage rosettes and gage orientation

Lecture 19 - Elastic and strain gage load cells

Lecture 20 - Various load cells and dynamometers

Lecture 21 - Principles of manometry

Lecture 22 - Piezometer and elastic pressure transducer

Lecture 23 - Electric pressure transducer and high and low pressure measurement

Lecture 24 - Bernoulli's equation in obstruction meters

Lecture 25 - Obstruction meters and volume flowmeters

Lecture 26 - Mass flowmeters and velocity probes

Lecture 27 - Expansion-based devices

Lecture 28 - RTD, Thermistor and Thermocouple

Lecture 29 - Introduction to pyrometers

Lecture 30 - Basic seismic transducer

Lecture 31 - Vibro-, velo- and accelerometer

[Lecture 32 - Introduction to acoustic measurement](#)

[Lecture 33 - Radioactivity and its biological effects](#)



Lecture 1 - External and Internal combustion engines, Engine components, SI and CI engines

Lecture 2 - Four-stroke and Two-stroke engines, Comparison between SI and CI engines, and Four-stroke and Two-stroke engines

Lecture 3 - Classification of IC engines

Lecture 4 - Engine operating characteristics

Lecture 5 - Otto, Diesel and Dual cycles

Lecture 6 - Otto, Diesel and Dual cycles (Continued...)

Lecture 7 - Otto, Diesel and Dual cycles (Continued...)

Lecture 8 - Otto, Diesel and Dual cycles (Continued...)

Lecture 9 - Comparison between the cycles, Actual cycles and their analysis

Lecture 10 - Carburetor, Mixture requirements

Lecture 11 - Carburetor, Mixture requirements (Continued...)

Lecture 12 - Idling, cruising and power ranges

Lecture 13 - Idling, cruising and power ranges (Continued...)

Lecture 14 - Classification, types of nozzles, Ignition system, Battery and Magneto ignition systems

Lecture 15 - Classification, types of nozzles, Ignition system, Battery and Magneto ignition systems (Continued...)

Lecture 16 - Classification, types of nozzles, Ignition system, Battery and Magneto ignition systems (Continued...)

Lecture 17 - Engine friction, Lubrication systems, forces on piston

Lecture 18 - Lubricating oils, Thermochemistry and Fuels, Self-ignition

Lecture 19 - Octane and Cetane Numbers, Alternative Fuels - Methanol, Ethanol, hydrogen, Natural Gas

Lecture 20 - Octane and Cetane Numbers, Alternative Fuels - Methanol, Ethanol, hydrogen, Natural Gas (Continued...)

Lecture 21 - Combustion in SI and CI Engines, Pressure Crank Angle Diagram

Lecture 22 - Combustion in SI and CI Engines, Pressure Crank Angle Diagram (Continued...)

Lecture 23 - Combustion in SI and CI Engines, Pressure Crank Angle Diagram (Continued...)

Lecture 24 - SI engine injection system, Energy distribution, Engine temperatures, Heat transfer in combustion chambers

Lecture 25 - SI engine injection system, Energy distribution, Engine temperatures, Heat transfer in combustion chambers (Continued...)

Lecture 26 - CI engine injection systems, Air-cooled and liquid-cooled engines, Modern trends

Lecture 27 - CI engine injection systems, Air-cooled and liquid-cooled engines, Modern trends (Continued...)

Lecture 28 - CI engine injection systems, Air-cooled and liquid-cooled engines, Modern trends (Continued...)

Lecture 29 - Problems on IC engine

Lecture 30 - Turbomachines, Gas Turbine theory

Lecture 31 - Open Cycle Gas Turbine Power Plant, Twin Shaft Arrangement

- Lecture 32 - Closed Cycle, Multi-Spool Arrangement, Steam Power Plant
- Lecture 33 - Basic Thermodynamics
- Lecture 34 - Brayton Cycle: Introduction and General Relationships
- Lecture 35 - Brayton Cycle: Efficiency, Work Ratio and Optimum Work Output Condition
- Lecture 36 - Brayton Cycle with Heat Exchanger/Reheater
- Lecture 37 - Brayton Cycle with Intercooler
- Lecture 38 - Real Brayton Cycle, Solved Example for Ideal Cycle
- Lecture 39 - Solved Examples for Real Brayton Cycle
- Lecture 40 - Introduction and Performance Parameters of Propulsion System
- Lecture 41 - Basics of Various Aircraft Engine
- Lecture 42 - Euler Turbomachinery Equation
- Lecture 43 - Introduction and Flow Analysis of Centrifugal Compressors
- Lecture 44 - Thermodynamics Analysis of Centrifugal Compressors
- Lecture 45 - Axial Compressor: Basics, Velocity triangles, T-S diagram and Work Interaction
- Lecture 46 - Axial Compressor: Different factors, Degree of Reaction and Free Vortex Condition
- Lecture 47 - Complete Analysis of Axial Flow Gas Turbine
- Lecture 48 - Solved Examples for Axial Compressors, Centrifugal Compressors and Turbine
- Lecture 49 - Radial Flow Turbine, Solved Example of Free vortex Condition
- Lecture 50 - Nozzles and Diffusers: Introduction, Intake efficiency, Nozzle efficiency

Lecture 1 - Introduction of welding

Lecture 2 - Classification of welding and joints

Lecture 3 - Parts of weld joint

Lecture 4 - Welding Symbol

Lecture 5 - welding power source - 1

Lecture 6 - Welding power source - 2

Lecture 7 - Welding Power sources characteristics - 1

Lecture 8 - Welding Power sources characteristics - 2

Lecture 9 - Physics of welding - 1

Lecture 10 - Physics of welding - 2

Lecture 11 - Physics of welding - 4 (Arc Stability and Arc Blow)

Lecture 12 - Physics of welding - 3

Lecture 13 - Physics of welding - 5 (Metal Transfer-1)

Lecture 14 - Physics of welding - 6 (Metal Transfer-2)

Lecture 15 - Physics of welding - 7 (Metal Transfer-3)

Lecture 16 - Physics of welding - 8 (Metal Transfer-4)

Lecture 17 - Physics of welding - 9 (Metal Transfer-5)

Lecture 18 - Physics of welding - 10 (Metalting Efficiency)

Lecture 19 - Oxy-Fuel Gas Welding

Lecture 20 - Shielded Metal Arc Welding

Lecture 21 - Gas Tungsten Arc Welding

Lecture 22 - Gas Metal Arc Welding

Lecture 23 - Submerged Arc Welding

Lecture 24 - Welding Defects and Inspection

Lecture 1 - Introduction to Polymer Assisted Abrasive Finishing Processes

Lecture 2 - Surface Integrity and Surface roughness representation - Part I

Lecture 3 - Surface Integrity and Surface roughness representation - Part II

Lecture 4 - Introduction to Grinding and Polymer assisted Grinding Wheels

Lecture 5 - Polymer medium for vibratory bowl finishing, Tumbling, Drag finishing

Lecture 6 - Polymer Pad and Chemo-mechanical Polishing

Lecture 7 - Elastic Emission Machining

Lecture 8 - Hydrodynamic Polishing, Elasto Abrasive Finishing

Lecture 9 - Abrasive Flow Machining and Finishing - Part I

Lecture 10 - Abrasive Flow Machining and Finishing - Part II

Lecture 11 - Advances in Abrasive Flow Finishing: DBGAFF, CFAAFM

Lecture 12 - Advances in Abrasive Flow Finishing: Spiral Polishing, R-AFF

Lecture 13 - AFF Processes: Magnetio AFF (MRAFF), UAA-AFF, EC-AFF

Lecture 14 - Finishing of Biomedical implants (Micro AFF: Micro holes, Micro slots, Bio Implants: Knee implants , Hip implants and Applications of one way, two way and orbital AFF)

Lecture 15 - Summary of the Course

- Lecture 1 - Materials and manufacturing Processes - 1
- Lecture 2 - Materials and manufacturing Processes - 2
- Lecture 3 - Physics based modeling approach at different scale
- Lecture 4 - Evaluation of properties and process modelling
- Lecture 5 - Thermofluid and electromagnetic analysis
- Lecture 6 - Solid-state deformation and residual stress - 1
- Lecture 7 - Solid-state deformation and residual stress - 2
- Lecture 8 - Melting, solidification and additive manufacturing
- Lecture 9 - Force and velocity diagram - 1
- Lecture 10 - Force and velocity diagram - 2
- Lecture 11 - Heat transfer analysis
- Lecture 12 - Principal and mechanism at different processes - 1
- Lecture 13 - Principal and mechanism at different processes - 2
- Lecture 14 - Mechanics of bulk metal forming
- Lecture 15 - Mechanics of sheet metal forming - 1
- Lecture 16 - Mechanics of sheet metal forming - 2
- Lecture 17 - Heat transfer and thermomechanical processing
- Lecture 18 - Fusion welding processes - 1
- Lecture 19 - Fusion welding processes - 2
- Lecture 20 - Physics of welding and metal transfer
- Lecture 21 - Heat source model in fusion welding
- Lecture 22 - Heat transfer and material flow
- Lecture 23 - Solidification in welding - 1
- Lecture 24 - Solidification in welding - 2
- Lecture 25 - Solid state welding - 1
- Lecture 26 - Solid state welding - 2
- Lecture 27 - Hybrid welding, residual stress and distortion
- Lecture 28 - Cooling and solidification at different casting processes
- Lecture 29 - Powder metallurgy
- Lecture 30 - Principle of surface and coating technologies
- Lecture 31 - Principle and development of additive manufacturing technologies - 1

[Lecture 32 - Principle and development of additive manufacturing technologies - 2](#)

[Lecture 33 - Fundamentals of heat treatment](#)

[Lecture 34 - Evaluation of microstructural properties and residual stress](#)

[Lecture 35 - Down-scaling of conventional manufacturing processes and Micro-to-nano manufacturing](#)

[Lecture 36 - Packaging, micro-finishing and micro-manufacturing processes](#)

[Lecture 37 - Processing and shaping of non-metals and bio-materials](#)

[Lecture 38 - Principle of glass and ceramics processing and their shaping](#)

[Lecture 1 - Introduction and Notation](#)

[Lecture 2 - Flow Regimes and Flow Regime Maps](#)

[Lecture 3 - The Homogeneous Model](#)

[Lecture 4 - The Separated Flow Model](#)

[Lecture 5 - The Separated Flow Model \(Continued...\)](#)

[Lecture 6 - The Drift Flux Model](#)

[Lecture 7 - Estimation of pressure drop in two phase flow](#)

[Lecture 8 - Two phase flow and pressure drop in miniature channels](#)

- Lecture 1 - Overview of thermodynamic system and state
- Lecture 2 - First and second laws of thermodynamics
- Lecture 3 - Concept of entropy and entropy generation
- Lecture 4 - Concept of exergy and exergy destruction
- Lecture 5 - Thermodynamic potentials and Maxwell relations
- Lecture 6 - Generalized relations for entropy and specific heats
- Lecture 7 - Joule-Thomson coefficient and Clapeyron equation
- Lecture 8 - Liquid-vapor phase-change process
- Lecture 9 - Use of property tables
- Lecture 10 - Equations-of-state and Compressibility factor
- Lecture 11 - Ideal cycles for reciprocating engines
- Lecture 12 - Otto, Diesel and Dual combustion cycles
- Lecture 13 - Stirling and Ericsson cycles
- Lecture 14 - Fuel-air cycle
- Lecture 15 - Numerical exercise on Fuel-air cycles
- Lecture 16 - Losses in actual cycle and valve-timing diagram
- Lecture 17 - Ideal Brayton cycle
- Lecture 18 - Intercooling and reheating in Brayton cycle
- Lecture 19 - Regeneration in Brayton cycle
- Lecture 20 - Ideal Rankine cycle
- Lecture 21 - Improvements and modifications in Rankine cycle
- Lecture 22 - Regenerative Rankine cycle
- Lecture 23 - Binary vapor power cycle
- Lecture 24 - Combined gas-steam power plant
- Lecture 25 - Different arrangements in combined cycles
- Lecture 26 - Vapor compression refrigeration cycle
- Lecture 27 - SSS cycles and refrigerants
- Lecture 28 - Modifications in VCR systems
- Lecture 29 - Vapor absorption refrigeration cycle
- Lecture 30 - P-v-T behavior of gas mixtures
- Lecture 31 - Numerical examples



[Lecture 32 - Properties of moist air](#)

[Lecture 33 - Psychrometric chart and various psychrometric processes](#)

[Lecture 34 - Sensible heat factor and bypass factor](#)

[Lecture 35 - Theoretical and actual combustion process](#)

[Lecture 36 - Thermodynamic analyses of reacting systems](#)

Lecture 1 - Relationship of Thermodynamics with Heat transfer

Lecture 2 - Modes of heat transfer

Lecture 3 - Fourier's law and thermal conductivity

Lecture 4 - Generalized heat diffusion equation

Lecture 5 - Heat diffusion equation in curvilinear coordinates

Lecture 6 - Concept of thermal resistance

Lecture 7 - Use of network of resistances in wall and cylinder

Lecture 8 - Critical thickness of insulation

Lecture 9 - Conduction with energy generation - I

Lecture 10 - Conduction with energy generation - II

Lecture 11 - General Heat Transfer Analysis

Lecture 12 - Fins with uniform cross-section area - I

Lecture 13 - Fins with uniform cross-section area - II

Lecture 14 - Fins with non-uniform cross-section area

Lecture 15 - Method of Separation of Variables

Lecture 16 - Graphical approach

Lecture 17 - Method of Superposition

Lecture 18 - Lumped capacitance approach - I

Lecture 19 - Lumped capacitance approach - II

Lecture 20 - Semi-infinite Solid

Lecture 21 - Steady Heat Conduction

Lecture 22 - Unsteady Heat Conduction

Lecture 23 - Problem solving using Energy Balance Method

Lecture 24 - Introduction to radiative heat fluxes

Lecture 25 - Spectral and directional definitions

Lecture 26 - Blackbody radiation

Lecture 27 - Emissivity

Lecture 28 - Irradiation of real surfaces

Lecture 29 - View factor

Lecture 30 - Blackbody radiation exchange

Lecture 31 - Radiation networks

[Lecture 32 - Gas radiation](#)

[Lecture 33 - Radiative Transfer Equation](#)

- Lecture 1 - Review of thermodynamics
- Lecture 2 - Rankine cycle
- Lecture 3 - Performance estimation of steam power cycles
- Lecture 4 - Carnot cycle examples
- Lecture 5 - Rankine cycle with superheat
- Lecture 6 - Rankine cycle with reheat theory and example
- Lecture 7 - Examples of Rankine cycle
- Lecture 8 - Examples of reheat Rankine cycle
- Lecture 9 - Rankine cycle with regeneration
- Lecture 10 - Feedwater heaters
- Lecture 11 - Cogeneration of power and process heat
- Lecture 12 - Examples of regeneration
- Lecture 13 - Examples of regenerative Rankine cycle
- Lecture 14 - Binary/multi-fluid cycles
- Lecture 15 - Low temperature power cycles
- Lecture 16 - Examples of binary cycles
- Lecture 17 - Types of boilers
- Lecture 18 - Boiler accessories
- Lecture 19 - Practice examples
- Lecture 20 - Stagnation conditions and Nozzle flow
- Lecture 21 - Nozzle flow
- Lecture 22 - Examples of Nozzle
- Lecture 23 - Impulse Turbine - 1
- Lecture 24 - Impulse Turbine - 2
- Lecture 25 - Examples on Impulse Turbine
- Lecture 26 - Reaction Turbine
- Lecture 27 - Reheat Factor
- Lecture 28 - Examples on Turbine - 1
- Lecture 29 - Examples on Turbine - 2
- Lecture 30 - Gas Mixture
- Lecture 31 - Psychrometry - 1

[Lecture 32 - Psychrometry - 2](#)

[Lecture 33 - Condensers](#)

- Lecture 1 - Introduction to Dynamic Behaviour of Materials - I
- Lecture 2 - Introduction to Dynamic Behaviour of Materials - II
- Lecture 3 - Introduction to Waves
- Lecture 4 - Quasi-static vs Dynamic Deformation
- Lecture 5 - Elastic Wave and its Classification
- Lecture 6 - Propagation of Elastic Waves in Continuum
- Lecture 7 - Wave Reflection, Refraction and Interaction
- Lecture 8 - General Solution of Elastic Wave Equation
- Lecture 9 - Additional Considerations of Elastic Wave in Cylindrical Bar
- Lecture 10 - Introduction to Plastic Waves
- Lecture 11 - Plastic Waves of Uniaxial Stress
- Lecture 12 - Plastic Waves of Combined Stress
- Lecture 13 - Taylor's Experiment for Plastic Wave Propagation - 1
- Lecture 14 - Taylor's Experiment for Plastic Wave Propagation - 2
- Lecture 15 - Taylor's Experiment: Wilkins-Guinan Analysis
- Lecture 16 - Introduction to Shock Waves - I
- Lecture 17 - Introduction to Shock Waves - II
- Lecture 18 - Shock Wave: Rankine Hugoniot Treatment
- Lecture 19 - Rankine Hugoniot Treatment and Shock Wave under Impact
- Lecture 20 - Shock Wave under Impact
- Lecture 21 - Equations of States (Shock Waves) : Experimental Methods
- Lecture 22 - Equations of States (Shock Waves) : Theoretical Calculations
- Lecture 23 - Complex Problems of Shock Waves and Temperature Rise under Shock Wave
- Lecture 24 - Shock Wave Attenuation, Interaction and Reflection - I
- Lecture 25 - Shock Wave Attenuation, Interaction and Reflection - II
- Lecture 26 - Shock Wave Interaction and Reflection
- Lecture 27 - Fundamentals of Materials Science and Engineering
- Lecture 28 - Shock Wave Induced Phase Transformations - 1
- Lecture 29 - Shock Wave Induced Phase Transformations - 2
- Lecture 30 - Shock Wave Induced Phase Transformations - 3
- Lecture 31 - Shock Wave Induced Phase Transformations - 4

[Lecture 32 - Experimental Techniques for Dynamic Deformation - 1](#)

[Lecture 33 - Experimental Techniques for Dynamic Deformation - 2](#)

[Lecture 34 - Plastic Deformation at High Strain Rates - 1](#)

[Lecture 35 - Plastic Deformation at High Strain Rates - 2](#)

[Lecture 36 - Plastic Deformation at High Strain Rates - 3](#)

[Lecture 37 - Plastic Deformation at High Strain Rates - 4](#)

[Lecture 38 - Plastic Deformation at High Strain Rates - 5](#)

[Lecture 39 - Plastic Deformation Under Shock Waves - 1](#)

[Lecture 40 - Plastic Deformation Under Shock Waves - 2](#)

[Lecture 41 - Plastic Deformation Under Shock Waves - 3](#)

[Lecture 42 - Shear Band - 1](#)

[Lecture 43 - Shear Band - 2](#)

[Lecture 44 - Dynamic Fracture - 1](#)

[Lecture 45 - Dynamic Fracture - 2](#)

Lecture 1 - Introduction to Plastic Working of Metals

Lecture 2 - Uniaxial Tension Test Analysis

Lecture 3 - Temperature effects in metal forming

Lecture 4 - Friction and Lubrication

Lecture 5 - Friction and Lubrication (Continued...)

Lecture 6 - Deformation zone + worked examples

Lecture 7 - Stresses at point and Theory of Plasticity

Lecture 8 - Slab Analysis

Lecture 9 - Slip Line Field Theory - Part 1

Lecture 10 - Slip Line Field Theory - Part 2

Lecture 11 - Upper Bound Theorem

Lecture 12 - Plasticity equations

Lecture 13 - Forging

Lecture 14 - Analysis of Forging

Lecture 15 - Analysis of Forging (Continued...)

Lecture 16 - Forging Die Design consideration

Lecture 17 - Forging Load

Lecture 18 - Rolling of Metals

Lecture 19 - Analysis of Rolling

Lecture 20 - Analysis of Rolling (Continued...)

Lecture 21 - Strain rate in the deformation zone

Lecture 22 - Rolling mills

Lecture 23 - Problem on rolling

Lecture 24 - Drawing of Rods, Wires and Tubes

Lecture 25 - Drawing of Rods, Wires and Tubes (Continued...)

Lecture 26 - Analysis of Wire Drawing

Lecture 27 - Wire Drawing: Tutorial Problems

Lecture 28 - Extrusion Process

Lecture 29 - Analysis of Extrusion

Lecture 30 - Introduction

Lecture 31 - Sheet deformation process



[Lecture 32 - Deformation of sheet in plane stress](#)

[Lecture 33 - Analysis of stamping](#)

[Lecture 34 - Instability in sheet metal forming](#)

[Lecture 35 - Deep drawing](#)

[Lecture 36 - Hydroforming](#)

Lecture 1 - Introduction to Artificial Intelligence

Lecture 2 - Problem Solving as State Space Search

Lecture 3 - Uninformed Search

Lecture 4 - Heuristic Search

Lecture 5 - Informed Search

Lecture 6 - Constraint Satisfaction Problems

Lecture 7 - Searching AND/OR Graphs

Lecture 8 - Game Playing

Lecture 9 - Minimax + Alpha-Beta

Lecture 10 - Introduction to Knowledge Representation

Lecture 11 - Propositional Logic

Lecture 12 - First Order Logic - I

Lecture 13 - First Order Logic - II

Lecture 14 - Inference in First Order Logic - I

Lecture 15 - Inference in First Order Logic - II

Lecture 16 - Answer Extraction

Lecture 17 - Procedural Control of Reasoning

Lecture 18 - Reasoning under Uncertainty

Lecture 19 - Bayesian Network

Lecture 20 - Decision Network

Lecture 21 - Introduction to Planning

Lecture 22 - Plan Space Planning

Lecture 23 - Planning Graph and GraphPlan

Lecture 24 - Practical Planning and Acting

Lecture 25 - Sequential Decision Problems

Lecture 26 - Making Complex Decisions

Lecture 27 - Introduction to Machine Learning

Lecture 28 - Learning Decision Trees

Lecture 29 - Linear Regression

Lecture 30 - Support Vector Machines

Lecture 31 - Unsupervised Learning

[Lecture 32 - Reinforcement Learning](#)

[Lecture 33 - Learning in Neural Networks](#)

[Lecture 34 - Deep Learning: A Brief Overview](#)

Lecture 1 - Overview of Basic Thermodynamics

Lecture 2 - Solved Examples for Flow process

Lecture 3 - Turbomachines: Introduction, Classification, Types

Lecture 4 - Components of Gas Turbine Power Plant, Gas Turbine Attachments

Lecture 5 - Introduction to Various Aircraft engines, Engine Performance parameters

Lecture 6 - Air Standard Ideal Brayton Cycle

Lecture 7 - Examples for Ideal Brayton Cycle

Lecture 8 - Non-Ideal Brayton Cycle

Lecture 9 - Examples for Non-Ideal Brayton Cycle

Lecture 10 - Brayton Cycle with Heat Exchanger / Re-heater

Lecture 11 - Brayton Cycle with Intercooler / All Attachments

Lecture 12 - Examples of Gas Turbine Attachment

Lecture 13 - Examples of Gas Turbine Attachment

Lecture 14 - Stagnation Conditions, Real Brayton Cycle with Stagnation Conditions

Lecture 15 - Polytropic Efficiency of Compressor and Turbine

Lecture 16 - Examples of Real Cycle

Lecture 17 - Nozzle Flow: Isentropic Relations, Area Velocity Relation, Choked Mass Flow Rate

Lecture 18 - Aircraft Engine Intake, Intake Efficiency

Lecture 19 - Propelling Nozzle, Nozzle Efficiency

Lecture 20 - Turbojet engine: Configuration and Examples

Lecture 21 - Turbofan engine: Configuration and Examples

Lecture 22 - Ramjet engine: Parameters and losses

Lecture 23 - Examples of Ramjet Engine

Lecture 24 - Thrust Augmentation and Engine performance parameters for Aircrafts

Lecture 25 - Introduction to Turbomachinery

Lecture 26 - Centrifugal Compressor: Velocity diagrams, Workdone

Lecture 27 - Centrifugal Compressor: Thermodynamic analysis, Stage efficiency and Degree of reaction

Lecture 28 - Examples of Centrifugal compressor

Lecture 29 - Axial Flow Compressor: Velocity diagrams, Workdone and Degree of Reaction

Lecture 30 - Axial Flow Compressor: Free vortex Condition

Lecture 31 - Examples of Axial Flow Compressor

[Lecture 32 - Examples of Axial Flow Compressor](#)

[Lecture 33 - Examples of Axial Flow Compressor](#)

[Lecture 34 - Axial Turbine: Velocity diagrams, Workdone, and Degree of Reaction](#)

[Lecture 35 - Radial Turbine: Velocity diagrams, h-s diagram, Stage efficiency and degree of reaction](#)

[Lecture 36 - Examples of Axial Turbine](#)

[Lecture 37 - Practice examples of Axial Turbine and centrifugal compressor](#)

[Lecture 38 - Cascade theory and Blade design](#)

[Lecture 39 - Cascade variables and Turbine Cascade](#)

[Lecture 40 - Velocity diagrams of Turbine Cascade, Compressor cascade](#)

[Lecture 41 - Turbine cooling methods](#)

[Lecture 42 - Practice examples of aircraft engine](#)

Lecture 1 - Applications of CFD

Lecture 2 - Basic equations of fluid dynamics and heat transfer

Lecture 3 - Initial and boundary conditions

Lecture 4 - Physical Classification, System of first-order PDEs

Lecture 5 - System of second-order PDEs

Lecture 6 - Finite difference by Taylor series expansion

Lecture 7 - Finite difference by general approximation and polynomials

Lecture 8 - Finite difference in non-uniform grid

Lecture 9 - Types of error and accuracy of FD solutions

Lecture 10 - Finite difference formulations of Elliptic Equations with boundary condition treatment

Lecture 11 - Iterative Methods

Lecture 12 - Applications

Lecture 13 - Linear Solvers

Lecture 14 - Finite difference formulations of Parabolic Equations

Lecture 15 - Finite difference formulations of Parabolic Equations: Implicit Methods

Lecture 16 - Finite difference formulations of Parabolic Equations: Unsteady Two-Dimensional Equation

Lecture 17 - Finite difference formulations of Parabolic Equations: Unsteady Three-Dimensional Equation

Lecture 18 - Finite difference formulations of the first order wave equation: Explicit Method

Lecture 19 - Finite difference formulations of the first order wave equation: Implicit Method

Lecture 20 - Von Neumann stability analysis of different schemes for Parabolic equations

Lecture 21 - Von Neumann stability analysis of different schemes for Parabolic equations

Lecture 22 - Von Neumann stability analysis of different schemes for Hyperbolic equations

Lecture 23 - Modified equation, Artificial viscosity, Numerical diffusion

Lecture 24 - Discretization vorticity-stream function equations using FDM

Lecture 25 - Boundary conditions for flow problems

Lecture 26 - Solutions of vorticity-stream function equations

Lecture 27 - Solution of Navier-Stokes Equation using FDM

Lecture 28 - Solution of Navier-Stokes Equation using FDM (Continued...)

Lecture 29 - Introduction to finite volume method

Lecture 30 - Finite volume discretization of steady diffusion equation

Lecture 31 - Finite volume discretization of unsteady diffusion equation

[Lecture 32 - Finite volume discretization of steady convection-diffusion equation](#)

[Lecture 33 - Finite volume discretization of unsteady convection-diffusion equation](#)

[Lecture 34 - Convection Schemes](#)

[Lecture 35 - Solution of Navier-Stokes Equations using FVM - I](#)

[Lecture 36 - Solution of Navier-Stokes Equations using FVM - II](#)

[Lecture 37 - Boundary Conditions](#)

Lecture 1 - Basic concepts, Calibration

Lecture 2 - Dimensions, Units, Standards, Systems of dimensions, System of units, Unit conversion table

Lecture 3 - Basic concept of dynamic measurements

Lecture 4 - Basic concept of dynamic measurements (Continued...)

Lecture 5 - Basic concept of dynamic measurements (Continued...)

Lecture 6 - System response and distortion, Impedance matching

Lecture 7 - Dimensional measurement Gauge blocks, The pneumatic displacement gauge

Lecture 8 - Dimensional measurement Gauge blocks, The pneumatic displacement gauge

Lecture 9 - Pressure Measurements: Definition of pressure and Dynamic response considerations

Lecture 10 - Mechanical pressure measurement devices, U-tube manometer, The inclined well type manometer

Lecture 11 - The aneroid barometer, Diaphragm and Bellows Gauges

Lecture 12 - The McLeod gauge, The Pirani gauge, The Ionization gauge

Lecture 13 - The McLeod gauge, The Pirani gauge, The Ionization gauge (Continued...)

Lecture 14 - The McLeod gauge, The Pirani gauge, The Ionization gauge (Continued...)

Lecture 15 - Pressure measurement using 3 holes/probes

Lecture 16 - Pressure measurement using 3 holes/probes (Continued...)

Lecture 17 - Flow obstruction flow rate measurement(venturimeter/orificemeter), the Rotameter

Lecture 18 - Flow obstruction flow rate measurement(venturimeter/orificemeter), the Rotameter (Continued...)

Lecture 19 - Thermal Anemometry(hot wire/hot film), Hot wire anemometer

Lecture 20 - Thermal Anemometry(hot wire/hot film), Hot wire anemometer (Continued...)

Lecture 21 - Laser Doppler anemometry

Lecture 22 - Measurement of velocity components by 3 holes and 4 holes probes

Lecture 23 - Ideal gas thermometer, Temperature measurement by mechanical and electrical effects

Lecture 24 - Ideal gas thermometer, Temperature measurement by mechanical and electrical effects (Continued...)

Lecture 25 - Thermostatic temperature, Resistance Temperature Detectors (RTD), Thermistors, Thermocouples

Lecture 26 - Temperature measurement by Radiation, The optical pyrometer

Lecture 27 - Transient response of thermal system, Thermocouple compensation, high speed flow

Lecture 28 - Transient response of thermal system, Thermocouple compensation, high speed flow (Continued...)

Lecture 29 - Transient response of thermal system, Thermocouple compensation, high speed flow (Continued...)

Lecture 30 - Constant temperature hot-wire anemometer, LDA

Lecture 31 - Use of PIV



[Lecture 32 - Use of PIV \(Continued...\)](#)

[Lecture 33 - Use of PIV \(Continued...\)](#)

[Lecture 34 - Measurement of pitch angle](#)

[Lecture 35 - Measurement of torque by dynamometers, strain gauge, transducers](#)

[Lecture 36 - Measurement of microscale flow features - I](#)

[Lecture 37 - Measurement of microscale flow features - II](#)

[Lecture 38 - Transient and Frequency response consideration](#)

[Lecture 39 - Examples](#)

[Lecture 40 - Analysis of experimental data, causes and types of experimental errors](#)

[Lecture 41 - Rejection of data: Chauvenets Criterion with example](#)

[Lecture 42 - Error propagation: function of two variables, several variables](#)

[Lecture 43 - The Method of Least square with example](#)

Lecture 1 - Basic concepts

Lecture 2 - Mechatronics

Lecture 3 - Mechatronics based systems

Lecture 4 - Automated systems and equipment used in manufacturing - Part I

Lecture 5 - Automated systems and equipment used in manufacturing - Part II

Lecture 6 - Selection of electrical and electronics components for mechatronics based systems

Lecture 7 - Terms related to performance of electro-mechanical systems

Lecture 8 - Computer aided design of components

Lecture 9 - Fabrication Processes

Lecture 10 - Measurement system and potentiometer sensors

Lecture 11 - Displacement, position and proximity sensors - I

Lecture 12 - Displacement, position and proximity sensors - II

Lecture 13 - Fluid flow, pressure, and temperature measurement

Lecture 14 - Signal Conditioning: amplification, filtering

Lecture 15 - Pulse modulation, Protection devices, and Wheatstone bridge

Lecture 16 - Signal conversion

Lecture 17 - Microprocessor Technology

Lecture 18 - Introduction to Microprocessor Programming

Lecture 19 - Application of electric drives in automation

Lecture 20 - DC and AC motors

Lecture 21 - Stepper motor and servo motor

Lecture 22 - Types of industrial automation and mechanisms

Lecture 23 - Ball screw based linear motion drives

Lecture 24 - Application of cams in automation

Lecture 25 - Application of indexing mechanisms in automation

Lecture 26 - Application of tool magazines in automation

Lecture 27 - Material handling systems

Lecture 28 - Fundamental concepts

Lecture 29 - Hydraulic pumps

Lecture 30 - Direction control valves

Lecture 31 - Flow control and pressure relief valves

[Lecture 32 - Graphical representation of hydraulic system elements](#)

[Lecture 33 - Basic concepts and air compressors](#)

[Lecture 34 - Air treatment and pressure regulation](#)

[Lecture 35 - Graphical representation and pneumatic circuits](#)

[Lecture 36 - Computer aided manufacturing and process planning](#)

[Lecture 37 - CNC machines and interpolation](#)

[Lecture 38 - CNC Programming](#)

- Lecture 1 - Review Concepts of Fluid Mechanics and Thermodynamics - I
- Lecture 2 - Review Concepts of Fluid Mechanics and Thermodynamics - II
- Lecture 3 - Review Concepts of Fluid Mechanics and Thermodynamics - III
- Lecture 4 - Wave Propagation in Compressible Medium - I
- Lecture 5 - Wave Propagation in Compressible Medium - II
- Lecture 6 - Wave Propagation in Compressible Medium - III
- Lecture 7 - Quasi-One Dimensional Isentropic Flow - I
- Lecture 8 - Quasi-One Dimensional Isentropic Flow - II
- Lecture 9 - Quasi-One Dimensional Isentropic Flow - III
- Lecture 10 - Normal Shock Waves - I
- Lecture 11 - Normal Shock Waves - II
- Lecture 12 - Normal Shock Waves - III
- Lecture 13 - Normal Shock Waves - IV
- Lecture 14 - Expansion Waves and Oblique Shocks - I
- Lecture 15 - Expansion Waves and Oblique Shocks - II
- Lecture 16 - Expansion Waves and Oblique Shocks - III
- Lecture 17 - Expansion Waves and Oblique Shocks - IV
- Lecture 18 - Expansion Waves and Oblique Shocks - V
- Lecture 19 - Expansion Waves and Oblique Shocks - VI
- Lecture 20 - Supersonic Nozzles and Diffusers - I
- Lecture 21 - Supersonic Nozzles and Diffusers - II
- Lecture 22 - Supersonic Nozzles and Diffusers - III
- Lecture 23 - Measurement Diagnostics and Experimental Facilities for Compressible Flow - II
- Lecture 24 - Compressible Flow with Friction and Heat Transfer - II
- Lecture 25 - Compressible Flow with Friction and Heat Transfer - III
- Lecture 26 - Measurement Diagnostics and Experimental Facilities for Compressible Flow - I
- Lecture 27 - Measurement Diagnostics and Experimental Facilities for Compressible Flow - II
- Lecture 28 - Measurement Diagnostics and Experimental Facilities for Compressible Flow - III
- Lecture 29 - Measurement Diagnostics and Experimental Facilities for Compressible Flow - IV
- Lecture 30 - Measurement Diagnostics and Experimental Facilities for Compressible Flow - V
- Lecture 31 - Measurement Diagnostics and Experimental Facilities for Compressible Flow - VI



Lecture 1 - Functional, First variation, Euler Lagrange equation; Several Dependent variables

Lecture 2 - Functional with higher order derivatives; Variational statement

Lecture 3 - Differential equation, Variational statement and Minimization problem; Rayleigh-Ritz method

Lecture 4 - FEM steps: Explained with discrete linear springs; Gaussian Quadrature rule for integration

Lecture 5 - Solving one Ordinary Differential Equation using Linear Finite Element

Lecture 6 - Solving one Ordinary Differential Equation using Quadratic Finite Element

Lecture 7 - Bar Element: Elemental equation; Matlab Implementation with Example

Lecture 8 - Bar Element: Postprocessing; Comparison with Analytical Solution; Bar with linear springs

Lecture 9 - Truss Element: Elemental equation; Matlab Implementation with Example

Lecture 10 - Beam Element: Variational statement; Hermite shape function

Lecture 11 - Beam Element: Elemental equation; Matlab implementation with Example

Lecture 12 - Beam Element: Matlab implementation for the example with Non-uniform distributed load

Lecture 13 - Frame Element: Derivation of elemental equation in global reference frame

Lecture 14 - Frame Element: Matlab implementation with one Example

Lecture 15 - Generalization of Geometry data; Stiffness matrix, Load vector formation at element level

Lecture 16 - Generalization of Assembly, Imposition of Boundary condition and Load information

Lecture 17 - Indicjal Notation: Summation convention, Kronecker delta, Permutation symbol

Lecture 18 - Second order tensor; Gradient, Divergence, Curl and Laplacian in Indicjal notation

Lecture 19 - Gauss Divergence theorem and its application in Heat transfer and Structural analysis

Lecture 20 - Derivation of weak form of 2D steady-state heat conduction problem

Lecture 21 - Triangular element, calculating element stiffness and element force vector

Lecture 22 - Numerical example, assembly, mapping

Lecture 23 - Numerical integration, Neumann boundary, and higher order shape functions

Lecture 24 - Quadrilateral element, Lagrange shape functions, Serendipity elements

Lecture 25 - Development of a MATLAB code for solving 2D steady-state heat conduction problem

Lecture 26 - Demonstration of the MATLAB code

Lecture 27 - Elasticity problems in two dimension and obtaining the weak form

Lecture 28 - Deriving element stiffness matrix and element force vector, numerical example

Lecture 29 - Development of a MATLAB code for solving planar elasticity problems

Lecture 30 - Superconvergent Patch Recovery, error estimator, adaptive refinement

Lecture 31 - Solving eigenvalue problem in bar and beam, writing FEM code in MATLAB

[Lecture 32 - Solving eigenvalue problem of membrane, writing FEM code in MATLAB](#)

[Lecture 33 - Solving transient problems \(parabolic type\)](#)

[Lecture 34 - Solving transient problems \(hyperbolic type\)](#)

[Lecture 35 - Solving elasticity problems in 3D using FEM, Solvers](#)

Lecture 1 - Origin of nonlinearities - 1

Lecture 2 - Origin of nonlinearities - 2

Lecture 3 - Tensor and Tensor Algebra - 1

Lecture 4 - Tensor and Tensor Algebra - 2

Lecture 5 - Tensor and Tensor Algebra - 3

Lecture 6 - Tensor and Tensor Algebra - 4

Lecture 7 - Linearization and directional derivative, Tensor analysis - 1

Lecture 8 - Linearization and directional derivative, Tensor analysis - 2

Lecture 9 - Worked Examples - 1

Lecture 10 - Worked Examples - 2

Lecture 11 - Idea of Motion, Material and Spatial Descriptions, Deformation Gradient Tensor

Lecture 12 - Strain, Polar Decomposition - 1

Lecture 13 - Polar Decomposition - 2, Volume and Area Change

Lecture 14 - Worked Examples, Linearized Kinematics

Lecture 15 - Velocity, Acceleration, Material Time Derivative

Lecture 16 - Velocity Gradient, Rate of Deformation tensor, Area and Volume Rate, Reynolds Transport Theorem

Lecture 17 - Solved Examples

Lecture 18 - Conservation of Mass, Balance of Linear Momentum, Cauchy's Stress Principle - 1

Lecture 19 - Cauchy's Stress Principle - 2, Cauchy Stress Tensor

Lecture 20 - Objectivity, Stress Objectivity, Equilibrium Equations - 1

Lecture 21 - Equilibrium Equations - 2, Principle of Virtual Work

Lecture 22 - Work Conjugacy, First Piola-Kirchhoff Stress Tensor

Lecture 23 - Second Piola-Kirchhoff Stress Tensor, Decomposition of Stress - 1

Lecture 24 - Decomposition of Stress - 2, Objective Stress Measures

Lecture 25 - Solved Examples

Lecture 26 - Constitutive relations and constraints, Hyperelasticity, Material elasticity tensor

Lecture 27 - Spatial Elasticity Tensor, Solved Example

Lecture 28 - Isotropic hyperelasticity - material and spatial description, Hyperelastic models

Lecture 29 - Isotropic Hyperelasticity, Neo-Hookean Material Model, Solved Examples

Lecture 30 - Introduction, Linearization Process Overview

Lecture 31 - Linearization of Internal Virtual Work and External Virtual Work



[Lecture 32 - Discretization of Kinematic Quantities, Equilibrium Equations](#)

[Lecture 33 - Discretization of Linearized Equilibrium Equations](#)

[Lecture 34 - Newton Raphson Method](#)

[Lecture 35 - Line Search Method](#)

[Lecture 36 - Arc Length Method, Solved Examples](#)

[Lecture 37 - FE Formulation of Ductile Fracture in Dynamic Elasto-Plastic Contact Problem - Introduction](#)

[Lecture 38 - FE Formulation of Ductile Fracture in Dynamic Elasto-Plastic Contact Problem - Formulation](#)

[Lecture 39 - FE Formulation of Ductile Fracture in Dynamic Elasto-Plastic Contact Problem - FEM](#)

[Lecture 40 - FE Formulation of Ductile Fracture in Dynamic Elasto-Plastic Contact Problem - Results](#)

Lecture 1 - Application of convective heat transfer

Lecture 2 - Foundations of heat transfer

Lecture 3 - Derivation of energy equation

Lecture 4 - Derivation of boundary layer equation

Lecture 5 - Derivation of boundary layer energy equation

Lecture 6 - Blasius solution: similarity method

Lecture 7 - Pohlhausen solution: similarity method

Lecture 8 - Pohlhausen solution: heat transfer parameters

Lecture 9 - Falkner-Skan equation: Boundary layer flow over a wedge

Lecture 10 - Momentum integral equation for flat plate boundary layer

Lecture 11 - Laminar BL flow over flat plate: Uniform surface temperature

Lecture 12 - Laminar BL flow over flat plate: Uniform surface heat flux

Lecture 13 - Solution of example problems

Lecture 14 - Hydrodynamic and thermal regions

Lecture 15 - Energy balance in channel flow

Lecture 16 - Determination of heat transfer coefficient

Lecture 17 - Velocity profile in fully-developed channel flows

Lecture 18 - Thermally fully developed laminar slug flow with uniform wall heat flux condition

Lecture 19 - Hydrodynamically and thermally fully developed flow with uniform wall heat flux condition

Lecture 20 - Fully developed flow through parallel plate channel with uniform wall temperature

Lecture 21 - Fully developed flow through circular pipe with uniform wall temperature

Lecture 22 - Thermally developing flow through circular pipe with uniform wall heat flux

Lecture 23 - Thermally developing flow through circular pipe with uniform wall temperature

Lecture 24 - Heat transfer in plane Couette flow

Lecture 25 - Solutions of example problems

Lecture 26 - Introduction and scale analysis

Lecture 27 - Natural convection over a vertical plate: Similarity Solution

Lecture 28 - Natural convection over a vertical plate: Similarity solution of energy equation

Lecture 29 - Natural convection over a vertical plate: Integral solution

Lecture 30 - Natural convection over inclined plate and mixed convection

Lecture 31 - Natural convection inside enclosures

[Lecture 32 - Solution of example problems](#)

[Lecture 33 - Basics of finite difference method](#)

[Lecture 34 - Solution of Navier-Stokes equations](#)

[Lecture 35 - Solution of energy equation](#)

[Lecture 36 - Derivation of Reynolds Averaged Navier-Stokes Equations](#)

[Lecture 37 - External Turbulent Flow](#)

[Lecture 38 - Integral solution for turbulent boundary layer flow over a flat plate](#)

[Lecture 39 - Convection in turbulent pipe flow](#)

[Lecture 40 - Boiling regimes and boiling curve](#)

[Lecture 41 - Laminar film condensation on a vertical plate](#)

[Lecture 42 - Laminar film condensation on horizontal tube](#)

[Lecture 43 - Solution of example problems](#)

- Lecture 1 - Introduction to composite materials
- Lecture 2 - Basic terminology in Shell
- Lecture 3 - Derivation of fundamental theorem of surfaces
- Lecture 4 - Derivative of unit vectors and various theorems
- Lecture 5 - Classification of shells
- Lecture 6 - Derivation of strain-displacement relation
- Lecture 7 - Derivation of shell governing equations - 1
- Lecture 8 - Derivation of shell governing equations - 2
- Lecture 9 - Derivation of shell governing equations - 3
- Lecture 10 - Derivation of special cases
- Lecture 11 - Derivation of shell constitutive relations
- Lecture 12 - Solved examples on membrane theory and moment shell theory
- Lecture 13 - Shell of revolution problems
- Lecture 14 - Derivation of Navier solution for infinite shell panel
- Lecture 15 - Basics of MATLAB coding
- Lecture 16 - Derivation of Navier solution for finite shell panel
- Lecture 17 - ABAQUS Modelling
- Lecture 18 - Extended Kanatovich method for shell panel
- Lecture 19 - Free Vibration solution of shell panels under Navier and Levy supports - 1
- Lecture 20 - Free Vibration solution of shell panels under Navier and Levy supports - 2
- Lecture 21 - Basics of Buckling of shells
- Lecture 22 - Buckling of cylindrical shells
- Lecture 23 - Buckling of Levy-type cylindrical shells
- Lecture 24 - 3D Bending
- Lecture 25 - 3D Free vibration
- Lecture 26 - 3D Buckling
- Lecture 27 - Advanced Material
- Lecture 28 - Free vibration of a composite cylindrical shell

- Lecture 1 - Properties, Modelling approaches, Process modelling and Optimization
- Lecture 2 - Fusion welding - 1
- Lecture 3 - Fusion welding - 2
- Lecture 4 - Soldering, Brazing, Solid-state welding processes
- Lecture 5 - Advanced welding processes
- Lecture 6 - Advances in laser microwelding
- Lecture 7 - Additive manufacturing processes
- Lecture 8 - Elastic stress analysis - I
- Lecture 9 - Elastic stress analysis - II and Potential energy method
- Lecture 10 - Three-Dimensional element
- Lecture 11 - Weighted residual method
- Lecture 12 - Material nonlinearity - I
- Lecture 13 - Material nonlinearity - II
- Lecture 14 - Fluid flow and Natural coordinate system - I
- Lecture 15 - Natural coordinate system in 3D and XFEM
- Lecture 16 - Introduction to heat source model
- Lecture 17 - Heat source models in welding - I
- Lecture 18 - Heat source models in welding - II
- Lecture 19 - Heat source model for Keyhole mode and solid state welding
- Lecture 20 - Implementation of FEM in fusion welding processes
- Lecture 21 - Implementation of FEM for fluid flow in fusion welding processes
- Lecture 22 - FEM modeling of EBW and RSW
- Lecture 23 - FEM modeling of FSW and hybrid FSW
- Lecture 24 - Demonstration of thermal model development using commercial software
- Lecture 25 - Fluid flow modeling in welding processes
- Lecture 26 - Heat transfer and fluid flow analysis in quasi-steady state
- Lecture 27 - Prediction of free surface profile
- Lecture 28 - Principle stress, Hydrostatic and Deviatoric Components of Stress
- Lecture 29 - Yield Function, Von Mises Yield Surface and Hardening rule
- Lecture 30 - Material models, Residual stress and distortion
- Lecture 31 - Phase transformation effect on Residual stress and distortion

[Lecture 32 - Demonstration of thermo-mechanical model development using commercial software](#)

[Lecture 33 - Fundamentals of metal transfer in arc welding](#)

[Lecture 34 - FE-based modelling approaches](#)

[Lecture 35 - Theoretical development of heat transfer model](#)

[Lecture 36 - Heating of nano-film](#)

[Lecture 37 - Theoretical development of stress analysis model](#)

[Lecture 38 - Fundamentals of wire arc additive manufacturing processes - I](#)

[Lecture 39 - Fundamentals of wire arc additive manufacturing processes - II](#)

[Lecture 40 - Modelling approaches of additive manufacturing](#)

- Lecture 1 - Introduction to mechanical systems
- Lecture 2 - Superposition rule, Commonly used nonlinear equations
- Lecture 3 - Equilibrium points: potential function
- Lecture 4 - Force and moment based Approach, Lagrange Principle
- Lecture 5 - Extended Hamilton's principle
- Lecture 6 - Use of scaling and book-keeping parameter for ordering
- Lecture 7 - Numerical solution, Analytical solutions: Harmonic Balance method
- Lecture 8 - Straight forward expansion
- Lecture 9 - Lindsted-Poincaré method
- Lecture 10 - Method of Averaging
- Lecture 11 - Method of multiple scales
- Lecture 12 - Method of generalized Harmonic Balance method
- Lecture 13 - Free vibration of undamped and damped SDOF systems with quadratic and cubic nonlinearity
- Lecture 14 - Super and sub harmonic resonance conditions
- Lecture 15 - Bifurcation analysis of fixed-point response
- Lecture 16 - Nonlinear system with hard excitations
- Lecture 17 - Super and sub harmonic resonance conditions
- Lecture 18 - Bifurcation analysis of fixed-point response
- Lecture 19 - Floquet theory, Hill's infinite determinant, Resonance in parametrically excited systems
- Lecture 20 - Parametrically excited pneumatic artificial muscle
- Lecture 21 - Parametric instability of sandwich plate
- Lecture 22 - Analysis of periodic, quasi-periodic and chaotic systems
- Lecture 23 - Stability and bifurcation analysis of periodic and quasi-periodic response
- Lecture 24 - Analysis of chaotic system
- Lecture 25 - Numerical methods for finding roots and solutions of ODE
- Lecture 26 - Time response, phase portraits, frequency response
- Lecture 27 - Poincaré section, FFT, Lyapunov exponent
- Lecture 28 - Passive and active vibration absorber with displacement and acceleration feedback
- Lecture 29 - Active vibration absorber with time delay acceleration feedback by HBM
- Lecture 30 - Application of Active vibration absorber with combination feedback
- Lecture 31 - Cantilever beam with tip mass for principal parametric resonance

[Lecture 32 - Cantilever beam with tip mass for combination resonance](#)

[Lecture 33 - Cantilever beam based piezoelectric based energy harvester](#)

[Lecture 34 - Nonlinear dynamics of turning operation with delay and internal resonance](#)

[Lecture 35 - Chatter in rolling mills and dynamic analysis of artificial pneumatic muscle](#)

[Lecture 36 - Chaotic systems and control of chaos](#)



Lecture 1 - Introduction to Optimization

Lecture 2 - Introduction to Evolutionary Computation

Lecture 3 - Binary-Coded Genetic Algorithm (BGA)

Lecture 4 - Operators and Simulations of Binary-Coded Genetic Algorithm

Lecture 5 - Real-Coded Genetic Algorithm (RGA)

Lecture 6 - Operators and Simulations of Real-Coded Genetic Algorithm

Lecture 7 - Algorithmic Implementation of BGA and RGA

Lecture 8 - Particle Swarm Optimization (PSO)

Lecture 9 - Simulations and Algorithmic Implementation of Particle Swarm Optimization

Lecture 10 - Differential Evolution (DE)

Lecture 11 - Simulations and Algorithmic Implementation of Differential Evolution

Lecture 12 - Constrained Optimization: Introduction and Optimality

Lecture 13 - Penalty Function Methods for Evolutionary Computing Techniques

Lecture 14 - Evolutionary Computing Techniques: Separation of Objective Function and Constraints

Lecture 15 - Simulations of Constraint Handling Techniques - Part 1

Lecture 16 - Simulations of Constraint Handling Techniques - Part 2

Lecture 17 - Introduction to Multi-Objective Optimization - Part 1

Lecture 18 - Introduction to Multi-Objective Optimization - Part 2

Lecture 19 - Multi-Objective Optimization: Ranking and Diversity

Lecture 20 - Classical Multi-Objective Optimization Methods

Lecture 21 - Non-Dominated Genetic Algorithm: NSGA-II: Introduction

Lecture 22 - Non-Dominated Genetic Algorithm: NSGA-II: Simulations

Lecture 23 - Strength Pareto Evolutionary Algorithm: SPEA2: Introduction

Lecture 24 - Strength Pareto Evolutionary Algorithm: SPEA2: Simulations

Lecture 25 - Performance Assessment of Multi-Objective EC Techniques

Lecture 26 - Closure of EC for Single and Multi-Objective Optimization

Lecture 1 - Preliminary concepts

Lecture 2 - Fluid Kinematics

Lecture 3 - Derivation of incompressible Navier-Stokes equations

Lecture 4 - Initial and Boundary Conditions

Lecture 5 - Plane Couette Flow

Lecture 6 - Plane Poiseuille Flow

Lecture 7 - Plane Poiseuille Flow with Slip and Thin Film Flow

Lecture 8 - Combined Couette - Poiseuille Flow

Lecture 9 - Example Problems

Lecture 10 - Hagen - Poiseuille Flow

Lecture 11 - Thin Film Flow and Annular Flow

Lecture 12 - Steady Flow Between Rotating Cylinders

Lecture 13 - Flow near a plate suddenly set in motion

Lecture 14 - Flow due to an oscillating plate

Lecture 15 - Transient Plane Couette Flow

Lecture 16 - Transient Axisymmetric Poiseuille Flow

Lecture 17 - Flow Through Rectangular Duct

Lecture 18 - Flow Through Equilateral Triangular Duct

Lecture 19 - Flow Through Elliptical Duct

Lecture 20 - Example Problems

Lecture 21 - Creeping Flow Around a Sphere

Lecture 22 - Reynolds Equation for Lubrication

Lecture 23 - One-dimensional Slider Bearing

Lecture 24 - Journal Bearing and Piston-ring Lubrication

Lecture 25 - Derivation of Boundary Layer Equations

Lecture 26 - Blasius Flow Over A Flat Plate: Similarity Solution

Lecture 27 - Momentum Integral Equation For Flat Plate Boundary Layer

Lecture 28 - Falkner-Skan equation: Boundary layer flow over a wedge

Lecture 29 - Karman-Pohlhausen Method for Non-zero Pressure Gradient Flows

Lecture 30 - The Correlation Method by Thwaites

Lecture 31 - Separation of Boundary Layer

[Lecture 32 - Example Problems](#)

[Lecture 33 - Two-dimensional Laminar Jet](#)

[Lecture 34 - Flow in the Wake of a Flat Plate](#)

[Lecture 35 - Free Shear Layer Between Two Different Streams](#)

[Lecture 36 - Derivation of Orr-Sommerfeld Equation](#)

[Lecture 37 - Viscous Stability](#)

[Lecture 38 - Inviscid Analysis](#)

[Lecture 39 - Introduction to Turbulent Flows](#)

[Lecture 40 - Derivation of Reynolds Averaged Navier-Stokes Equations](#)

[Lecture 41 - External Turbulent Flows](#)

[Lecture 42 - Integral Solution for Turbulent Boundary Layer Flow](#)

[Lecture 43 - Internal Turbulent Flow](#)

[Lecture 44 - Turbulence Modelling](#)

Lecture 1 - Plasma Arc Welding (PAW)

Lecture 2 - Flux Cored Arc Welding (FCAW)

Lecture 3 - Thermit Welding

Lecture 4 - Resistance Welding - Part 1 (Resistance Spot Welding)

Lecture 5 - Resistance Welding - Part 2 (Types of Resistance Welding)

Lecture 6 - Friction Welding

Lecture 7 - Friction Stir Welding - Part 1

Lecture 8 - Friction Stir Welding - Part 2

Lecture 9 - Soldering

Lecture 10 - Brazing

Lecture 11 - Residual Stress - Part 1

Lecture 12 - Residual Stress - Part 2

Lecture 13 - Influencing Factors and Control of Residual Stresses

Lecture 14 - Residual Stress Measurement - 1

Lecture 15 - Residual Stress Measurement - 2

Lecture 16 - Residual Stress Measurement by NDT

Lecture 17 - Welding Induced Distortion

Lecture 18 - Welding Induced Distortion (Control and Measurement)

Lecture 19 - Welding Induced Distortion (Measurement and Prediction)

Lecture 20 - Welded Joint Analysis

Lecture 21 - Welded Joints Analysis (Strength of Parallel and Transverse Fillet Welds)

Lecture 22 - Welded Joints Analysis (Analysis of Eccentrically Loaded Welded Joint)

Lecture 23 - Welded Joints Static Analysis (Analysis of Eccentrically Loaded Welded Joint - Part 1)

Lecture 24 - Welded Joints Static Analysis (Analysis of Eccentrically Loaded Welded Joint - Part 2)

Lecture 25 - Welded Joints Static Analysis (Welded Joint Subjected to Bending Moment)

Lecture 26 - Welded Joints Static Analysis (Welded Joint Subjected to Bending Moment - Part 1)

Lecture 27 - Welded Joints Static Analysis (Welded Joint Subjected to Bending Moment - Part 2)

[Lecture 1 - Introduction to Additive Manufacturing](#)

[Lecture 2 - CAD Models for Additive Manufacturing](#)

[Lecture 3 - Manipulation of STL Files](#)

[Lecture 4 - Slicing Methods - Part A](#)

[Lecture 5 - Slicing Methods - Part B](#)

[Lecture 6 - Toolpath Planning](#)

[Lecture 7 - Demonstration of CAD-CAM Packages](#)

[Lecture 8 - Introduction to Liquid AM](#)

[Lecture 9 - Stereolithography Apparatus: Fundamentals of Photopolymerization - Part 1](#)

[Lecture 10 - Stereolithography Apparatus: Fundamentals of Photopolymerization - Part 2](#)

[Lecture 11 - Stereolithography Apparatus: Sub-systems - Part 1](#)

[Lecture 12 - Stereolithography Apparatus: Sub-systems - Part 2](#)

[Lecture 13 - Other Liquid AM Processes - 1](#)

[Lecture 14 - Other Liquid AM Processes - 2](#)

[Lecture 15 - Sheet Additive Manufacturing - Part 1](#)

[Lecture 16 - Sheet Additive Manufacturing - Part 2](#)

[Lecture 17 - Wire Additive Manufacturing](#)

[Lecture 18 - Fused Deposition Modeling](#)

[Lecture 19 - Metal Wire Additive Manufacturing](#)

[Lecture 20 - Metal Inert Gas-Wire Arc Additive Manufacturing \(MIG-WAAM\) - Part 1](#)

[Lecture 21 - Metal Inert Gas-Wire Arc Additive Manufacturing \(MIG-WAAM\) - Part 2](#)

[Lecture 22 - Tungsten Inert Gas/Plasma-Wire Arc Additive Manufacturing \(TIG/Plasma-WAAM\)](#)

[Lecture 23 - Electron beam-based Wire Beam Additive Manufacturing \(WBAM\)](#)

[Lecture 24 - Laser Metal Wire Additive Manufacturing](#)

[Lecture 25 - Powder-Feed Additive Manufacturing - Part 1](#)

[Lecture 26 - Powder-Feed Additive Manufacturing - Part 2](#)

[Lecture 27 - Process Modeling for Powder Feed Additive Manufacturing - Part 1](#)

[Lecture 28 - Process Modeling for Powder Feed Additive Manufacturing - Part 2](#)

[Lecture 29 - Laser Beam based Powder Bed Additive Manufacturing - Part 1](#)

[Lecture 30 - Laser Beam based Powder Bed Additive Manufacturing - Part 2](#)

[Lecture 31 - Electron Beam based Powder Bed Additive Manufacturing](#)

[Lecture 32 - Binder based Powder Bed Additive Manufacturing - Part 1](#)

[Lecture 33 - Binder based Powder Bed Additive Manufacturing - Part 2](#)

- Lecture 1 - Thermodynamic Systems and Pure Substance
- Lecture 2 - Heat and Work Transfer - First Law of Thermodynamics
- Lecture 3 - Second Law of Thermodynamics
- Lecture 4 - Entropy and Exergy
- Lecture 5 - Introduction to Steam Power Plant
- Lecture 6 - Thermodynamics aspects of Steam Power Plant-Efficiency and Work ratiom
- Lecture 7 - Rankine Cycle and its analysis
- Lecture 8 - Improvement in Rankine Cycle Efficiency: Superheating and Reheating
- Lecture 9 - Improvement in Rankine Cycle Efficiency: Reheating and Regenerative Methods
- Lecture 10 - Improvement in Rankine Cycle Efficiency: Regenerative Methods
- Lecture 11 - Regenerative Cycles
- Lecture 12 - Impulse Steam Turbine: Velocity Diagrams,Work Transfer,Blade Efficiency
- Lecture 13 - Impulse Steam Turbine: Velocity Diagrams,Work Transfer,Blade Efficiency (Continued...)
- Lecture 14 - Reaction Steam Turbine
- Lecture 15 - Reaction Steam Turbine: Velocity Diagram, Work transfer, Blade Efficiency
- Lecture 16 - Steam Nozzle: Analysis and Efficiency
- Lecture 17 - Steam Nozzle: Analysis and Efficiency (Continued...)
- Lecture 18 - Boilers and Condensers
- Lecture 19 - Condensers and Second Law Analysis of Steam Power cycle
- Lecture 20 - Exergy Analysis of a Steam Turbine
- Lecture 21 - Numerical Problems: Steam Power Cycle
- Lecture 22 - IC engine-Components, Nomenclature and Classifications
- Lecture 23 - Basic Engine Cycle and Engine Kinematic Analysis
- Lecture 24 - Engine Operating Characteristics
- Lecture 25 - Thermodynamics Analysis of Air Standard Cycles
- Lecture 26 - Valve Timing Diagram and Fuel-Air Cycle
- Lecture 27 - Thermochemistry and Fuel Characteristics
- Lecture 28 - Combustion Phenomena in Engines
- Lecture 29 - Heat Transfer Analysis in Engines
- Lecture 30 - Exergy Analysis and Engine Emission/Pollution
- Lecture 31 - Gas Turbine Engine-Components and Thermal Circuit

- [Lecture 32 - Gas Turbine Performance Cycle - I](#)
- [Lecture 33 - Gas Turbine Performance Cycle - II](#)
- [Lecture 34 - Real Gas Turbine Performance Cycle](#)
- [Lecture 35 - Aircraft Propulsion Cycle - I](#)
- [Lecture 36 - Aircraft Propulsion Cycle - II](#)
- [Lecture 37 - Vapour Compression Refrigeration System - I](#)
- [Lecture 38 - Vapour Compression Refrigeration System - II](#)
- [Lecture 39 - Absorption Refrigeration and Refrigerants](#)
- [Lecture 40 - Fundamentals of Psychrometrics](#)
- [Lecture 41 - Air-Conditioning Processes](#)
- [Lecture 42 - Cooling Tower and Air Washers](#)
- [Lecture 43 - Reciprocating Compressor - Analysis and Modelling](#)
- [Lecture 44 - Multistage Compression - Analysis and Modelling](#)



- Lecture 1 - Composite Materials - Introduction
- Lecture 2 - Composite Materials - Classification
- Lecture 3 - Anisotropic Elasticity
- Lecture 4 - Orthotropic Materials
- Lecture 5 - Hooke's Law for 2D Lamina
- Lecture 6 - Engineering Constants for 2D Lamina
- Lecture 7 - Strength Failure Criteria - Part I
- Lecture 8 - Strength Failure Criteria - Part II
- Lecture 9 - Hygrothermal Behavior of Lamina
- Lecture 10 - Introduction and Terminologies
- Lecture 11 - Evaluation of Elastic Moduli
- Lecture 12 - Evaluation of Longitudinal Strength
- Lecture 13 - Evaluation of Transverse and Shear Strengths
- Lecture 14 - Evaluation of Hygrothermal Properties
- Lecture 15 - Elasticity Approach
- Lecture 16 - Experimental Evaluation
- Lecture 17 - Laminate - Introduction
- Lecture 18 - Classical Lamination Theory - Part I
- Lecture 19 - Classical Lamination Theory - Part II
- Lecture 20 - Response of Laminate - Significance of ABBD
- Lecture 21 - Special Classes of Laminates
- Lecture 22 - Engineering Constants of Laminates
- Lecture 23 - Hygrothermal Behaviour of Laminates
- Lecture 24 - Analysis of Laminates
- Lecture 25 - Failure of Laminates
- Lecture 26 - Failure Analysis under Combined Loading
- Lecture 27 - Design Example - I
- Lecture 28 - Design Example - II
- Lecture 29 - Interlaminar Stresses- Delamination
- Lecture 30 - Prediction of Delamination
- Lecture 31 - Transverse Deflection

[Lecture 32 - Buckling and Free Vibration](#)

Lecture 1 - Lasers in Manufacturing: Importance and Applications

Lecture 2 - Fundamentals of Laser Technology

Lecture 3 - Laser System: Construction and Types

Lecture 4 - Principle of Operation, Types of Laser Cutting, and Kerf Geometry

Lecture 5 - Types of Lasers in Material Removal, Process and Performance Parameters

Lecture 6 - A Case-study on Cutting a Circular Part using CO2 Laser Machine

Lecture 7 - Mechanisms of Laser Welding - Part I

Lecture 8 - Mechanisms of Laser Welding - Part II

Lecture 9 - Effects of Process Parameters during Laser Welding and Study of Defects in Weld Beads

Lecture 10 - A Case Study on Welding of Mild Steel Sheets using 2.5 kW CO2 Laser Machine

Lecture 11 - Material Forming and Fundamentals of Laser Forming

Lecture 12 - Mechanisms of Laser Forming

Lecture 13 - Process Parameters and their Effects on the Performance of Laser Forming

Lecture 14 - Surface Treatment and Application of Lasers

Lecture 15 - Laser Surface Hardening

Lecture 16 - Laser Surface Alloying

Lecture 17 - Laser Cladding

Lecture 18 - Additive Manufacturing Techniques

Lecture 19 - Laser Scanning Stereolithography

Lecture 20 - Selective Laser Sintering and Selective Laser Melting

Lecture 21 - Process and Performance Parameters of Laser Based Additive Manufacturing Techniques

Lecture 22 - Lasers in Manufacturing Automation

Lecture 23 - CNC for Laser Based Manufacturing

Lecture 24 - CAD for Laser Based Manufacturing

Lecture 25 - Laser-assisted Material Forming

Lecture 26 - Effect of Coatings, 3D Laser Forming and Micro-forming

- Lecture 1 - Temperature and Zeroth Law of Thermodynamics
- Lecture 2 - Work and Heat Transfer - First Law of Thermodynamics
- Lecture 3 - Heat Engines and Refrigerators/Heat Pump - Second Law of Thermodynamics
- Lecture 4 - Entropy Analysis - Part I
- Lecture 5 - Entropy Analysis - Part II
- Lecture 6 - Entropy Analysis - Part III
- Lecture 7 - Exergy Analysis - Part I
- Lecture 8 - Exergy Analysis - Part II
- Lecture 9 - Exergy Analysis - Part III
- Lecture 10 - Thermodynamic Functions and Maxwell's Equations
- Lecture 11 - Property Relations for Phase Change Processes
- Lecture 12 - Property Relations for Single Phase Systems
- Lecture 13 - Heat Capacity Equations and its Applications
- Lecture 14 - Joule - Thomson Coefficient and Liquefaction of Gases
- Lecture 15 - Ideal Gas and Real Gas
- Lecture 16 - Gas Mixtures and Multi-Component System
- Lecture 17 - Ideal Gas Mixture
- Lecture 18 - Mixing Analysis of Thermodynamic Systems
- Lecture 19 - Thermodynamic Considerations of Combustion
- Lecture 20 - Conservation of Energy for Reacting Systems
- Lecture 21 - Adiabatic Flame Temperature, Entropy and Gibbs Function for Reacting System
- Lecture 22 - Equilibrium Products of Combustion and Effective Energy Utilization
- Lecture 23 - Fundamentals of Chemical Reactions
- Lecture 24 - Reaction Mechanisms - Part I
- Lecture 25 - Reaction Mechanisms - Part II
- Lecture 26 - Chemical and Thermal Analysis of Reacting Systems
- Lecture 27 - Simplified Conservation Equations for Reacting Flows
- Lecture 28 - Laminar Premixed Flame - Part I
- Lecture 29 - Laminar Premixed Flame - Part II
- Lecture 30 - Laminar Diffusion Flame
- Lecture 31 - Droplet Evaporation and Turbulent Flame

Lecture 32 - Engine Combustion and Pollution

- Lecture 1 - First law of Thermodynamics for control mass and control volume systems
- Lecture 2 - First law of Thermodynamics for control volume system (Flow system)
- Lecture 3 - Steady State Steady Flow Processes, combination of First and Second Laws
- Lecture 4 - Second Law of Thermodynamics: A Brief Review
- Lecture 5 - Combined First and Second Laws Applied to Processes
- Lecture 6 - Combined First and Second Laws: Flow and Non-Flow Processes
- Lecture 7 - Description of Steam Power Plant: Application of 1st and 2nd Laws to Different Processes
- Lecture 8 - Second Law Applied to Processes of Power Plant and Ideal Cycle of Power Plant
- Lecture 9 - Steam Power Plant: Thermodynamic aspects, Efficiency, Work ratio and Ideal Cycle
- Lecture 10 - Ideal Power Cycle and its Limitations, Introduction to Actual Power Cycle
- Lecture 11 - Limitations of Carnot Cycle, Simple Rankine Cycle and Analysis
- Lecture 12 - Analysis of Simple Rankine Cycle and its Design Modifications
- Lecture 13 - Reheat Cycle and Analysis
- Lecture 14 - Reheat Cycle and Analysis (Continued...)
- Lecture 15 - Regenerative Principle of Steam Power Cycles
- Lecture 16 - Analysis of Regenerative Steam Power Cycles
- Lecture 17 - Regenerative Steam Power Cycle with Closed Feed-Water Heater, Ideal Working Fluid
- Lecture 18 - Multi-fluid Cycle and Analysis
- Lecture 19 - Analysis of Multi-fluid Cycle; Second Law Analysis of Steam Power Cycle
- Lecture 20 - Problems of Steam Power Cycle
- Lecture 21 - Problems of Steam Power Cycle (Continued...)
- Lecture 22 - Types of Boiler, Different Cycles in Boiler Operation, Boiler attachment
- Lecture 23 - Cochran Boiler Operation, Boiler attachment
- Lecture 24 - Boiler Attachments
- Lecture 25 - Superheaters and their Arrangements, Steam Temperature Control
- Lecture 26 - Characteristics of Convective and Radiant Superheaters; Steam Temperature Control
- Lecture 27 - Problems on Boiler/Steam Generator
- Lecture 28 - Use of nozzles in steam power plant, flow analysis of steam in nozzle
- Lecture 29 - Flow analysis of steam in nozzle: Mass flow rate
- Lecture 30 - Mass flow rate of steam in nozzle, Critical Pressure Ratio
- Lecture 31 - Critical Pressure Ratio and its Physical Significance

- Lecture 32 - Nozzle efficiency and factors that affect the efficiency
- Lecture 33 - Factors that affect the efficiency, problem on flow nozzle
- Lecture 34 - Problem on flow nozzle
- Lecture 35 - Steam Turbines: types and analysis using velocity triangles
- Lecture 36 - Analysis of Impulse Steam Turbine
- Lecture 37 - Compounding of Steam Turbine
- Lecture 38 - Analysis of Reaction Steam Turbine
- Lecture 39 - Problems on Steam Turbine
- Lecture 40 - The Role of Condenser in Power Plant
- Lecture 41 - Cooling Tower: Types and Analysis
- Lecture 42 - Cooling Tower Performance
- Lecture 43 - IC Engines, Classification, Different Parts, SI and CI Engines
- Lecture 44 - Comparison of 2-stroke and 4-stroke Engines
- Lecture 45 - Comparison of SI and CI Engines, Compression Ratio
- Lecture 46 - Introduction to Carburettor and Regimes of Engine Operation
- Lecture 47 - Regimes of Engine Operation and Simple Float Type Carburettor
- Lecture 48 - Simple Float Type Carburettor and its Analysis
- Lecture 49 - Mass Flow Rate of Fuel and limitations of Simple Float Type Carburettor
- Lecture 50 - Limitations of Simple Float Type Carburettor, Problem on Carburettion
- Lecture 51 - Engine Operating Characteristics: MEP and Indicator diagram
- Lecture 52 - Performance Analysis parameters of IC Engine
- Lecture 53 - Fuel of IC Engines
- Lecture 54 - Alternative Fuels and Self Ignition Characteristics of Fuel: Octane Number, Cetane Number
- Lecture 55 - Thermodynamic Analysis of SI Engine
- Lecture 56 - Thermodynamic Analysis of CI Engine
- Lecture 57 - Numerical Problems on Engine Performance
- Lecture 58 - Pressure-Crank angle diagram, Engine Efficiencies
- Lecture 59 - Numerical Problems on SI and CI Engines
- Lecture 60 - Vapour Compression Refrigeration Cycle and its analysis
- Lecture 61 - Problems on Vapour Compression Refrigeration Cycle
- Lecture 62 - Gas Turbine Units and Thermodynamic Cycles
- Lecture 63 - Gas Compressor and Optimum Pressure Ratio
- Lecture 64 - Compressor Efficiency and Multistage Compression with Intercooling

[Lecture 65 - Gas Turbine Unit: Combined Cycle](#)

[Lecture 66 - Problems On Gas Turbine Cycle](#)



**NPTEL : Acoustics (Mechanical Engineering)**

**Co-ordinators : Prof. Nachiketa Tiwari**

Lecture 1 - Intro, sound wave versus vibration, different types of waves, octave, music scales, sense of SPL

Lecture 2 - Review: Linearity, complex numbers, and spring mass system

Lecture 3 - Review: Poles and zeroes, phase and magnitude plots, transfer functions, Bode plots

Lecture 4 - Review: Transfer functions, and Bode plots

Lecture 5 - 1-D wave equation, and its solution

Lecture 6 - Solution for 1-D wave equation

Lecture 7 - Waveguides, transmission line equations, and standing waves

Lecture 8 - Waveguides, transmission line equations, and standing waves

Lecture 9 - Examples of 1-D waves in tubes, short tubes, Kundt's tube

Lecture 10 - Thermodynamic processes during sound transmission

Lecture 11 - Numerical examples

Lecture 12 - Sound transmission through walls

Lecture 13 - Sound transmission through walls

Lecture 14 - Leakage in walls, STC Ratings, Octave bands

Lecture 15 - Instantaneous power flow

Lecture 16 - Radial propagation of sound, monopoles, and dipoles

Lecture 17 - Radial propagation of sound, monopoles, and dipoles

Lecture 18 - Radial propagation of sound, monopoles, and dipoles

Lecture 19 - Numerical examples

Lecture 20 - Numerical examples

Lecture 21 - Directivity

Lecture 22 - Directivity

Lecture 23 - Directivity

Lecture 24 - Directivity

Lecture 25 - Generalized elements

Lecture 26 - Examples of electromechanical systems

Lecture 27 - Transformers, radiation impedance, and Helmholtz resonator

Lecture 28 - Radiation impedance

Lecture 29 - Radiation impedance

Lecture 30 - Models of electro-mechanical-acoustic systems

Lecture 31 - Solution for a loudspeaker model

[Lecture 32 - Microphones](#)

[Lecture 33 - Vibro-meter, seismometer, accelerometer, shaker table](#)

[Lecture 34 - Sound propagation in rooms, 1-D rooms, 2D rooms](#)

[Lecture 35 - Sound in 3-D rooms](#)

[Lecture 36 - Absorption coefficient, and irregular rooms](#)

[Lecture 37 - Room constant, and Sabine's coefficient](#)

[Lecture 38 - Design of a muffler](#)

[Lecture 39 - Noise in machines, basics of noise management](#)

[Lecture 1 - Advanced Machining Processes](#)

[Lecture 2 - Advanced Machining Processes](#)

[Lecture 3 - Advanced Machining Processes](#)

[Lecture 4 - Advanced Machining Processes](#)

[Lecture 5 - Advanced Machining Processes](#)

[Lecture 6 - Advanced Machining Processes](#)

[Lecture 7 - Advanced Machining Processes](#)

[Lecture 8 - Advanced Machining Processes](#)

[Lecture 9 - Advanced Machining Processes](#)

[Lecture 10 - Advanced Machining Processes](#)

[Lecture 11 - Advanced Machining Processes](#)

[Lecture 12 - Advanced Machining Processes](#)

[Lecture 13 - Advanced Machining Processes](#)

[Lecture 14 - Advanced Machining Processes](#)

[Lecture 15 - Advanced Machining Processes](#)

[Lecture 16 - Advanced Machining Processes](#)

[Lecture 17 - Advanced Machining Processes](#)

[Lecture 18 - Advanced Machining Processes](#)

[Lecture 19 - Advanced Machining Processes](#)

[Lecture 20 - Advanced Machining Processes](#)

[Lecture 21 - Advanced Machining Processes](#)

[Lecture 22 - Advanced Machining Processes](#)

[Lecture 23 - Advanced Machining Processes](#)

[Lecture 24 - Advanced Machining Processes](#)

[Lecture 25 - Advanced Machining Processes](#)

[Lecture 26 - Advanced Machining Processes](#)

[Lecture 27 - Advanced Machining Processes](#)

[Lecture 28 - Advanced Machining Processes](#)

[Lecture 29 - Advanced Machining Processes](#)

[Lecture 30 - Advanced Machining Processes](#)

[Lecture 31 - Advanced Machining Processes](#)

[Lecture 32 - Advanced Machining Processes](#)

[Lecture 33 - Advanced Machining Processes](#)

[Lecture 34 - Advanced Machining Processes](#)

[Lecture 1](#)

[Lecture 2](#)

[Lecture 3](#)

[Lecture 4](#)

[Lecture 5](#)

[Lecture 6](#)

[Lecture 7](#)

[Lecture 8](#)

[Lecture 9](#)

[Lecture 10 \(same as 9\)](#)

[Lecture 11](#)

[Lecture 12 \(Lecture Missing\)](#)

[Lecture 13](#)

[Lecture 14](#)

[Lecture 15](#)

[Lecture 16](#)

[Lecture 17](#)

[Lecture 18](#)

[Lecture 19](#)

[Lecture 20](#)

[Lecture 21](#)

[Lecture 22](#)

[Lecture 23](#)

[Lecture 24](#)

[Lecture 25](#)

[Lecture 26](#)

[Lecture 27](#)

[Lecture 28](#)

[Lecture 29](#)

[Lecture 30](#)

[Lecture 31](#)

[Lecture 32](#)

[Lecture 33](#)

[Lecture 34](#)

[Lecture 35](#)

[Lecture 36](#)

[Lecture 37](#)

[Lecture 38](#)

[Lecture 39](#)

[Lecture 40](#)

[Lecture 1](#)

[Lecture 2](#)

[Lecture 3](#)

[Lecture 4](#)

[Lecture 5](#)

[Lecture 6](#)

[Lecture 7](#)

[Lecture 8](#)

[Lecture 9](#)

[Lecture 10](#)

[Lecture 11](#)

[Lecture 12](#)

[Lecture 13](#)

[Lecture 14](#)

[Lecture 15](#)

[Lecture 16](#)

[Lecture 17](#)

[Lecture 18](#)

[Lecture 19](#)

[Lecture 20](#)

[Lecture 21](#)

[Lecture 22](#)

[Lecture 23](#)

[Lecture 24](#)

[Lecture 25](#)

[Lecture 26](#)

[Lecture 27](#)

[Lecture 28](#)

[Lecture 29](#)

[Lecture 30](#)

[Lecture 31](#)

[Lecture 32](#)

[Lecture 33](#)

[Lecture 34](#)

[Lecture 35](#)

[Lecture 36](#)

[Lecture 37](#)

[Lecture 38](#)

[Lecture 39](#)

[Lecture 40](#)



Lecture 1 - Introduction

Lecture 2 - Basic Ideas of Applied Linear Algebra

Lecture 3 - Systems of Linear Equations

Lecture 4 - Square Non-Singular Systems

Lecture 5 - Ill-Conditioned and Ill-Posed Systems

Lecture 6 - The Algebraic Eigenvalue Problem

Lecture 7 - Canonical Forms, Symmetric Matrices

Lecture 8 - Methods of Plane Rotations

Lecture 9 - Householder Method, Tridiagonal Matrices

Lecture 10 - QR Decomposition, General Matrices

Lecture 11 - Singular Value Decomposition

Lecture 12 - Vector Space: Concepts

Lecture 13 - Multivariate Calculus

Lecture 14 - Vector Calculus in Geometry

Lecture 15 - Vector Calculus in Physics

Lecture 16 - Solution of Equations

Lecture 17 - Introduction to Optimization

Lecture 18 - Multivariate Optimization

Lecture 19 - Constrained Optimization: Optimality Criteria

Lecture 20 - Constrained Optimization: Further Issues

Lecture 21 - Interpolation

Lecture 22 - Numerical Integration

Lecture 23 - Numerical Solution of ODE's as IVP

Lecture 24 - Boundary Value Problems, Question of Stability in IVP Solution

Lecture 25 - Stiff Differential Equations, Existence and Uniqueness Theory

Lecture 26 - Theory of First Order ODE's

Lecture 27 - Linear Second Order ODE's

Lecture 28 - Methods of Linear ODE's

Lecture 29 - ODE Systems

Lecture 30 - Stability of Dynamic Systems

Lecture 31 - Series Solutions and Special Functions

[Lecture 32 - Sturm-Liouville Theory](#)

[Lecture 33 - Approximation Theory and Fourier Series](#)

[Lecture 34 - Fourier Integral to Fourier Transform, Minimax Approximation](#)

[Lecture 35 - Separation of Variables in PDE's, Hyperbolic Equations](#)

[Lecture 36 - Parabolic and Elliptic Equations, Membrane Equation](#)

[Lecture 37 - Analytic Functions](#)

[Lecture 38 - Integration of Complex Functions](#)

[Lecture 39 - Singularities and Residues](#)

[Lecture 40 - Calculus of Variations](#)

Lecture 1 - Rigid Body Motion - Part 1

Lecture 2 - Rigid Body Motion - Part 2

Lecture 3 - Dynamic Force Analysis of Mechanisms

Lecture 4 - Space Motion of Rigid Bodies

Lecture 5 - Inertia Tensor Angular Momentum

Lecture 6 - Euler's Equation of Motion

Lecture 7 - Gyroscopic Action in Machines

Lecture 8 - Unbalance in Machines

Lecture 9 - Rotary Balancing

Lecture 10 - Balancing Machines

Lecture 11 - Field Balancing of Rotors

Lecture 12 - Single-Cylinder Engine Balancing

Lecture 13 - Balancing of Single Slider Machines

Lecture 14 - In-Line Engine Balancing

Lecture 15 - V and Radial Engine Balancing

Lecture 16 - Turning Moment Diagram

Lecture 17 - Flywheel Analysis

Lecture 18 - Dynamics of Machines

Lecture 19 - Dynamics of Machines

Lecture 20 - Dynamics of Machines

Lecture 21 - Dynamics of Machines

Lecture 22 - Dynamics of Machines

Lecture 23 - Dynamics of Machines

Lecture 24 - Dynamics of Machines

Lecture 25 - Dynamics of Machines

Lecture 26 - Dynamics of Machines

Lecture 27 - Dynamics of Machines

Lecture 28 - Dynamics of Machines

Lecture 29 - Rotating Vector Approach

Lecture 30 - Equivalent viscous damping

Lecture 31 - Dynamics of Machines

[Lecture 32 - Systems with two degree of freedom](#)

[Lecture 33 - Tuned Vibration Absorber](#)

[Lecture 34 - Design of Vibration Absorbers](#)

[Lecture 35 - Flexibility Matrix Influence Coeff](#)

[Lecture 36 - Forced Vibration of multiple](#)

[Lecture 37 - Forced Vibration of Multiple degrees](#)

[Lecture 38 - Vibration of Continuous Systems](#)

[Lecture 39 - Vibration of Continuous Systems](#)

[Lecture 40 - Vibration of Beams](#)

[Lecture 41 - Rayleigh's method](#)

[Lecture 42 - Rayleigh-Ritz Method](#)

[Lecture 43 - Vibration Measurement](#)

[Lecture 44 - Vibration Measurement Types of Pickups](#)

**NPTEL : Finite Element Method (Mechanical Engineering)**

**Co-ordinators : Prof. C.S. Upadhyay**

[Module 1 - Lecture 1](#)

[Module 1 - Lecture 2](#)

[Module 1 - Lecture 3](#)

[Module 2 - Lecture 1](#)

[Module 2 - Lecture 2](#)

[Module 2 - Lecture 3](#)

[Module 2 - Lecture 4](#)

[Module 3 - Lecture 1](#)

[Module 3 - Lecture 2](#)

[Module 3 - Lecture 3](#)

[Module 4 - Lecture 1](#)

[Module 4 - Lecture 2](#)

[Module 4 - Lecture 3](#)

[Module 5 - Lecture 1](#)

[Module 5 - Lecture 2](#)

[Module 5 - Lecture 3](#)

[Module 6 - Lecture 1](#)

[Module 6 - Lecture 2](#)

[Module 6 - Lecture 3](#)

[Module 7 - Lecture 1](#)

[Module 7 - Lecture 2](#)

[Module 7 - Lecture 3](#)

[Module 7 - Lecture 4](#)

[Module 8 - Lecture 1](#)

[Module 8 - Lecture 2](#)

[Module 8 - Lecture 3](#)

[Module 9 - Lecture 1](#)

[Module 9 - Lecture 2](#)

[Module 9 - Lecture 3](#)

[Module 10 - Lecture 1](#)

[Module 10 - Lecture 2](#)

[Module 11 - Lecture 1](#)

[Module 11 - Lecture 2](#)

[Module 12 - Lecture 1](#)

[Module 13 - Lecture 1](#)

[Module 13 - Lecture 2](#)

[Module 14 - Lecture 1](#)

[Module 14 - Lecture 2](#)

**NPTEL : Kinematics of Machines (Mechanical Engineering)**

**Co-ordinators : Prof. Ashok K Mallik**

[Module 1 - Lecture 1](#)

[Module 1 - Lecture 2](#)

[Module 1 - Lecture 3](#)

[Module 2 - Lecture 1](#)

[Module 2 - Lecture 2](#)

[Module 2 - Lecture 3](#)

[Module 3 - Lecture 1](#)

[Module 3 - Lecture 2](#)

[Module 3 - Lecture 3](#)

[Module 3 - Lecture 4](#)

[Module 4 - Lecture 1](#)

[Module 4 - Lecture 2](#)

[Module 5 - Lecture 1](#)

[Module 5 - Lecture 2](#)

[Module 5 - Lecture 3](#)

[Module 6 - Lecture 1](#)

[Module 6 - Lecture 2](#)

[Module 6 - Lecture 3](#)

[Module 7 - Lecture 1](#)

[Module 7 - Lecture 2](#)

[Module 7 - Lecture 3](#)

[Module 8 - Lecture 1](#)

[Module 8 - Lecture 2](#)

[Module 9 - Lecture 1](#)

[Module 9 - Lecture 2](#)

[Module 9 - Lecture 3](#)

[Module 9 - Lecture 4](#)

[Module 10 - Lecture 1](#)

[Module 10 - Lecture 2](#)

[Module 10 - Lecture 3](#)

[Module 11 - Lecture 1](#)

[Module 11 - Lecture 2](#)

[Module 11 - Lecture 3](#)

[Module 12 - Lecture 1](#)

[Module 12 - Lecture 2](#)

[Module 12 - Lecture 3](#)

[Module 13 - Lecture 1](#)

[Module 13 - Lecture 2](#)

[Module 13 - Lecture 3](#)



[Lecture 1](#)

[Lecture 2](#)

[Lecture 3](#)

[Lecture 4](#)

[Lecture 5](#)

[Lecture 6](#)

[Lecture 7](#)

[Lecture 8](#)

[Lecture 9](#)

[Lecture 10](#)

[Lecture 11](#)

[Lecture 12](#)

[Lecture 13](#)

[Lecture 14](#)

[Lecture 15](#)

[Lecture 16](#)

[Lecture 17](#)

[Lecture 18](#)

[Lecture 19](#)

[Lecture 20](#)

[Lecture 21](#)

[Lecture 22](#)

[Lecture 23](#)

[Lecture 24](#)

[Lecture 25](#)

[Lecture 26](#)

[Lecture 27](#)

[Lecture 28](#)

[Lab session 1 - Advanced manufacturing process for micro sytem fabrication](#)

[Lab session 2 - EDM Micro Machening](#)

[Lab session 3 - EDM Micro Drilling](#)

[Lab session 4 - Laser Machening Process](#)

[Lab session 5 - Vaccume Assisted Forming](#)

[Lab session 6 - Vaccume Forming](#)

[Lab session 7 - Photolithiography](#)

[Lab session 8 - Replication part 1](#)

[Lab session 9 - Replication part 2](#)

[Lab session 10 - PCB Making](#)

[Lecture 1 - Technical Arts 101](#)

[Lecture 2 - Technical Arts 101](#)

[Lecture 3 - Technical Arts 101](#)

[Lecture 4 - Technical Arts 101](#)

[Lecture 5 - Technical Arts 101](#)

[Lecture 6 - Technical Arts 101](#)

[Lecture 7 - Technical Arts 101](#)

[Lecture 8 - Technical Arts 101](#)

[Lecture 9 - Technical Arts 101](#)

[Lecture 10 - Technical Arts 101](#)

[Lecture 11 - Technical Arts 101](#)

[Lecture 12 - Technical Arts 101](#)

[Lecture 13 - Technical Arts 101](#)

[Lecture 14 - Technical Arts 101](#)

[Lecture 15 - Technical Arts 101](#)

[Lecture 16 - Technical Arts 101](#)

[Lecture 17 - Technical Arts 101](#)

[Lecture 18 - Technical Arts 101](#)

[Lecture 19 - Technical Arts 101](#)

[Lecture 20 - Technical Arts 101](#)

[Lecture 21 - Technical Arts 101](#)

[Lecture 22 - Technical Arts 101](#)

[Lecture 23 - Technical Arts 101](#)

[Lecture 24 - Technical Arts 101](#)

[Lecture 25 - Technical Arts 101](#)

[Lecture 26 - Technical Arts 101](#)

[Lecture 27 - Technical Arts 101](#)

[Lecture 28 - Technical Arts 101](#)

[Lab Session 1](#)

[Lab Session 2](#)

[Lab Session 3](#)

[Lab Session 4](#)

[Lab Session 5](#)

[Lab Session 6](#)

[Lab Session 7](#)

[Lab Session 8](#)

[Lab Session 9](#)

[Lab Session 10](#)

[Lab Session 11](#)

[Lab Session 12](#)

Lecture 1 - Lecture 1

Lecture 2 - Lecture 2

Lecture 3 - Lecture 3

Lecture 4 - Review Lecture 1,2,3

Lecture 5 - Lecture 4

Lecture 6 - Lecture 5

Lecture 7 - Lecture 6

Lecture 8 - Review Lecture 4,5,6

Lecture 9 - Lecture 7

Lecture 10 - Lecture 8

Lecture 11 - Lecture 9-10

Lecture 12 - Lecture-11

Lecture 13 - Lecture-12

Lecture 14 - Lecture-13

Lecture 15 - Lecture-14

Lecture 16 - Lecture-15

Lecture 17 - Lecture-16

Lecture 18 - Lecture-17

Lecture 19 - Lecture-18

Lecture 20 - Lecture-19

Lecture 21 - Review Lecture 7 to 10

Lecture 22 - Review Lecture 11 to 13

Lecture 23 - Review Lecture 14 to 16

Lecture 24 - Lecture-20

Lecture 25 - Lecture-21

Lecture 26 - Lecture-22

Lecture 27 - Lecture-23

Lecture 28 - Lecture-24

Lecture 29 - Lecture-25

Lecture 30 - Review Lecture 17,18,19

Lecture 31 - Review Lecture 20,21,22

[Lecture 32 - Lecture-26](#)

[Lecture 33 - Lecture-27](#)

[Lecture 34 - Lecture-28](#)

[Lecture 35 - Lecture-29](#)

[Lecture 36 - Lecture-30](#)

[Lecture 37 - Lecture-31](#)

[Lecture 38 - Lecture-32](#)

[Lecture 39 - Lecture-33](#)

[Lecture 40 - Review lecture 23,24,25](#)

[Lecture 41 - Review lecture 26,27,28](#)

[Lecture 42 - Review lecture 29 to 33](#)

[Lecture 1](#)

[Lecture 2](#)

[Lecture 3](#)

[Lecture 4](#)

[Lecture 5](#)

[Lecture 6](#)

[Lecture 7](#)

[Lecture 8](#)

[Lecture 9](#)

[Lecture 10](#)

[Lecture 11](#)

[Lecture 12](#)

[Lecture 13](#)

[Lecture 14](#)

[Lecture 15](#)

[Lecture 16](#)

[Lecture 17](#)

[Lecture 18](#)

[Lecture 19](#)

[Lecture 20](#)

[Lecture 21](#)

[Lecture 22](#)

[Lecture 23](#)

[Lecture 24](#)

[Lecture 25](#)

[Lecture 26](#)

[Lecture 27](#)

[Lecture 28](#)

[Lecture 29](#)

[Lecture 30](#)

[Lecture 31](#)

[Lecture 32](#)

[Lecture 33](#)

[Lecture 34](#)

[Lecture 35](#)

[Lecture 36](#)

[Lecture 37](#)

[Lecture 38](#)

[Lecture 39](#)

[Lecture 40](#)

[Lecture 41](#)

[Lecture 42](#)

[Lecture 43](#)

[Lecture 44](#)

[Lecture 45](#)

[Lecture 46](#)

[Lecture 47](#)

[Lecture 48](#)



Lecture 1 - Introduction to Quality Engineering

Lecture 2 - Quality Costs

Lecture 3 - Product Design

Lecture 4 - Design of Experiments

Lecture 5 - Applications of Quality Loss Function

Lecture 6 - Product Selection Strategies

Lecture 7 - Robust Design Approaches

Lecture 8 - Taguchi's Method

Lecture 9 - Failure mode and effects analysis

Lecture 10 - Problem Solving : Failure mode and effects analysis - 1

Lecture 11 - Problem solving : Failure mode and effects analysis - 2

Lecture 12 - Product quality improvement methods

Lecture 13 - Quality tools - Part 1

Lecture 14 - Quality Tools - Part 2

Lecture 15 - Different types of control charts

Lecture 16 - Mean, Variance and Standard deviation

Lecture 17 - X bar chart, R-chart

Lecture 18 - Plotting methods for control charts

Lecture 19 - Six Sigma - Part 1

Lecture 20 - Six Sigma - Part 2

Lecture 21 - Theory of probability

Lecture 22 - Determining the defective products using Probability

Lecture 23 - Sampling based on Permutations and Combinations

Lecture 24 - Binomial distribution

Lecture 25 - Poisson distribution

Lecture 26 - Poisson distribution

Lecture 27 - Normal Distribution

Lecture 28 - Overview of control charts and different types of distribution

Lecture 29 - Fundamental of Robotics and its applications in Automated Systems

Lecture 30 - Joint configuration systems of Robot

Lecture 1 - Introduction to Finite Element Analysis(FEA)

Lecture 2 - Introduction of FEA, Nodes, Elements and Shape Functions

Lecture 3 - Nodes, Elements and Shape Functions

Lecture 4 - Polynomials as Shape Functions, Weighted Residuals, Elements and Assembly Level Equations

Lecture 5 - Types of Errors in FEA, Overall FEA Process and Convergence

Lecture 6 - Strengths of FE Method, Continuity conditions at Interfaces

Lecture 7 - Key concepts and terminologies

Lecture 8 - Weighted integral statements

Lecture 9 - Integration by parts - Review

Lecture 10 - Gradient and Divergence Theorems-Part - I

Lecture 11 - Gradient and Divergence Theorems Part - II

Lecture 12 - Functionals

Lecture 13 - Variational Operator

Lecture 14 - Weighted Integral and Weak Formulation

Lecture 15 - Weak Formulation

Lecture 16 - Weak Formulation and Weighted Integral : Principle of minimum potential energy

Lecture 17 - Variational Methods : Rayleigh Ritz Method

Lecture 18 - Rayleigh Ritz Method

Lecture 19 - Method of Weighted Residuals

Lecture 20 - Different types of Weighted Residual Methods - Part I

Lecture 21 - Different types of Weighted Residual Methods - Part II

Lecture 22 - FEA formulation for 2nd order BVP - Part I

Lecture 23 - FEA formulation for 2nd order BVP - Part II

Lecture 24 - Element Level Equations

Lecture 25 - 2nd Order Boundary Value Problem

Lecture 26 - Assembly of element equations

Lecture 27 - Assembly of element equations and implementation of boundary conditions

Lecture 28 - Assembly process and the connectivity matrix

Lecture 29 - Radially Symmetric Problems

Lecture 30 - One dimensional heat transfer

Lecture 31 - 1D-Heat conduction with convective effects : examples

[Lecture 32 - Euler-Bernoulli beam](#)

[Lecture 33 - Interpolation functions for Euler-Bernoulli beam](#)

[Lecture 34 - Finite element equations for Euler-Bernoulli beam](#)

[Lecture 35 - Assembly equations for Euler-Bernoulli beam](#)

[Lecture 36 - Boundary conditions for Euler-Bernoulli beam](#)

[Lecture 37 - Shear deformable beams](#)

[Lecture 38 - Finite element formulation for shear deformable beams : Part - I](#)

[Lecture 39 - Finite element formulation for shear deformable beams : Part - II](#)

[Lecture 40 - Equal interpolation but reduced integration element](#)

[Lecture 41 - Eigenvalue problems](#)

[Lecture 42 - Eigenvalue problems : examples](#)

[Lecture 43 - Introduction to time dependent problems](#)

[Lecture 44 - Spatial approximation](#)

[Lecture 45 - Temporal approximation for parabolic problems : Part - I](#)

[Lecture 46 - Temporal approximation for parabolic problems : Part - II](#)

[Lecture 47 - Temporal approximation for hyperbolic problems](#)

[Lecture 48 - Explicit and implicit method, diagonalization of mass matrix, closure](#)

Lecture 1 - Introduction

Lecture 2 - Vibration versus Waves

Lecture 3 - Nature of Sound

Lecture 4 - The Decibel Scale

Lecture 5 - Some Key Terms

Lecture 6 - Adding Decibels

Lecture 7 - Modeling Sound Propagation

Lecture 8 - The Momentum Equation

Lecture 9 - The Continuity Equation and The Gas Law

Lecture 10 - 1-D Wave Equation

Lecture 11 - General Solution for 1-D Wave Equation

Lecture 12 - Complex Time Signal and Transfer Functions

Lecture 13 - Transmission line equations

Lecture 14 - Planar Waves in Closed Tubes

Lecture 15 - Planar Waves in 1-D Open Tubes

Lecture 16 - A Semi-Infinite Tube and Overall Summary

Lecture 17 - 1-D Tubes with Imperfect Terminations

Lecture 18 - Measuring Impedance Through Kundt's Apparatus

Lecture 19 - Classification of Microphones

Lecture 20 - Classification of Microphones - Continuation

Lecture 21 - Classification of Microphones by Application

Lecture 22 - Microphone Sensitivity

Lecture 23 - Microphone Sensitivity- Continuation

Lecture 24 - Selecting the Right Microphone

Lecture 25 - Fourier Series Expansion

Lecture 26 - Fourier Series Expansion - Continuation

Lecture 27 - Fourier Integral

Lecture 28 - Fourier Integral - Continuation

Lecture 29 - Fourier Transform

Lecture 30 - Fourier Transform - Continuation

Lecture 31 - Discrete Fourier Transform (DFT)

[Lecture 32 - Discrete Fourier Transform \(DFT\) - Continuation](#)

[Lecture 33 - DFT - Calculating Frequencies and Padding](#)

[Lecture 34 - DFT - Influence of Duration and Sampling frequency on resolution](#)

[Lecture 35 - FFT and Inverse FFT](#)

[Lecture 36 - Considerations while deciding instrumentation](#)

[Lecture 37 - Considerations while selecting instruments for noise measurements](#)

[Lecture 38 - Measuring impedance through two microphone method](#)

[Lecture 39 - Designing an impedance measurement tube](#)

[Lecture 40 - Octave band analysis](#)

[Lecture 41 - Calculating results in octave bands](#)

[Lecture 42 - Weighting](#)

[Lecture 43 - Short time Fourier transforms \(STFT\)](#)

[Lecture 44 - Spectrograms](#)

[Lecture 45 - Reverberation time](#)

[Lecture 46 - Anechoic rooms](#)

[Lecture 47 - STC, NRC and sound attenuation](#)

[Lecture 48 - Reverberant rooms](#)

- Lecture 1 - Introduction to Manufacturing Process Technology
- Lecture 2 - Structure of Matter (Bonding of Solids, Crystal Structures)
- Lecture 3 - Brief introduction of non-conventional machining processes
- Lecture 4 - Structure of matters (bonding of solids, crystal structures)
- Lecture 5 - Elastic and Plastic Deformation
- Lecture 6 - Crystal imperfection and dislocation
- Lecture 7 - Plastic Deformation
- Lecture 8 - Material Properties, Stress Strain Diagram for different types of materials
- Lecture 9 - Friction and Wear, Solid solutions
- Lecture 10 - Equilibrium Phase Diagram
- Lecture 11 - Iron-carbon equilibrium phase diagram
- Lecture 12 - Control of material properties (Alloying and heat treatment), Mechanical properties and Recrystallization
- Lecture 13 - Introduction To Casting Process
- Lecture 14 - Pattern and Mold Design
- Lecture 15 - Mold Making Procedures
- Lecture 16 - Fundamentals of Melting and Furnaces & Pouring and Gating Design
- Lecture 17 - Vertical and Bottom Gating Systems Edit Lesson
- Lecture 18 - Numerical Estimation To Find Mold Filling Time and Mold Design
- Lecture 19 - Effects of friction and velocity distribution in time of filling
- Lecture 20 - Numerical design of gating systems using frictional and bending losses
- Lecture 21 - Principle of cooling and solidification in single and multiphase systems
- Lecture 22 - Estimation of rate of solidification
- Lecture 23 - Principles of cooling and solidification of casting
- Lecture 24 - Modeling of Solidification Rates of Thin Casting in a Metal Mold
- Lecture 25 - Solidification with Predominant Interface Resistance
- Lecture 26 - Solidification with Constant Casting Surface Temperature
- Lecture 27 - Solidification of Casting with Predominant Resistance in Mold and Solidified Metal
- Lecture 28 - Solidification Time for Permanent Mold Casting
- Lecture 29 - Solidification with Constant Casting Surface
- Lecture 30 - Riser Design and Placement - Part 1
- Lecture 31 - Riser Design and Placement - Part 2

[Lecture 32 - Riser Design and Placement - Part 3](#)

[Lecture 33 - Introduction of Machining Processes](#)

[Lecture 34 - Review of Basic Machining Processes and the Mechanics of Chip Formation](#)

[Lecture 35 - Estimation of Cutting Ratio and Shear Angle](#)

[Lecture 36 - Merchant's Force Analysis](#)

[Lecture 37 - Merchant Theory \(Cutting Forces Analysis\)](#)

[Lecture 38 - Merchant Theory \(Force analysis\) Part-2](#)

[Lecture 39 - Lee Shaffer's Solution](#)

[Lecture 40 - Specific Energy Model for Cutting](#)

[Lecture 41 - Modeling of Heat Generation and Cutting Tool Temperature](#)

[Lecture 42 - Temperature in Cutting and Builtup Edge Formation](#)

[Lecture 43 - Metal Cutting Operation](#)

[Lecture 44 - Tool life and Tool wear](#)

[Lecture 45 - Economics of Machining](#)

[Lecture 46 - Joining Process](#)

[Lecture 47 - Principle of Solid State Welding](#)

[Lecture 48 - Numerical Design of Welding Power Sources in Arc Welding](#)

Lecture 1 - History and Evolution of Materials

Lecture 2 - Classification of Materials

Lecture 3 - Advanced and Exotic Materials

Lecture 4 - Mechanical Properties of Materials - I

Lecture 5 - Mechanical Properties of Materials - II

Lecture 6 - Mechanical Properties of Materials - III

Lecture 7 - Bonding between atoms

Lecture 8 - The Role of Crystal Structure - I

Lecture 9 - The Role of Crystal Structure - II

Lecture 10 - The Role of Crystal Structure - III

Lecture 11 - Metals - I (Ferrous alloys)

Lecture 12 - Metals - II (Non-Ferrous alloys)

Lecture 13 - Metals - III (Strengthening and Degradation)

Lecture 14 - Ceramics - I

Lecture 15 - Ceramics - II

Lecture 16 - Polymers : Introduction and Classification

Lecture 17 - Polymeric Structure

Lecture 18 - Effects of Glass transition temperature

Lecture 19 - Polymer Mechanical properties

Lecture 20 - Composites - I

Lecture 21 - Composites - II

Lecture 22 - Composites - III

Lecture 23 - Smart Materials - I (Introduction)

Lecture 24 - Smart Materials - II (Piezoelectricity)

Lecture 25 - Smart Materials - III (Magnetostriction)

Lecture 26 - Smart Materials - IV (Smart Polymers)

Lecture 27 - Smart Materials - V (SMA)

Lecture 28 - Materials Selection in Engineering Design

Lecture 29 - Numerical: Cantilever beam (High stiffness and light weight)

Lecture 30 - Numerical: Cantilever beam (High strength and light weight)

Lecture 31 - Numerical: Connecting rod



[Lecture 32 - Numerical: Probe for scanning probe microscope](#)

[Lecture 33 - Optical Properties](#)

[Lecture 34 - Optical Fiber](#)

[Lecture 35 - Thermal Properties](#)

[Lecture 36 - Numerical: Material selection for Heat exchanger](#)

[Lecture 37 - Electric Properties - I](#)

[Lecture 38 - Electric Properties - II](#)

[Lecture 39 - Magnetic Properties](#)

[Lecture 40 - Laboratory demonstration](#)

- Lecture 1 - Introduction to Advanced Machining Processes
- Lecture 2 - Classification of Machining Processes
- Lecture 3 - Silicon growth and Crystallography
- Lecture 4 - Micro Fabrication Technology
- Lecture 5 - Photolithography
- Lecture 6 - Soft Lithography
- Lecture 7 - Introduction to Wet Etching Techniques
- Lecture 8 - Introduction to Dry Etching Techniques
- Lecture 9 - Introduction of Additive Techniques
- Lecture 10 - Introduction to Abrasive Jet Machining Process
- Lecture 11 - Ultrasonic Machining Process
- Lecture 12 - Determination of MRR of Ultrasonic Machining Process
- Lecture 13 - Mechanics of Ultrasonic Machining (USM)
- Lecture 14 - Effect of Process parameters of USM
- Lecture 15 - Ultrasonic Machining Unit
- Lecture 16 - Electrochemical Machining Processes (ECM)
- Lecture 17 - Material Removal Rate of ECM
- Lecture 18 - Electrode Double Layer
- Lecture 19 - Material removal rate of an alloy in ECM
- Lecture 20 - Kinematics and Dynamics of ECM
- Lecture 21 - Temperature and Pressure rise during ECM
- Lecture 22 - Determination of Electrolyte flow velocity in ECM
- Lecture 23 - Effect of heat and Hydrogen bubble generation during ECM Process
- Lecture 24 - Theoretical determination of Tool shape
- Lecture 25 - Design for Electrolyte flow in ECM
- Lecture 26 - Introductions of Electro-chemical Drilling Process
- Lecture 27 - Introduction to Finishing Process
- Lecture 28 - Electric Discharge Machining Process
- Lecture 29 - EDM part-2
- Lecture 30 - Effect of various process parameters on EDM process
- Lecture 31 - Analysis of RC circuit for EDM

- [Lecture 32 - Electrodischarge machining system](#)
- [Lecture 33 - Effect of various parameters on EDM Process](#)
- [Lecture 34 - Tool Electrodes and Dielectric fluids and Electron Beam Machining](#)
- [Lecture 35 - Mechanics of Electron Beam Machining Process](#)
- [Lecture 36 - Functional Characteristics of EBM Process Edit Lesson](#)
- [Lecture 37 - Introduction of Laser Beam Machining Process](#)
- [Lecture 38 - Material removal rate of LBM](#)
- [Lecture 39 - Heat conduction and Temperature rise during LBM](#)
- [Lecture 40 - Modelling of LBM processes](#)
- [Lecture 41 - Metal forming Processes Edit Lesson](#)
- [Lecture 42 - Yield Criterion used in Metal Forming Processes Edit Lesson](#)
- [Lecture 43 - Concept of Principal stress, strain](#)
- [Lecture 44 - Trescas' Yield criteria and Rolling Process](#)
- [Lecture 45 - Rolling Processes - Part 1](#)
- [Lecture 46 - Rolling Processes - Part 2](#)
- [Lecture 47 - Additive Manufacturing Processes](#)
- [Lecture 48 - Fused Deposition Modeling Process](#)

Lecture 1 - Overview of the Course

Lecture 2 - Fundamental principles

Lecture 3 - Steps followed in FEA

Lecture 4 - Weak Formulation

Lecture 5 - Weak Formulation : Example Problem

Lecture 6 - Assembling element level equations

Lecture 7 - Errors in FEA Solution

Lecture 8 - Measures of Errors in FEA Solution

Lecture 9 - Convergence and Accuracy of Solution - Part I

Lecture 10 - Convergence and Accuracy of Solution - Part II

Lecture 11 - Convergence - Part I

Lecture 12 - Convergence - Part II

Lecture 13 - Numerical Integration Schemes - Part I

Lecture 14 - Numerical Integration Schemes - Part II

Lecture 15 - Approximations - Part I

Lecture 16 - Approximations - Part II

Lecture 17 - Approximations - Part III

Lecture 18 - Gauss Quadrature

Lecture 19 - Gaussian Quadrature review

Lecture 20 - Gaussian Quadrature - Part II

Lecture 21 - Gaussian Quadrature - Part III

Lecture 22 - Newton-Cotes Quadrature

Lecture 23 - Two dimensional FEM problem

Lecture 24 - Two dimensional one variable FEM problem

Lecture 25 - 2D Finite element problems with single variable (Model equation)

Lecture 26 - 2D Finite element problems with single variable (Weak formulation)

Lecture 27 - Elemental level 2D finite element equations

Lecture 28 - Interpolation functions for 2D finite element problems

Lecture 29 - Interpolation functions for linear triangular elements - Part I

Lecture 30 - Interpolation functions for linear triangular elements - Part II

Lecture 31 - Interpolation functions for Triangular and Rectangular elements

- [Lecture 32 - Evaluation of Stiffness and Force matrices](#)
- [Lecture 33 - Stiffness and Force matrices for Triangular element](#)
- [Lecture 34 - Stiffness and Force matrices for Rectangular element](#)
- [Lecture 35 - Boundary elements for Finite element Equations](#)
- [Lecture 36 - Boundary integrals for Triangular element](#)
- [Lecture 37 - Assembly of 2-D finite elements - Part I](#)
- [Lecture 38 - Assembly of 2-D finite elements - Part II](#)
- [Lecture 39 - 2-D Heat transfer problems - Part I](#)
- [Lecture 40 - 2-D Heat transfer problems - Part II](#)
- [Lecture 41 - Numerical integration schemes for 2-D problems](#)
- [Lecture 42 - Jacobian and transformation matrix for 2-D problems](#)
- [Lecture 43 - Numerical Integration Schemes for 2-D Problems : Closure](#)
- [Lecture 44 - Post-processing](#)
- [Lecture 45 - Plane Elasticity Problems](#)
- [Lecture 46 - Plane Elasticity Problems : Development of Weak form](#)
- [Lecture 47 - Plane Elasticity Problems : Element level equations](#)
- [Lecture 48 - Plane Elasticity Problems : Closure](#)

- Lecture 1 - Introduction to Vibration control
- Lecture 2 - Strategies and Steps in Vibration Control
- Lecture 3 - Strategies, Active control, Detuning and Decoupling
- Lecture 4 - Viscous damping model
- Lecture 5 - Coulomb and Hysteretic damping model
- Lecture 6 - Energy Dissipation in Structural Materials
- Lecture 7 - Material Selection Criterion against Damping
- Lecture 8 - Design for Enhanced Material Damping
- Lecture 9 - Linear Viscoelastic Materials and Models
- Lecture 10 - Maxwell and 3-Parameter Models
- Lecture 11 - Complex modulus and Applications of VEM
- Lecture 12 - Basics of Dynamic Vibration Absorber
- Lecture 13 - Modelling of Dynamic Vibration Absorber
- Lecture 14 - Proof mass Actuator
- Lecture 15 - Springs for Vibration Isolation
- Lecture 16 - Introduction to Active Vibration Control
- Lecture 17 - Basics of Classical Control System
- Lecture 18 - Basics of State Space Control
- Lecture 19 - Controllability and Observability of System
- Lecture 20 - Full State Feedback Control
- Lecture 21 - SMSS Laboratory Demonstration

Lecture 1 - Lesson 1 - Course Overview

Lecture 2 - Lesson 2 - Introduction

Lecture 3 - Lesson 3 - Nature Of Sound

Lecture 4 - Lesson 4 - The Decibel scale

Lecture 5 - Lesson 5 - Key Terms In Acoustics

Lecture 6 - Lesson 6 - Adding Decibels

Lecture 7 - Lesson 1 - Important Mathematical Concepts-Complex Algebra

Lecture 8 - Lesson 2 - Important Mathematical Concepts-Complex Time Signals

Lecture 9 - Lesson 3 - Important Mathematical Concepts-Transfer Function

Lecture 10 - Lesson 4 - Important Mathematical Concepts-Pole Zero Plot

Lecture 11 - Lesson 5 - Important Mathematical Concepts - Bode Plot For Simple Pole

Lecture 12 - Lesson 6 - Important Mathematical Concepts - Bode Plot For Simple Zero

Lecture 13 - Lesson 1 - Bode Plots (Magnitude) for Complex Transfer Functions

Lecture 14 - Lesson 2 - Momentum Equation for 1-D Sound Propagation

Lecture 15 - Lesson 3 - Continuity Equation for 1-D Sound Propagation

Lecture 16 - Lesson 4 - Gas Law for 1-D Sound Propagation

Lecture 17 - Lesson 5 - 1-D Wave Equation

Lecture 18 - Lesson 6 - Solution for 1-D Wave Equation

Lecture 19 - Lesson 1 - Waveguide

Lecture 20 - Lesson 2 - Transmission Line Equations - Part I

Lecture 21 - Lesson 3 - Transmission Line Equations - Part II

Lecture 22 - Lesson 4 - Transmission Line Equations - Part III

Lecture 23 - Lesson 5 - Transmission Line Equations - Part IV

Lecture 24 - Lesson 6 - Transmission Line Equations - Part V

Lecture 25 - Lesson 1 - Instantaneous Power

Lecture 26 - Lesson 2 - Instantaneous Power in a L-R Circuit

Lecture 27 - Lesson 3 - Power Factor, and Acoustic Power

Lecture 28 - Lesson 4 - Power Flow into an Infinitely Long Tube

Lecture 29 - Lesson 5 - Point Sources of Sound

Lecture 30 - Lesson 6 - Relations for Outward Travelling Spherical Acoustic Wave

Lecture 31 - Lesson 1 - Specific Acoustic Impedance for a Closed Tube

[Lecture 32 - Lesson 2 - Specific Acoustic Impedance for an Open Tube and an Infinitely Long Tube](#)

[Lecture 33 - Lesson 3 - Specific Acoustic Impedance for a Tube with Imperfect Termination](#)

[Lecture 34 - Lesson 4 - Kundt's Tube](#)

[Lecture 35 - Lesson 5 - Volume Velocity](#)

[Lecture 36 - Lesson 6 - Comparison of Impedances for a Radially Propagating Wave and a Planar Wave](#)

[Lecture 37 - Lesson 1 - Interference of sound sources - Part I](#)

[Lecture 38 - Lesson 2 - Interference of sound sources - Part II](#)

[Lecture 39 - Lesson 3 - Interference of sound sources - Part III](#)

[Lecture 40 - Lesson 4 - Interference of sound sources - Part IV](#)

[Lecture 41 - Lesson 5 - Directivity](#)

[Lecture 42 - Lesson 6 - Complex power, pressure and velocity for a spherical source](#)

[Lecture 43 - Lesson 1 - Noise reduction - Mass Attenuation Method](#)

[Lecture 44 - Lesson 2 - Noise Reduction - Pressure Ratio](#)

[Lecture 45 - Lesson 3 - Noise Reduction - Velocity of Wall](#)

[Lecture 46 - Lesson 4 - 3 Media Problem - Introduction](#)

[Lecture 47 - Lesson 5 - 3 Media Problem - Apply Boundary Conditions](#)

[Lecture 48 - Lesson 6 - 3 Media Problem - Special cases](#)

[Lecture 49 - Lesson 1 - Mufflers](#)

[Lecture 50 - Lesson 2 - Designing of Reactive Mufflers](#)

[Lecture 51 - Lesson 3 - Designing of Dissipative Mufflers](#)

[Lecture 52 - Lesson 4 - Time and Frequency Domain Representation of a Signal](#)

[Lecture 53 - Lesson 5 - Fourier Series](#)

[Lecture 54 - Lesson 6 - Fourier Series](#)

[Lecture 55 - Lesson 1 - Fourier Transform](#)

[Lecture 56 - Lesson 2 - Fourier Transform](#)

[Lecture 57 - Lesson 3 - Fourier Transform](#)

[Lecture 58 - Lesson 4 - Discrete Fourier Transform \(DFT\)](#)

[Lecture 59 - Lesson 5 - Discrete Fourier Transform \(DFT\)](#)

[Lecture 60 - Lesson 6 - Discrete Fourier Transform \(DFT\)](#)

[Lecture 61 - Lesson 1 - Measuring Sound Signals](#)

[Lecture 62 - Lesson 2 - Microphones](#)

[Lecture 63 - Lesson 3 - Microphones](#)

[Lecture 64 - Lesson 4 - Weighting](#)



[Lecture 65 - Lesson 5 - Loudness](#)

[Lecture 66 - Lesson 6 - Loudness](#)

[Lecture 67 - Lesson 1 - Octave Band Analysis - Part I](#)

[Lecture 68 - Lesson 2 - Octave Band Analysis - Part II](#)

[Lecture 69 - Lesson 3 - Octave Band Analysis - Part III](#)

[Lecture 70 - Lesson 4 - Reverberation Time](#)

[Lecture 71 - Lesson 5 - Calculation of Reverberation Time and Sound Transmission Class \(STC\)](#)

[Lecture 72 - Lesson 6 - Noise Reduction Coefficient \(NRC\)](#)

Lecture 1 - Recap - I

Lecture 2 - Recap - II

Lecture 3 - Recap - III

Lecture 4 - Determination of Phase Diagram (Experimentally) - I

Lecture 5 - Determination of Phase Diagram (Experimentally) - II

Lecture 6 - Determination of Phase Diagram (Thermodynamically)

Lecture 7 - Effect of pressure on phase transformation temperature and concept of equilibrium between condensed and vapor phase

Lecture 8 - Effect of different parameters on heat treatment and concept of saturation vapor pressure with examples

Lecture 9 - Title: Formation of ideal solid or liquid solution and (G-X) diagrams for ideal solutions (Part-I)

Lecture 10 - G-X diagrams (Part- II) and concept of chemical potential (Micro Sign) from G-X diagrams.

Lecture 11 - Concept of common tangent for equilibrium between two phases

Lecture 12 - Expressions for equilibrium of two phases - I

Lecture 13 - Expressions for equilibrium of two phases - II

Lecture 14 - Expressions for equilibrium of two phases - III

Lecture 15 - Determining nucleation of phases using G-X plot

Lecture 16 -  $\hat{\Delta}G$  for nucleation and overall transformation, concepts of solid state transformation including precipitation and Quasi-Chemical Model (QCM)

Lecture 17 - Introduction to real solutions and expression of  $\hat{H}_{mix}$  based on the Quasi-Chemical Model (QCM)

Lecture 18 - Expression for  $\hat{H}_{mix}$  as a function of interaction energy and mole fraction, based on the QCM - Part I

Lecture 19 - Expression for  $\hat{H}_{mix}$  as a function of interaction energy and mole fraction, based on the QCM - Part II

Lecture 20 - Graphical representation of  $\hat{H}_{mix}$ ,  $\hat{G}_{mix}$ , and  $-T\hat{S}_{mix}$  for real solutions and evolution of eutectic phase diagram from the G-X plots

Lecture 21 - Effect of  $\hat{H}_{mix}$  on determination of phase diagrams (same crystal structure)

Lecture 22 - Effect of  $\hat{H}_{mix}$  on determination of phase diagrams (Continued...)

Lecture 23 - Importance of phase diagrams

Lecture 24 - Effect of heat treatment on microstructure evolution in steel - I

Lecture 25 - Effect of heat treatment on microstructure evolution in steel - II

Lecture 26 - Recap of homogeneous and heterogeneous nucleation for solid to solid transformation

Lecture 27 - Nucleation rate and its dependence on T (temp. of interest),  $\hat{I}^*T$ ,  $\hat{I}^*G^*$  and  $\hat{I}^*G^*$  and, introduction to growth kinetics

Lecture 28 - Growth kinetics (Continued...)

Lecture 29 - Growth rate variation with undercooling and kinetics of overall phase transformation

Lecture 30 - Implication of Avrami's equation with example on excel spreadsheet

Lecture 31 - Experimental verification of Avrami Equation

Lecture 32 - Linear regression (least squares) method to find the value of n and k in Avrami equation

Lecture 33 - In this lecture, method to determine the goodness of fit has been explained. Procedure to estimate the values of n and k from experimental data have also been discussed.

Lecture 34 - Stereology and quantitative metallography - I

Lecture 35 - Stereology and quantitative metallography - II

Lecture 36 - Grain size measurements methods

Lecture 37 - Statistical tools for analysis and reporting of obtained data with examples

Lecture 38 - Evolution of TTT and CCT diagram from f vs. t plots

Lecture 39 - TTT, CCT continue and hardenability of steel

Lecture 40 - Importance of heat treatment practices in real life (with examples)

Lecture 1 - Brief Introduction

Lecture 2 - Define Phase, Equilibrium

Lecture 3 - Free Energy, Stability of Phases

Lecture 4 - Gibbs Free Energy of Binary Solution

Lecture 5 - Ideal Solution and Chemical Potential

Lecture 6 - Thermodynamics of solid solutions

Lecture 7 - G vs X curves

Lecture 8 - Solid solutions: Types

Lecture 9 - Heterogeneous phase equilibria

Lecture 10 - G vs X curves for eutectic system

Lecture 11 - G-X plot for peritectic system

Lecture 12 - Effect of temperature of solid solubility, Influence of interfaces on Equilibrium

Lecture 13 - Introduction of Diffusion

Lecture 14 - Mechanism of Diffusion, Fick's I law

Lecture 15 - Fick's II law

Lecture 16 - Fick's II law (Continued...), Diffusion and Temperature

Lecture 17 - Interfacial Free Energy, Solid/Vapor Interface

Lecture 18 - Boundaries in single phase solids

Lecture 19 - High angle grain boundaries, Equilibrium in poly-crystalline materials, Interphase interfaces in solids

Lecture 20 - Interphase interfaces in solids (Continued...)

Lecture 21 - CSL Boundaries

Lecture 22 - Types of Nucleations

Lecture 23 - Homogeneous Nucleation

Lecture 24 - Homogeneous Nucleation (Continued...)

Lecture 25 - Heterogeneous Nucleation

Lecture 26 - Heterogeneous nucleation (Continued...)

Lecture 27 - Growth

Lecture 28 - Atomic mechanism of growth

Lecture 29 - Dendritic Solidification

Lecture 30 - Growth rate for dendrite formation

Lecture 31 - Alloy solidification

- [Lecture 32 - Alloy solidification \(Continued...\)](#)
- [Lecture 33 - Eutectic: Solidification](#)
- [Lecture 34 - Eutectic: solidification \(Continued...\)](#)
- [Lecture 35 - Solidification of casting / ingot](#)
- [Lecture 36 - Precipitation hardenable alloy](#)
- [Lecture 37 - Precipitation age- hardening alloy \(Continued...\)](#)
- [Lecture 38 - Age hardening alloy](#)
- [Lecture 39 - Eutectoid transformation](#)
- [Lecture 40 - Eutectoid transformation \(Continued....\)](#)
- [Lecture 41 - Eutectoid transformation in steel \(Continued...\)](#)
- [Lecture 42 - Martensite](#)
- [Lecture 43 - Martensite \(Continued...\)](#)
- [Lecture 44 - Martensite \(Continued...\) and TTT curves](#)
- [Lecture 45 - TTT diagram](#)
- [Lecture 46 - Recovery, Recrystallization and Grain growth](#)
- [Lecture 47 - Recovery](#)
- [Lecture 48 - Recrystallization](#)
- [Lecture 49 - Recrystallization \(Continued...\)](#)
- [Lecture 50 - Introduction to spinodal decomposition](#)

Lecture 1 - Introduction to Composites

Lecture 2 - Matrices

Lecture 3 - Fiber reinforcements

Lecture 4 - Fiber reinforcements (Continued...)

Lecture 5 - Composites properties

Lecture 6 - Composites testing

Lecture 7 - Selection of material

Lecture 8 - Selection of material (Continued...)

Lecture 9 - Design for Manufacturing

Lecture 10 - Design for Manufacturing (Continued...)

Lecture 11 - Composite Manufacturing Processes

Lecture 12 - Filament winding Processes

Lecture 13 - Resin transfer moulding

Lecture 14 - Pultrusion

Lecture 15 - Compression Moulding Process

Lecture 16 - Vacuum Impregnation Methods

Lecture 17 - Stacking of Composites

Lecture 18 - Thermoplastic Composites Manufacturing Processes - Part 1

Lecture 19 - Thermoplastic Composites Manufacturing Processes - Part 2 (Continued...)

Lecture 20 - Non-destructive testing methods for composite materials

Lecture 21 - Metal Matrix Composites

Lecture 22 - Metal Matrix Composites applications (Continued...)

Lecture 23 - Processing of Metal Matrix Composites - Part 1

Lecture 24 - Processing of Metal Matrix Composites - Part 2

Lecture 25 - Ceramic Matrix Composites

Lecture 26 - Fabrication of Ceramic Matrix Composites (CMCs)

Lecture 27 - Carbon - Carbon Composites

Lecture 28 - Polymer Matrix and Nano Composites

Lecture 29 - Machining of Composites

Lecture 30 - Repair of Composites

Lecture 31 - Manufacturing Processes: Selection and Considerations



[Lecture 1](#)

[Lecture 2](#)

[Lecture 3](#)

[Lecture 4](#)

[Lecture 5](#)

[Lecture 6](#)

[Lecture 7](#)

[Lecture 8](#)

[Lecture 9](#)

[Lecture 10](#)

[Lecture 11](#)

[Lecture 12](#)

[Lecture 13](#)

[Lecture 14](#)

[Lecture 15](#)

[Lecture 16](#)

[Lecture 17](#)

[Lecture 18](#)

[Lecture 19](#)

[Lecture 20](#)

[Lecture 21](#)

[Lecture 22](#)

[Lecture 23](#)

[Lecture 24](#)

[Lecture 25](#)

[Lecture 26](#)

[Lecture 27](#)

[Lecture 28](#)

[Lecture 29](#)

[Lecture 30 - Work Systems](#)

[Lecture 31 - Measures of Productivity](#)



[Lecture 32 - Productivity Measurement](#)

[Lecture 33 - Work Study](#)

[Lecture 34 - Motion and time study](#)

[Lecture 35 - Motion Study](#)

[Lecture 36 - Flow Diagram](#)

[Lecture 37 - Time Study](#)

[Lecture 38 - Manual Work System](#)

[Lecture 39 - Worker Machine Systems](#)

[Lecture 40 - Industrial accidents](#)

[Lecture 41 - Human Errors](#)

[Lecture 42 - Workers compensation laws](#)

[Lecture 43 - Organisation Ergonomics - Part 1](#)

[Lecture 44 - Organisation Ergonomics - Part 2](#)

[Lecture 45 - Job Satisfaction](#)

[Lecture 46 - Worker behavior](#)

[Lecture 47 - Job ranking Techniques](#)

[Lecture 48 - Waging System](#)

[Lecture 49 - Biomechanics - 1](#)

[Lecture 50 - Biomechanics - 2](#)

[Lecture 51 - Applications of Biomechanics](#)

[Lecture 52 - Problem solving - 1](#)

[Lecture 53 - Problem solving - 2](#)

[Lecture 54 - Problem solving - 3](#)

[Lecture 1 - Basics of Production](#)

[Lecture 2 - Basics of Production \(Continued...\)](#)

[Lecture 3 - Sustainability and Manufacturing](#)

[Lecture 4 - Introduction to Simulation](#)

[Lecture 5 - Introduction to Simulation \(Continued...\)](#)

[Lecture 6 - Basic Statistical Concepts for Sustainable Manufacturing Analysis](#)

[Lecture 7 - Basic Statistical Concepts for Sustainable Manufacturing Analysis \(Continued...\)](#)

[Lecture 8 - Life Cycle Assessment](#)

[Lecture 9 - Life Cycle Assessment Elements](#)

[Lecture 10 - Life Cycle Assessment Procedure](#)

[Lecture 11 - Life Cycle Assessment \(Continued...\)](#)

[Lecture 12 - Sustainability Framework](#)

[Lecture 13 - Basic Modeling Concepts for Factory Simulation](#)

[Lecture 14 - Basic Modeling Concepts for Factory Simulation \(Continued...\)](#)

[Lecture 15 - Green Manufacturing Modelling: Metrics for Green Manufacturing](#)

[Lecture 16 - Green Manufacturing Modelling \(Continued...\) Indices for Green Manufacturing](#)

[Lecture 17 - Green Manufacturing Modelling \(Continued...\) Developing Green Manufacturing System](#)

[Lecture 18 - Productivity and Sustainability](#)

[Lecture 19 - Productivity and Sustainability \(Continued...\)](#)

[Lecture 20 - Green Manufacturing Techniques](#)

[Lecture 21 - Green Manufacturing Techniques \(Continued...\)](#)

[Lecture 22 - Renewable Sources of Energy](#)

[Lecture 23 - Renewable Sources of Energy \(Continued...\)](#)

[Lecture 24 - Renewable energy in India and Industrial Symbiosis](#)

[Lecture 25 - Demonstration of Various Instruments Used for Green Machining](#)

[Lecture 26 - Laboratory demonstration](#)

[Lecture 27 - Developing a Smart Factory](#)

[Lecture 28 - Demonstration on PLM Software](#)

[Lecture 29 - Developing a Smart Factory \(Continued...\)](#)

[Lecture 30 - Sustainability and Green Manufacturing System](#)

Lecture 1 - Course Overview

Lecture 2 - Introduction

Lecture 3 - Nature Of Sound

Lecture 4 - Beats

Lecture 5 - The Decibel Scale

Lecture 6 - Key Terms in Acoustics

Lecture 7 - Decibel Scale - Part 1

Lecture 8 - Decibel Scale - Part 2

Lecture 9 - Decibel Scale - Part 3

Lecture 10 - Complex Numbers

Lecture 11 - Complex Time Function

Lecture 12 - Linear Systems

Lecture 13 - Transfer Functions

Lecture 14 - Introduction to One Dimensional Wave Equation

Lecture 15 - The Momentum Equation

Lecture 16 - The Continuity Equation and The Gas Law

Lecture 17 - One Dimensional Wave Equation

Lecture 18 - Solution for One Dimensional Wave Equation

Lecture 19 - Transmission Line Equations

Lecture 20 - One Dimensional Example Problems

Lecture 21 - Impedance

Lecture 22 - Pressure Wave Travels in a Closed Tube

Lecture 23 - Standing Wave Formation in a Closed Tube With Rigid Termination

Lecture 24 - Pressure Wave Travels in an Open Tube

Lecture 25 - 1-D sound wave propagation: Kundt's tube - I

Lecture 26 - 1-D sound wave propagation: Kundt's tube - II

Lecture 27 - Radially propagating sound waves in spherical coordinate system - I

Lecture 28 - Radially propagating sound waves in spherical coordinate system - II

Lecture 29 - Complex impedance for radially propagating sound waves in spherical coordinate system

Lecture 30 - Volume velocity - I

Lecture 31 - Interference of 1-D spherically propagating sound waves - I

- Lecture 32 - Interference of 1-D spherically propagating sound waves - II
- Lecture 33 - Noise sources and introduction to microphones
- Lecture 34 - Classification of microphones - I
- Lecture 35 - Classification of microphones - II
- Lecture 36 - Classification of microphones - III
- Lecture 37 - Microphone Parameters
- Lecture 38 - Understanding microphone specifications
- Lecture 39 - Noise Source: Terminology
- Lecture 40 - Noise Source: Sound Attenuation
- Lecture 41 - Noise Source: Sound Pressure Level due to a noise source located outdoors
- Lecture 42 - Noise Source: Role of reflecting surfaces
- Lecture 43 - Noise Source: Sound Pressure Level due to a noise source located indoors - Part I
- Lecture 44 - Noise Source: Sound Pressure Level due to a noise source located indoors - Part II
- Lecture 45 - Measuring Sound Power Level - Understanding standard octave bands
- Lecture 46 - Measuring Sound Power Level - Fan noise - Part I
- Lecture 47 - Measuring Sound Power Level - Fan noise - Part II
- Lecture 48 - Measuring Sound Power Level - Fan noise - Part III
- Lecture 49 - Weighting
- Lecture 50 - Noise coming from Motors
- Lecture 51 - Noise coming from Motors and Pumps
- Lecture 52 - Noise coming from Pump and Motor Working Simultaneously
- Lecture 53 - Noise coming from Compressors
- Lecture 54 - Example problems regarding Noise coming from Compressor
- Lecture 55 - Noise Spread Mechanisms
- Lecture 56 - Reverberation time
- Lecture 57 - Reverberation time example problem
- Lecture 58 - Noise from Adjacent Room
- Lecture 59 - Acoustic Enclosures
- Lecture 60 - Acoustic Enclosures - Example Problems
- Lecture 61 - Large acoustical enclosures - I
- Lecture 62 - Large acoustical enclosures - II
- Lecture 63 - Acoustic barriers - I
- Lecture 64 - Acoustic barriers - II

[Lecture 65 - Acoustic barriers - III](#)

[Lecture 66 - Helmholtz resonator - I](#)

[Lecture 67 - Silencers](#)

[Lecture 68 - Side Branched Mufflers - I](#)

[Lecture 69 - Side Branched Mufflers - II](#)

[Lecture 70 - Side Branched Mufflers - III](#)

[Lecture 71 - Expansion Chamber Muffler](#)

[Lecture 72 - Single Expansion Chamber Muffler](#)

Lecture 1 - Brief introduction of Design systems

Lecture 2 - Product Development

Lecture 3 - Basic protocols of industrial design

Lecture 4 - Design thinking and innovation

Lecture 5 - Brain Storming

Lecture 6 - Design prototyping

Lecture 7 - Generic Phases of the Design

Lecture 8 - Configurational Design Aspects

Lecture 9 - Concurrent Engineering

Lecture 10 - Concurrent Engineering - 2

Lecture 11 - Concurrent Engineering Approaches

Lecture 12 - Concurrent Engineering Approaches - 2

Lecture 13 - Benefits of concurrent engineering

Lecture 14 - Concurrent engineering environment influencing dimensions

Lecture 15 - Concurrent engineering environment influencing dimensions - 2

Lecture 16 - Program and product Interface dimensions in Concurrent engineering

Lecture 17 - Product Development Methodology

Lecture 18 - Elements of concurrent engineering: Optimization in product development

Lecture 19 - Business relationships in concurrent engineering

Lecture 20 - Organizational elements in concurrent engineering

Lecture 21 - Techniques for the Implementation of concurrent engineering environment

Lecture 22 - Average quality loss

Lecture 23 - Robustness in Design

Lecture 24 - Robustness in Design - 2

Lecture 25 - Material selection in Engineering design

Lecture 26 - Material selection in Engineering Design.

Lecture 27 - Basic steps in Material Selection Process

Lecture 28 - Design of Work Systems

Lecture 29 - Motion Study

Lecture 30 - Axiomatic Design

Lecture 31 - Introduction to group technology

Lecture 32 - Failure Mode Effect Analysis

- Lecture 1 - Definition of the composite materials
- Lecture 2 - Composite materials and its applications
- Lecture 3 - Classification of the composite materials
- Lecture 4 - What Makes fiber so strong?
- Lecture 5 - Advantages and limitations of composite materials
- Lecture 6 - Properties of the composite materials.
- Lecture 7 - Different Types of Fiber
- Lecture 8 - Production process and different types of Glass Fiber
- Lecture 9 - Graphite Fibers
- Lecture 10 - Aramid and Boron Fibers
- Lecture 11 - Ceramic Fibers
- Lecture 12 - Matrix - Properties and classifications
- Lecture 13 - Polymers as matrix material and its classification
- Lecture 14 - Thermosets and thermoplastics
- Lecture 15 - Properties of thermosets and thermoplastics
- Lecture 16 - Thermoset materials and its production methods
- Lecture 17 - Thermoplastics and metals as matrix materials
- Lecture 18 - Ceramic and carbon matrices
- Lecture 19 - What is a good fabrication process of a composite?
- Lecture 20 - Fabrication of Thermoset Composites
- Lecture 21 - Hand Lay-Up Process
- Lecture 22 - Bag Molding Process
- Lecture 23 - Resin Transfer Molding Process
- Lecture 24 - Fabrication of Thermoplastic, Metal and Ceramic Matrix based Composites
- Lecture 25 - Terminologies and basic concepts
- Lecture 26 - Orthotropic material
- Lecture 27 - Modeling of unidirectional composites
- Lecture 28 - Composite density as a function of mass fraction and volume fraction
- Lecture 29 - Calculation of longitudinal modulus for unidirectional composites
- Lecture 30 - Failure modes of unidirectional composite
- Lecture 31 - Failure of Unidirectional Lamina



- Lecture 32 - Minimum Volume Fraction and Critical Volume Fraction
- Lecture 33 - Example based on Failure of Composite Material
- Lecture 34 - Example based on Minimum and Critical Volume Fraction
- Lecture 35 - Transverse Modulus of Unidirectional Composite
- Lecture 36 - Halpin-Tsai Relation for Transverse Modulus
- Lecture 37 - Transverse modulus of unidirectional composites
- Lecture 38 - Transverse strength of unidirectional composites
- Lecture 39 - Poisson's ratio of unidirectional composites
- Lecture 40 - Failure modes of composite materials
- Lecture 41 - Failure modes of composite materials
- Lecture 42 - Other properties
- Lecture 43 - Concept of Tensor
- Lecture 44 - Stress Transformation (Two Dimensional)
- Lecture 45 - Analysis of Specially Orthotropic Lamina
- Lecture 46 - Analysis of Generally Orthotropic Lamina
- Lecture 47 - Transformation of Engineering Constants - Part I
- Lecture 48 - Transformation of Engineering Constants - Part II
- Lecture 49 - Variation of elastic constants with respect to fiber orientation for generally orthotropic lamina
- Lecture 50 - Generally orthotropic lamina
- Lecture 51 - Generalized Hooke's law for anisotropic materials
- Lecture 52 - Generalized Hooke's law for anisotropic materials
- Lecture 53 - Elastic constants for Specially orthotropic materials
- Lecture 54 - Elastic constants for Specially orthotropic materials in plane stress
- Lecture 55 - Relation Between Engineering Constants and Elements of Stiffness and Compliance Matrices - Part I
- Lecture 56 - Relation Between Engineering Constants and Elements of Stiffness and Compliance Matrices - Part II
- Lecture 57 - Stress Strain Relations for A Lamina With Arbitrary Orientation - Part I
- Lecture 58 - Stress- Strain Relation for A Lamina With Arbitrary Orientation - Part II
- Lecture 59 - Strength of An Orthotropic Lamina
- Lecture 60 - Importance of Sign of Shear Stress in context of Strength of A Unidirectional Lamina
- Lecture 61 - Strain displacement relations for a laminate
- Lecture 62 - Stress-strain relations for individual layers of a laminate
- Lecture 63 - Resultant forces and moments
- Lecture 64 - Relations between force and moment resultants and mid-plane strains and curvatures

[Lecture 65 - Physical significance of extensional stiffness matrix \[A\], coupling matrix \[B\] and bending stiffness matrix \[D\] matrices](#)

[Lecture 66 - Lamination sequence \(standard laminate code\)](#)

[Lecture 67 - Calculation of A, B and D Matrices.](#)

[Lecture 68 - Simplification of Stiffness Matrices - Part I](#)

[Lecture 69 - Simplification of Stiffness Matrices - Part II](#)

[Lecture 70 - Quasi-Isotropic Laminates - Part I](#)

[Lecture 71 - Quasi-Isotropic Laminates - Part II](#)

[Lecture 72 - Failure of Composite Laminates](#)

- Lecture 1 - Introduction to product design and Manufacturing
- Lecture 2 - Introduction to product design and Manufacturing (Continued...)
- Lecture 3 - Fundamentals of Manufacturing towards Product Development
- Lecture 4 - Fundamentals of Manufacturing towards Product Development (Continued...)
- Lecture 5 - Engineering Design Process
- Lecture 6 - Product design morphology
- Lecture 7 - Product characteristics
- Lecture 8 - Elements of Visual Design - Part 1
- Lecture 9 - Elements of Visual Design - Part 2
- Lecture 10 - Elements of Visual Design - Part 3
- Lecture 11 - Translating Customer Needs
- Lecture 12 - Translating Customer Needs
- Lecture 13 - Value Engineering, an introduction
- Lecture 14 - Value Engineering Methodology - Part 1
- Lecture 15 - Value Engineering Methodology - Part 2, FAST diagramming
- Lecture 16 - Value Engineering Methodology - Part 3
- Lecture 17 - Value Engineering, case study
- Lecture 18 - Materials Selection - Part 1
- Lecture 19 - Materials Selection - Part 2
- Lecture 20 - Manufacturing Process Selection - Part 1
- Lecture 21 - Manufacturing Process Selection - Part 2
- Lecture 22 - Product Costing
- Lecture 23 - Design for Manufacturing
- Lecture 24 - Design for Assembly
- Lecture 25 - Design for Maintenance
- Lecture 26 - Design for Environment - Part 1
- Lecture 27 - Design for Environment - Part 2
- Lecture 28 - Quality Control
- Lecture 29 - Quality Assurance
- Lecture 30 - Patent - Part 1
- Lecture 31 - Patent - Part 2

[Lecture 32 - Creativity techniques - Part 1](#)

[Lecture 33 - Creativity techniques - Part 2](#)

[Lecture 34 - Frugal Innovation](#)

[Lecture 35 - Rapid Prototyping, an introduction](#)

[Lecture 36 - Rapid Prototyping Modelling](#)

[Lecture 37 - Rapid Prototyping Processes - Part 1](#)

[Lecture 38 - Rapid Prototyping Processes - Part 2](#)

[Lecture 39 - Laboratory demonstration; 3D printing - Part 1](#)

[Lecture 40 - Laboratory demonstration; 3D printing - Part 2](#)

[Lecture 41 - Laboratory demonstration; 3D printing - Part 3](#)

[Lecture 42 - Plant Layout Planning - Part 1](#)

[Lecture 43 - Plant Layout Planning - Part 2](#)

[Lecture 44 - Laboratory demonstration; Plant Simulation - Part 1](#)

[Lecture 45 - Laboratory demonstration; Plant Simulation - Part 2](#)

[Lecture 46 - Laboratory demonstration; Plant Simulation - Part 3](#)

[Lecture 47 - Computer Integrated Manufacturing - Part 1](#)

[Lecture 48 - Computer Integrated Manufacturing - Part 2](#)

[Lecture 49 - Reverse Engineering](#)

[Lecture 50 - Managing Competitiveness](#)

- Lecture 1 - Basic Thermodynamics: System, phase and components
- Lecture 2 - Basic Thermodynamics: Gibbs Free Energy
- Lecture 3 - Phase Stability in Materials
- Lecture 4 - Effects of Temperature and Pressure on Single Components System
- Lecture 5 - Clausius-Clapeyron Equation and Binary Solution
- Lecture 6 - Calculation of Configurational Entropy
- Lecture 7 - Chemical Potential
- Lecture 8 - Phase Stability in Binary Solution
- Lecture 9 - Activity and Thermodynamics of Regular Solution
- Lecture 10 - Thermodynamic of Real Solution
- Lecture 11 - Free Energy Curves and Various Systems
- Lecture 12 - Solubility Limits 2-phase Co-existence
- Lecture 13 - Phase Diagram Formation: Binary Solution
- Lecture 14 - Phase Diagram Construction: Partial Soluble Phases
- Lecture 15 - Phase Diagram Construction: Eutectic Phase
- Lecture 16 - Intermetallics and Phase Diagrams
- Lecture 17 - Phase Rule
- Lecture 18 - Gibb's Phase Rule: Unary and Binary System
- Lecture 19 - Gibb's Phase Rule: Eutectic Point and Lever Rule
- Lecture 20 - Phase Fraction Calculation in a Phase Diagram
- Lecture 21 - Microstructure evolution in Cu-Ni binary system
- Lecture 22 - Microstructure evolution (Continued...)
- Lecture 23 - Phase evolution in hypoeutectic region
- Lecture 24 - Phase evolution at Eutectic point
- Lecture 25 - Phase Diagrams of Cu-Ni and Al-Si
- Lecture 26 - Phase Diagrams of Pb-Sn and Fe-C
- Lecture 27 - Phase Diagram of Fe-C (Continued...)
- Lecture 28 - Fe-C Phase Diagram (Continued...)
- Lecture 29 - Fe-C Phase Diagram (Continued...)
- Lecture 30 - Phase Diagrams for non-Ferrous Alloys
- Lecture 31 - Method of measuring Phase diagram

[Lecture 32 - Methods of measuring phase diagram \(Continued...\)](#)

[Lecture 33 - Methods of measuring phase diagram: PbMg<sub>2</sub>](#)

[Lecture 34 - Ternary Phase Diagram](#)

[Lecture 35 - Ternary Phase Diagram \(Continued...\)](#)

[Lecture 36 - Ternary system with two phases](#)

[Lecture 37 - Ternary system with three phases](#)

[Lecture 38 - Ternary phase diagram with 4 phases](#)

[Lecture 39 - Application of Phases diagrams](#)

[Lecture 40 - Summary of Course](#)

Lecture 1 - Basics of composite materials

Lecture 2 - Different type of Fibers

Lecture 3 - Properties of single layer continuous fiber composites

Lecture 4 - Properties of single layer continuous fiber composites

Lecture 5 - Strength of single layer continuous fiber composites

Lecture 6 - Strength of single layer continuous fiber composites

Lecture 7 - Concept of Tensor

Lecture 8 - General Anisotropic Material

Lecture 9 - Specially Orthotropic Material

Lecture 10 - Specially Orthotropic Material Under Plane Stress

Lecture 11 - Stress and Strain Transformation

Lecture 12 - Transformation of Stiffness and Compliance Matrices

Lecture 13 - Strain - Displacement relations

Lecture 14 - Relations for stress and strain along thickness of laminate

Lecture 15 - Stress - Strain variation along Laminate thickness

Lecture 16 - Force and Moment resultant - Part 1

Lecture 17 - Force and Moment resultant - Part 2

Lecture 18 - Important observation related to [A], [B] and [D] matrices

Lecture 19 - Quasi-Isotropic Laminates

Lecture 20 - Maximum Stress Theory

Lecture 21 - Maximum Strain Theory

Lecture 22 - Importance of Sign of Shear Stress.

Lecture 23 - Failure Initiation in Composite Laminate.

Lecture 24 - Progressive Failure of Laminae in A Laminate

Lecture 25 - Governing equations for composite plates

Lecture 26 - Force equilibrium in Z-direction

Lecture 27 - Moment equilibrium equations

Lecture 28 - Equilibrium equations for composite plates

Lecture 29 - Boundary conditions associated with different edges of composite plate - Part 1

Lecture 30 - Boundary conditions associated with different edges of composite plate - Part 2

Lecture 31 - Generalized Solution for Semi-Infinite Plate - Part I

- Lecture 32 - Generalized Solution for Semi-Infinite Plate - Part II
- Lecture 33 - Particular Solution for Semi-Infinite Plate: Case A
- Lecture 34 - Particular Solution for Semi-Infinite Plate: Case B
- Lecture 35 - Particular Solution for Semi-Infinite Plate: Case C
- Lecture 36 - Particular Solution for Semi-Infinite Plate: Case D
- Lecture 37 - Solution for governing equation related to semi-infinite composite plate
- Lecture 38 - Nature of displacement  $u_0(x)$  and how it gets influence by important parameters of lamination sequence
- Lecture 39 - Semi-infinite plate loaded in the x-direction - Part 1
- Lecture 40 - Semi-infinite plate loaded in the x-direction - Part 2
- Lecture 41 - Thermal effects in composite laminates - Part 1
- Lecture 42 - Thermal effects in composite laminates - Part 2
- Lecture 43 - Thermal effects in composite laminates - Part 3
- Lecture 44 - Finite Rectangular Plate
- Lecture 45 - Different Boundary Conditions in Finite Rectangular Plate
- Lecture 46 - Example Based On a Finite Rectangular Plate: Part-I
- Lecture 47 - Example Based On a Finite Rectangular Plate: Part-II
- Lecture 48 - Example Based On a Finite Rectangular Plate: Part-III
- Lecture 49 - Anticlastic curvature
- Lecture 50 - Principle of virtual work
- Lecture 51 - Virtual work method: apply to beam problem
- Lecture 52 - Virtual work method: apply to simply supported plate
- Lecture 53 - Beam (two term solution)
- Lecture 54 - 3rd Interpretation of special Galerkin method
- Lecture 55 - Role of D16 and D26 Terms On Laminated Plate Response: Part-I
- Lecture 56 - Role of D16 and D26 Terms On Laminated Plate Response: Part-II
- Lecture 57 - Role of D16 and D26 Terms On Laminated Plate Response: Part-III
- Lecture 58 - Role of D16 and D26 Terms On Laminated Plate Response: Part-IV
- Lecture 59 - Free Vibration in Composite Plate: Part-I
- Lecture 60 - Free Vibration in Composite Plate: Part-II
- Lecture 61 - Buckling of composite plates
- Lecture 62 - Force equilibrium in z-direction for buckling of composite plates
- Lecture 63 - Moment equilibrium around x, y and z-directions for buckling of composite plates
- Lecture 64 - Buckling of an infinitely long composite plate



[Lecture 65 - Buckling of a simply supported finite plate](#)

[Lecture 66 - Composite plate under bidirectional compression](#)

[Lecture 67 - Shear Bucking in Rectangular Composite Plate: Part-I](#)

[Lecture 68 - Shear Bucking in Rectangular Composite Plate: Part-II](#)

[Lecture 69 - Introduction to Short-Fiber Composites](#)

[Lecture 70 - Theories of Stress Transfer: Part-I](#)

[Lecture 71 - Theories of Stress Transfer: Part-II](#)

[Lecture 72 - Modulus of Short-Fiber Composites and Closure](#)

Lecture 1 - Introduction to measurements and metrology

Lecture 2 - Instruments in measurement systems

Lecture 3 - Instruments in measurement systems

Lecture 4 - General concepts and definitions in metrology

Lecture 5 - Standards of measurement

Lecture 6 - Limits, Fits, and Tolerances - Part 1

Lecture 7 - Limits, Fits, and Tolerances - Part 2

Lecture 8 - Limits, Fits, and Tolerances - Part 3

Lecture 9 - Limits, Fits, and Tolerances - Part 4

Lecture 10 - Linear Measurements - Part 1

Lecture 11 - Linear Measurements - Part 2

Lecture 12 - Laboratory demonstration, Vernier Caliper

Lecture 13 - Laboratory demonstration, Dial gauge and vernier, micrometer, surface plate, feeler gauge

Lecture 14 - Angular Measurements - Part 1

Lecture 15 - Angular Measurements - Part 2

Lecture 16 - Laboratory demonstration, Vernier height gauge

Lecture 17 - Laboratory demonstration, Thread gauge, spirit level

Lecture 18 - Laboratory demonstration, Combination set, slip gauges, sine bar

Lecture 19 - Comparators - Part 1

Lecture 20 - Comparators - Part 2

Lecture 21 - Transducers - Part 1

Lecture 22 - Transducers - Part 2

Lecture 23 - Screw thread metrology

Lecture 24 - Gears metrology - Part 1

Lecture 25 - Gears metrology - Part 2

Lecture 26 - Laboratory demonstration, Gear Vernier

Lecture 27 - Surface metrology

Lecture 28 - Temperature measurements

Lecture 29 - Pressure measurements - Part 1

Lecture 30 - Pressure measurements - Part 2

Lecture 31 - Strain measurements - Part 1

- Lecture 32 - Strain measurements - Part 2
- Lecture 33 - Optical measurements and Nanometrology - Part 1
- Lecture 34 - Optical measurements and Nanometrology - Part 2
- Lecture 35 - Optical measurements and Nanometrology - Part 3
- Lecture 36 - Statistics in Metrology, an introduction - Part 1
- Lecture 37 - Statistics in Metrology, an introduction - Part 2
- Lecture 38 - Data and scales in measurements
- Lecture 39 - Discrete and continuous data
- Lecture 40 - Statistics for metrology, fundamental concepts - Part 1
- Lecture 41 - Statistics for metrology, fundamental concepts - Part 2
- Lecture 42 - Statistics for metrology, fundamental concepts - Part 3
- Lecture 43 - Probability distributions for estimating measurement
- Lecture 44 - Normal distribution
- Lecture 45 - Statistics for proportions
- Lecture 46 - Chi square distribution, and Data outlier detection
- Lecture 47 - Quality Control, introduction
- Lecture 48 - Quality Control, control charts for variables
- Lecture 49 - Quality Control, control charts for attributes
- Lecture 50 - Quality Control, critical aspects
- Lecture 51 - 3D measurements, Coordinate Measuring Machine (CMM)
- Lecture 52 - Laboratory demonstration, Coordinate Measuring Machine (CMM)

Lecture 1 - Introduction to Smart Materials

Lecture 2 - Piezoelectric Material

Lecture 3 - Magnetostrictive Material

Lecture 4 - Active Smart Polymer

Lecture 5 - Shape Memory Alloys

Lecture 6 - Introduction to composites

Lecture 7 - Classification of Composites

Lecture 8 - Micromechanics and Macromechanics of Composites

Lecture 9 - Classical Laminated Plate Theory

Lecture 10 - ABD Matrices

Lecture 11 - Modelling of piezoelectric material 1

Lecture 12 - Modelling of piezoelectric material 2

Lecture 13 - Modelling of Magnetostrictive material

Lecture 14 - Modelling of Shape memory Alloys

Lecture 15 - Smart Actuators

Lecture 16 - Smart Materials based MEMS

Lecture 17 - Smart MEMS Applications

Lecture 18 - Energy Harvesting

Lecture 19 - Concept of Self Healing

Lecture 1 - Design concepts

Lecture 2 - Computer Aided Design (CAD)

Lecture 3 - Geometrical transformation

Lecture 4 - Composition of geometrical transformation

Lecture 5 - Geometric modeling

Lecture 6 - Representation of curves

Lecture 7 - Parametric representation of synthetic curves

Lecture 8 - Curve fitting problem (Hermite case)

Lecture 9 - Problem solving (based on Bezier curve)

Lecture 10 - Representation of Surfaces

Lecture 11 - Introduction to Micro-Electro mechanical Systems (MEMS)

Lecture 12 - Lab-on-Chip

Lecture 13 - Introduction to Sensors

Lecture 14 - Introduction to Transducers

Lecture 15 - Introduction to device fabrications

Lecture 16 - Introduction to Silicon as a MEMS material

Lecture 17 - Etching processes

Lecture 18 - Types of Photolithography

Lecture 19 - Introduction to actuators

Lecture 20 - Designing of the Micro-Valve

Lecture 21 - Electrochemical valves

Lecture 22 - Micropumps

Lecture 23 - Designing of peristaltic pumps

Lecture 24 - Different types of pumps and sensors

Lecture 25 - Gas Sensors

Lecture 26 - Computer Numerical Control

Lecture 27 - Numerical Control Programming

Lecture 28 - NC Part Programming

Lecture 29 - Canned Cycles

Lecture 30 - Introduction to Rapid Prototyping

Lecture 31 - Different Types of Rapid Prototyping Technologies

[Lecture 32 - LAB Demonstration of FDM Process](#)

[Lecture 33 & 34](#)

[Lecture 35](#)

[Lecture 36](#)

[Lecture 37, 38 & 39](#)

[Lecture 40](#)

- Lecture 1 - Introduction to Rapid Manufacturing - Part 1
- Lecture 2 - Introduction to Rapid Manufacturing - Part 2
- Lecture 3 - Introduction to Rapid Manufacturing - Part 3
- Lecture 4 - Product Development Process - Part 1
- Lecture 5 - Product Development Process - Part 2
- Lecture 6 - Product Development Process - Part 3
- Lecture 7 - Design for Modularity (Manufacturing)
- Lecture 8 - Design for Modularity (Assembly; Part 1)
- Lecture 9 - Design for Modularity (Assembly; Part 2)
- Lecture 10 - Design for Modularity
- Lecture 11 - Subtractive versus Rapid Manufacturing
- Lecture 12 - Reverse Engineering - Part 1
- Lecture 13 - Reverse Engineering - Part 2
- Lecture 14 - Laboratory Demonstration, Co-ordinate Measuring Machine - Part 1
- Lecture 15 - Laboratory Demonstration, Co-ordinate Measuring Machine - Part 2
- Lecture 16 - Laboratory Demonstration, 3D scanners - Part 1
- Lecture 17 - Laboratory Demonstration, 3D scanners - Part 2
- Lecture 18 - Polymerization Processes - Part 1
- Lecture 19 - Polymerization Processes - Part 2
- Lecture 20 - Powder based processes - Part 1
- Lecture 21 - Powder based processes - Part 2
- Lecture 22 - Powder based processes - Part 3
- Lecture 23 - Extrusion based processes - Part 1
- Lecture 24 - Extrusion based processes - Part 2
- Lecture 25 - Sheet Stacking processes
- Lecture 26 - 3D printing processes
- Lecture 27 - Laboratory Demonstration, 3D printing - Part 1
- Lecture 28 - Laboratory Demonstration, 3D printing - Part 2
- Lecture 29 - Laboratory Demonstration, 3D printing - Part 3
- Lecture 30 - Beam Deposition processes
- Lecture 31 - Materials in Rapid Manufacturing - Part 1

[Lecture 32 - Materials in Rapid Manufacturing - Part 2](#)

[Lecture 33 - Post-processing concerns - Part 1](#)

[Lecture 34 - Post-processing concerns - Part 2](#)

[Lecture 35 - Product costing for Rapid Manufacturing - Part 1](#)

[Lecture 36 - Product costing for Rapid Manufacturing - Part 2](#)

[Lecture 37 - Rapid Product Development, CAD/CAM - Part 1](#)

[Lecture 38 - Rapid Product Development, CAD/CAM - Part 2](#)

[Lecture 39 - Rapid Product Development, CAD/CAM - Part 3](#)

[Lecture 40 - Rapid Product Development, CAE and CIM](#)

[Lecture 41 - Rapid Product Development, Technomatix, Plant Simulation 10 - Part 1](#)

[Lecture 42 - Rapid Product Development, Technomatix, Plant Simulation 10 - Part 2](#)

[Lecture 43 - Rapid Product Development, Technomatix, Plant Simulation 10 - Part 3](#)

[Lecture 44 - Rapid Manufacturing, case studies](#)



Lecture 1 - Introduction to Combustion

Lecture 2 - Introduction to Combustion (Continued...)

Lecture 3 - Introduction to Combustion (Continued...)

Lecture 4 - Introduction to Combustion (Continued...) + Combustion and Thermochemistry

Lecture 5 - Combustion and Thermochemistry

Lecture 6 - Combustion and Thermochemistry (Continued...)

Lecture 7 - Combustion and Thermochemistry (Continued...) + Chemical Kinetics

Lecture 8 - Chemical Kinetics (Continued...)

Lecture 9 - Chemical Kinetics (Continued...)

Lecture 10 - Chemical Kinetics (Continued...) + Combustion Chemistry

Lecture 11 - Combustion Chemistry (Continued...)

Lecture 12 - Heat and Mass Transfer

Lecture 13 - Heat and Mass Transfer + Coupling of Chemical Kinetics and Thermodynamics

Lecture 14 - Coupling of Chemical Kinetics and Thermodynamics (Continued...)

Lecture 15 - Coupling of Chemical Kinetics and Thermodynamics + Laminar Premixed Flames

Lecture 16 - Laminar Premixed Flames (Continued...)

Lecture 17 - Laminar Premixed Flames (Continued...)

Lecture 18 - Laminar Premixed Flames (Continued...) + Laminar Non-Premixed Flames

Lecture 19 - Laminar Non-Premixed Flames (Continued...)

Lecture 20 - Laminar Non-Premixed Flames (Continued...)

Lecture 21 - Laminar Non-Premixed Flames

Lecture 22 - Laminar Non-Premixed Flames (Continued...)

Lecture 23 - Laminar Non-Premixed Flames (Continued...)

Lecture 24 - Laminar Non-Premixed Flames (Continued...)

Lecture 25 - Laminar Non-Premixed Flames (Continued...)

Lecture 26 - Laminar Non-Premixed Flames + Turbulence

Lecture 27 - Turbulence : Introduction

Lecture 28 - Turbulence : Introduction (Continued...)

Lecture 29 - Turbulence : Flow Stability analysis

Lecture 30 - Turbulence : Flow Stability analysis (Continued...)

Lecture 31 - Turbulence : Stability and Burger's Equation

- Lecture 32 - Turbulence : Energy cascade, length scales and Statistical description
- Lecture 33 - Turbulence : Statistical analysis and free shear flows
- Lecture 34 - Turbulence : Free shear and wall bounded shear flows
- Lecture 35 - Turbulence : Turbulent boundary layer
- Lecture 36 - Turbulence
- Lecture 37 - Turbulence : Temperature effects and Modelling
- Lecture 38 - Turbulence : Modelling and statistics
- Lecture 39 - Turbulence : Modelling (Continued...)
- Lecture 40 - Turbulence : Modelling (Continued...)
- Lecture 41 - Turbulence : Chemistry Interaction
- Lecture 42 - Turbulence : Chemistry Interaction (Continued...)
- Lecture 43 - Turbulence : Chemistry Interaction (Continued...)
- Lecture 44 - Turbulence : Chemistry Interaction (Continued...)
- Lecture 45 - Turbulence : Chemistry Interaction (Continued...)
- Lecture 46 - Turbulent Combustion : Stochastic method of solution
- Lecture 47 - Turbulent Combustion : Transported scalar PDF model
- Lecture 48 - Turbulent Combustion : Transported joint velocity - scalar PDF model
- Lecture 49 - Turbulent Combustion : Modelling Turbulent Premixed Combustion
- Lecture 50 - Turbulent Combustion : Modelling Turbulent Premixed Combustion (Continued...)
- Lecture 51 - Turbulent Combustion : Modelling Turbulent Premixed Combustion (Continued...)
- Lecture 52 - Turbulent Combustion : Modelling Turbulent Premixed Combustion (Continued...)
- Lecture 53 - Turbulent Combustion : Modelling Turbulent Non-Premixed Combustion
- Lecture 54 - Turbulent Combustion : Modelling Turbulent Non-Premixed Combustion (Continued...)
- Lecture 55 - Turbulent Combustion : Modelling Turbulent Non-Premixed Combustion (Continued...)
- Lecture 56 - Turbulent Combustion : Modelling Turbulent Non-Premixed Combustion
- Lecture 57 - Turbulent Combustion : Modelling Turbulent Non-Premixed Combustion (Continued...)
- Lecture 58 - Multiphase Combustion : Introduction + Droplet Evaporation
- Lecture 59 - Multiphase Combustion : Droplet Combustion
- Lecture 60 - Multiphase Combustion : Spray Combustion

Lecture 1 - Introduction to Manufacturing Automation

Lecture 2 - Various Aspects of Manufacturing Automation

Lecture 3 - Part Transfer Mechanisms

Lecture 4 - Automated Flow Lines

Lecture 5 - Analysis of Automated Flow Lines

Lecture 6 - Vibratory Bowl Feeder

Lecture 7 - Analysis of Vibratory Bowl Feeder

Lecture 8 - Reciprocating Tube Hopper Feeder

Lecture 9 - Centreboard Hopper Feeder and its analysis

Lecture 10 - Reciprocating fork and External Gate Hopper Feeders

Lecture 11 - Rotary Disc Feeder and Centrifugal Hopper Feeder

Lecture 12 - Bladed Wheel and Tumbling Barrel Hopper Feeders

Lecture 13 - Rotary Centreboard and Magnetic Feeders

Lecture 14 - Part Orienting Devices

Lecture 15 - Feed Tracks and their analysis

Lecture 16 - Powered Feed Track and Escapements

Lecture 17 - Various Escapements and Part Placing Mechanisms

Lecture 18 - Design for Automatic Assembly

Lecture 19 - Performance and Economics of Assembly Systems

Lecture 20 - Performance of Indexing and Free Transfer Machines

Lecture 1 - Introduction to CIM - Part 1

Lecture 2 - Introduction to CIM - Part 2

Lecture 3 - Computers and Manufacturing Systems - Part 1

Lecture 4 - Computers and Manufacturing Systems - Part 2

Lecture 5 - Computers and Manufacturing Systems - Part 3

Lecture 6 - Computer Graphics - Part 1

Lecture 7 - Computer Graphics - Part 2

Lecture 8 - Computer Graphics - Part 3

Lecture 9 - Computer Graphics - Part 4

Lecture 10 - Geometric Modelling - Part 1

Lecture 11 - Geometric Modelling - Part 2

Lecture 12 - Computer Numerical Control - Part 1

Lecture 13 - Computer Numerical Control - Part 2

Lecture 14 - Computer Numerical Control - Part 3

Lecture 15 - Computer Numerical Control - Part 4

Lecture 16 - CNC Machining - Part 1

Lecture 17 - CNC Machining - Part 2

Lecture 18 - CNC Tooling

Lecture 19 - CNC Part Programming - Part 1

Lecture 20 - CNC Part Programming - Part 2

Lecture 21 - CNC Part Programming - Part 3

Lecture 22 - CNC Part Programming - Part 4

Lecture 23 - Laboratory Demonstration, Computer Aided Design - Part 1

Lecture 24 - Laboratory Demonstration, Computer Aided Design - Part 2

Lecture 25 - CAM softwares

Lecture 26 - Laboratory Demonstration, Computer Aided Manufacturing - Part 1

Lecture 27 - Laboratory Demonstration, Computer Aided Manufacturing - Part 2

Lecture 28 - Group Technology

Lecture 29 - Computer Aided Process Planning - Part 1

Lecture 30 - Computer Aided Process Planning - Part 2

Lecture 31 - Flexible Manufacturing System

- [Lecture 32 - Robotics](#)
- [Lecture 33 - Programmable Logic Controller](#)
- [Lecture 34 - Automatic Identification and Data Capture](#)
- [Lecture 35 - Computer Aided Quality Control - Part 1](#)
- [Lecture 36 - Computer Aided Quality Control - Part 2](#)
- [Lecture 37 - Laboratory Demonstration, Coordinate Measuring Machine](#)
- [Lecture 38 - Rapid Manufacturing - Part 1](#)
- [Lecture 39 - Rapid Manufacturing - Part 2](#)
- [Lecture 40 - Laboratory demonstration, Rapid Manufacturing - Part 1](#)
- [Lecture 41 - Laboratory demonstration, Rapid Manufacturing - Part 2](#)
- [Lecture 42 - Laboratory Demonstration, CAD using Fusion 360, an introduction](#)
- [Lecture 43 - Laboratory Demonstration, CAD using Fusion 360, Rendering and 3D printing](#)
- [Lecture 44 - Material Handling](#)
- [Lecture 45 - Laboratory Demonstration, Plant Simulation software - Part 1](#)
- [Lecture 46 - Laboratory Demonstration, Plant Simulation software - Part 2](#)
- [Lecture 47 - Laboratory Demonstration, Plant Simulation software - Part 3](#)
- [Lecture 48 - Computers in Manufacturing Industry, current scenario - Part 1](#)
- [Lecture 49 - Computers in Manufacturing Industry, current scenario - Part 2](#)
- [Lecture 50 - Computers in Manufacturing Industry, current scenario - Part 3](#)

Lecture 1 - Introduction to Machining

Lecture 2 - Mechanism of plastic deformation

Lecture 3 - Basic machining parameters, Cutting Tools and Types of Machining

Lecture 4 - Types of Chips, Tool nomenclature and tool angles

Lecture 5 - Tool Nomenclature in Normal Rake System and conversion of angles

Lecture 6 - Selection of Tool angles

Lecture 7 - Forces in machining, Merchant's Circle Diagram

Lecture 8 - Stress, Strain and Strain Rate and Shear Plane Angle

Lecture 9 - Numerical Examples; Lee and Shaffer's model

Lecture 10 - Friction in metal cutting: Zorev's Friction Model

Lecture 11 - Practical Machining Operations

Lecture 12 - Slab Milling; Measurement of Cutting Forces

Lecture 13 - Dynamometers; Tool Wear and Tool Life

Lecture 14 - Factors affecting tool life; Abrasive Machining Processes

Lecture 15 - Mechanics of Grinding Process

Lecture 16 - Chip length and specific energy in Grinding

Lecture 17 - Grinding wheel wear; Oblique Cutting

Lecture 18 - Rake angles in oblique cutting; Economics of Machining

Lecture 19 - Economics of Machining (Continued...); Thermal aspects of machining

Lecture 20 - Surface finish

[Lecture 1 - Introduction to Cognitive Robotics \(Private\)](#)

[Lecture 2 - Smart Materials - I \(Private\)](#)

[Lecture 3 - Smart Materials - II \(Private\)](#)

[Lecture 4 - Smart Materials - III \(Private\)](#)

[Lecture 5 - Architecture of the Brain](#)

[Lecture 6 - Architecture of the Brain \(Continued...\)](#)

[Lecture 7 - Nerve Cells](#)

[Lecture 8 - Introduction to Synchronisation Models](#)

[Lecture 9 - Synchronisation models \(Continued...\)](#)

[Lecture 10 - Introduction to EEG](#)

[Lecture 11 - Theories of Intelligence - I](#)

[Lecture 12 - Theories of Intelligence - II](#)

[Lecture 13 - Kuramoto Model](#)

[Lecture 14 - Child Robot Interaction](#)

Lecture 1 - Introduction to Robotics

Lecture 2 - Robot Joints and Work Volume

Lecture 3 - Spatial transformations

Lecture 4 - Homogenous Transformtions

Lecture 5 - Practice Problems with MATLAB in Rotation matrices

Lecture 6 - Kinematics: Derivation of Link Transformations

Lecture 7 - Problem Solving DH Parameters

Lecture 8 - Forward Kinematics

Lecture 9 - Inverse Kinematics

Lecture 10 - Problems in Kinematics

Lecture 11 - Inverse Kinematics of PUMA Robot

Lecture 12 - Jacobian and Singularity

Lecture 13 - Velocity and Static Forces

Lecture 14 - Dynamics - Lagrangian Euler

Lecture 15 - Newton Euler Dynamics

Lecture 16 - Trajectory Planning

Lecture 17 - Inverse Dynamics using MATLAB

Lecture 18 - Sensors

Lecture 19 - Actuators and Basic Control System

Lecture 20 - Block Diagram Reduction and Position Regulator

Lecture 21 - Control of a single joint

Lecture 22 - Non Linear Control of Manipulators

Lecture 23 - Force Control

Lecture 24 - Manipulator Mechanism Design

Lecture 25 - Industrial Robots and Applications

Lecture 26 - Specifications and Programming

Lecture 27 - VAL programming

Lecture 28 - Experiment With PUMA Robot Using VAL- II



Lecture 1 - Introduction to Acoustic Wave Propagation

Lecture 2 - D'Alembert's solution and 1-D Continuity equation

Lecture 3 - Muffler Acoustics-Application to Automotive Exhaust Noise Control

Lecture 4 - Linearization of governing equations, and Development of 1-D Acoustic wave and Helmholtz equation

Lecture 5 - Solution of 1-D Helmholtz equation: Propagation in 1-D ducts/pipes

Lecture 6 - 1-D Acoustic Wave Equation in Ducts Carrying Uniform Mean Flow: Derivation

Lecture 7 - 1-D Acoustic Wave Equation in Ducts Carrying Uniform Mean Flow: Solution

Lecture 8 - 3-D Acoustic Wave Equation in Rectangular and Circular Waveguides: Derivation, Modal Solution and Concept of Cut-on Frequency

Lecture 9 - Sound Pressure Level, Intensity Level and Sound Power Level

Lecture 10 - Acoustic Impedance and Reflection Coefficient

Lecture 11 - Lumped System Analysis: Inertance and Compliance

Lecture 12 - Lumped Analysis of a Uniform Pipe Closed/Open at an End, Concept of End Correction

Lecture 13 - Helmholtz Resonator, Electro-Acoustic Analogy and Layout of a typical engine exhaust system

Lecture 14 - Muffler Performance Measures: Insertion Loss

Lecture 15 - Muffler Performance Measures: Transmission Loss and Level Difference

Lecture 16 - Lumped Analysis of a Tube, Simple Area Discontinuity and Transfer Matrices

Lecture 17 - Sudden area Discontinuity (Continued...)

Lecture 18 - Simple Expansion Chamber Analysis Using Transfer Matrix Method

Lecture 19 - Transmission Loss (TL) Graph for a Simple Expansion Muffler (MATLAB)

Lecture 20 - Extended-Inlet and Extended-Outlet Muffler Analysis

Lecture 21 - Extended-Inlet and Extended-Outlet Muffler Analysis (Continued...)

Lecture 22 - TL Analysis of Extended-Inlet and Extended-Outlet Muffler (MATLAB)

Lecture 23 - TL Analysis of Side-Inlet and Side-Outlet Muffler Using Transfer Matrix Method

Lecture 24 - Wave Propagation in Gradually Varying Area Ducts: Webster's Horn Equation

Lecture 25 - Webster's Horn Equation (Continued...) and Exponential Ducts

Lecture 26 - Solution of Webster's Horn Equation for Conical Ducts

Lecture 27 - TL analysis for Conical Muffler Configurations (MATLAB)

Lecture 28 - Segmentation Approach for Analysing Gradually Varying Area Ducts (MATLAB)

Lecture 29 - Acoustic Intensity (Energy Flux) in a Pipe with Mean Flow, and Transmission Loss Expression

Lecture 30 - Aeroacoustic State Variables Transfer Matrix for a Tubular Element (Uniform Pipe)

# DIGIMAT - The No.1 Autonomous Learning Platform for Creative Learning

Lecture 31 - Transfer Matrix for Extended-Inlet and Outlet Element and Use of Perforated Elements in Commercial Mufflers

Lecture 32 - Two-interacting Duct Configurations: Development of Equations and Concentric Tube Resonators

Lecture 33 - Concentric Tube Resonator: Partially Perforated Pipe or Airway (MATLAB)

Lecture 34 - Review of Perforate Impedance Expressions

Lecture 35 - MATLAB Demonstration for Fully and Partially Perforated CTR

Lecture 36 - Cross-Flow elements: Setting-up the Equations

Lecture 37 - Cross-Flow elements: MATLAB Demonstration for Simple Configurations

Lecture 38 - Plug Mufflers, Three-pass Perforated Element Muffler (Commercial Configurations) - MATLAB

Lecture 39 - Multiply-Connected Mufflers: HQ Tubes

Lecture 40 - TL Analysis of HQ Tubes (MATLAB): Network Analysis and Analytical Formula

Lecture 41 - Transmission Loss in terms of Scattering and Impedance Matrix Parameters

Lecture 42 - Rectangular Chamber Muffler: Characterization and TL Analysis using 3-D Piston-driven Model

Lecture 43 - Circular Chambers: Characterization and TL Analysis Using 3-D Piston-driven Model

Lecture 44 - Analytical Mode-Matching for Extended-Inlet and Outlet Muffler: Setting-up of the Equations

Lecture 45 - MATLAB Demonstration for Transmission Loss Calculations

Lecture 46 - Dissipative Mufflers (Lined Circular duct) - A Brief Discussion

Lecture 47 - Summary of the Topics Covered in This Course, Topics to be Covered in a Future Course

[Lecture 1](#)

[Lecture 2](#)

[Lecture 3](#)

[Lecture 4](#)

[Lecture 5](#)

[Lecture 6](#)

[Lecture 7](#)

[Lecture 8](#)

[Lecture 9](#)

[Lecture 10](#)

[Lecture 11](#)

[Lecture 12](#)

[Lecture 13](#)

[Lecture 14](#)

[Lecture 15](#)

[Lecture 16](#)

[Lecture 17](#)

[Lecture 18](#)

[Lecture 19](#)

[Lecture 20](#)

[Lecture 21](#)

[Lecture 22](#)

[Lecture 23](#)

[Lecture 24](#)

[Lecture 25](#)

[Lecture 26](#)

[Lecture 27](#)

[Lecture 28](#)

[Lecture 29](#)

[Lecture 30](#)

[Lecture 31](#)

[Lecture 32](#)

[Lecture 33](#)

[Lecture 34](#)

[Lecture 35](#)

Lecture 1 - Casting: Introduction to Casting

Lecture 2 - Various aspects of Casting

Lecture 3 - Patterns and Moulds

Lecture 4 - Sand Mould and Gating System

Lecture 5 - Gating System Design

Lecture 6 - Aspiration Effects and Riser Design

Lecture 7 - Solidification of Metals and Alloys

Lecture 8 - Stress, Strain and Strain Rate and Shear Plane Angle

Lecture 9 - Steps in Sand Casting Processes

Lecture 10 - Expendable Mould Casting Processes

Lecture 11 - Permanent Mould Casting

Lecture 12 - Various Casting Processes and Cost Analysis

Lecture 13 - Cost analysis, Casting Defects and Product Design

Lecture 14 - Introduction to Joining Processes

Lecture 15 - Characteristic Features of Welding Processes

Lecture 16 - Various Welding Processes

Lecture 17 - Advanced Welding Processes

Lecture 18 - Characteristic Features of Arc Welding

Lecture 19 - Shielded metal arc welding, MIG and TIG Welding

Lecture 20 - Gas Welding, Brazing and Soldering, Welding Defects

Lecture 1 - Historical Perspectives and Introduction to the Course

Lecture 2 - Finite Difference Method - Basic Idea of Discretization

Lecture 3 - Explicit and Implicit Formulations, Stability Analysis - Part 1

Lecture 4 - Stability Analysis - Part 2

Lecture 5 - Important Aspects of Flow Modelling - Part 1

Lecture 6 - Important Aspects of Flow Modelling - Part 2

Lecture 7 - Important Aspects of Flow Modelling - Part 3

Lecture 8 - Applications of Our Knowledge to a Problem of Practical Interest and Setting up an Algorithm

Lecture 9 - Finite Volume Method - Part 1

Lecture 10 - Finite Volume Method - Part 2

Lecture 11 - Finite Volume Method - Part 3

Lecture 12 - Introduction to Finite Element Method (Preliminary Concepts)

Lecture 13 - Introduction to Finite Element Method (Galerkin Weighted Residual Method)

Lecture 14 - Introduction to Finite element Method (Elemental contributions and formation of Global Matrix)

Lecture 15 - Vorticity Stream Function Approach (Formulation and Algorithm)

Lecture 16 - Vorticity-Stream Function Approach For Solving Navier-Stokes Equations

Lecture 17 - Solving Navier-Stokes Equations For Incompressible Flows using SIMPLE Algorithm - Part 1

Lecture 18 - Solving Navier-Stokes Equations For Incompressible Flows using SIMPLE Algorithm - Part 2

Lecture 19 - Solving Navier-Stokes Equations For Incompressible Flows using MAC Algorithm - Part 2

Lecture 20 - MAC Algorithm (Pressure - Velocity Iteration and the Solution)

Lecture 21 - MAC Algorithm (Solution of Energy Equation)

Lecture 22 - A Finite Volume Method to solve NS Equations in 3D Complex Geometry - Part 1

Lecture 23 - A Finite Volume Method to solve NS Equations in 3D Complex Geometry - Part 2

Lecture 24 - A Finite Volume Method to solve NS Equations in 3D Complex Geometry - Part 3

Lecture 25 - Mathematical Approaches to Turbulent Flows (Preliminaries and Modeling Framework)

Lecture 26 - Mathematical Approaches to Turbulent Flows (Modeling on the basis of RANS)

- Lecture 1 - Engineering Materials and Their Properties - 1
- Lecture 2 - Engineering Materials and Their Properties - 2
- Lecture 3 - Engineering Materials and Their Properties - 3
- Lecture 4 - Metal Machining-1: Introduction to Machining
- Lecture 5 - Metal Machining-2: Mechanism of plastic deformation
- Lecture 6 - Metal Machining-3: Types of Chips, Tool nomenclature and tool angles
- Lecture 7 - Metal Machining-4: Selection of Tool angles, Forces in machining
- Lecture 8 - Metal Machining-5: Merchant's Circle Diagram
- Lecture 9 - Metal Machining-6: Friction in Metal Cutting
- Lecture 10 - Metal Machining-7: Practical Machining Operations; Force Measurement
- Lecture 11 - Metal Machining-8: Force Measurement
- Lecture 12 - Metal Machining-9: Tool Wear and Tool Life
- Lecture 13 - Metal Machining-10: Factors affecting Tool Life
- Lecture 14 - Metal Machining-11: Abrasive Machining Processes
- Lecture 15 - Metal Machining-12: Abrasive Machining Processes
- Lecture 16 - Metal Machining-13: Grinding; Economics of Machining
- Lecture 17 - Machining-14: Economics of Machining
- Lecture 18 - Non-Traditional Machining-1: Introduction; Classification
- Lecture 19 - Non-Traditional Machining-2: Various Non-Traditional Machining Processes
- Lecture 20 - Non-Traditional Machining-3, Computer Numerical Control (CNC) -1
- Lecture 21 - Computer Numerical Control (CNC) - 2
- Lecture 22 - Computer Numerical Control (CNC) - 3
- Lecture 23 - Engineering Metrology
- Lecture 24 - Laboratory Demonstration/Hands-On Practice - 1
- Lecture 25 - Laboratory Demonstration/Hands-On Practice - 2
- Lecture 26 - Laboratory Demonstration/Hands-On Practice - 3
- Lecture 27 - Laboratory Demonstration/Hands-On Practice - 4
- Lecture 28 - Laboratory Demonstration/Hands-On Practice - 5
- Lecture 29 - Laboratory Demonstration/Hands-On Practice - 6
- Lecture 30 - Laboratory Demonstration/Hands-On Practice - 7
- Lecture 31 - Laboratory Demonstration/Hands-On Practice - 8

[Lecture 32 - Laboratory Demonstration/Hands-On Practice - 9](#)

[Lecture 33 - Laboratory Demonstration/Hands-On Practice - 10](#)



- Lecture 1 - Introduction and Classification
- Lecture 2 - Introduction and Classification (Continued...)
- Lecture 3 - Review of the Fundamental Laws
- Lecture 4 - Equation of Motion in Rotating Frame
- Lecture 5 - Euler Equation for Turbomachinery
- Lecture 6 - Euler Equation for Turbomachinery: Illustration
- Lecture 7 - Problem Session - Chapter-1: Applications of Euler Equation
- Lecture 8 - Similarity Analysis - I
- Lecture 9 - Similarity Analysis - II
- Lecture 10 - Similarity Analysis - III
- Lecture 11 - Problem Session - II
- Lecture 12 - Cassade Analysis - I
- Lecture 13 - Cassade Analysis - II
- Lecture 14 - Cassade Analysis - III
- Lecture 15 - Cassade Analysis - IV
- Lecture 16 - Cassade Analysis (Problem Session)
- Lecture 17 - Gas Turbine Cycle Analysis - I
- Lecture 18 - Gas Turbine Cycle Analysis - II
- Lecture 19 - Gas Turbine Cycle Analysis - III
- Lecture 20 - Gas Turbine Cycle Analysis - IV
- Lecture 21 - Gas Turbine Cycle Analysis - V
- Lecture 22 - Illustrative Examples Gas Turbine Cycle
- Lecture 23 - Illustrative Examples Jet Propulsion
- Lecture 24 - Axial Flow Compressor - I
- Lecture 25 - Axial Flow Compressor - II
- Lecture 26 - Axial Flow Compressor - III
- Lecture 27 - Axial Flow Compressor - IV
- Lecture 28 - Illustrative Examples Axial Flow Compressor
- Lecture 29 - Centrifugal Compressor - I
- Lecture 30 - Centrifugal Compressor - II
- Lecture 31 - Centrifugal Compressor - III

[Lecture 32 - Axial Flow Turbine - I](#)

[Lecture 33 - Axial Flow Turbine - II](#)

[Lecture 34 - Axial Flow Turbine - III](#)

[Lecture 35 - Axial Flow Turbine - IV](#)

[Lecture 36 - Axial Flow Turbine - V](#)

[Lecture 37 - Axial Flow Steam Turbine - I](#)

[Lecture 38 - Axial Flow Steam Turbine - II](#)

[Lecture 39 - Axial Flow Steam Turbine - III](#)

[Lecture 40 - Axial Flow Steam Turbine - IV](#)

[Lecture 41 - Axial Flow Steam Turbine - V](#)

[Lecture 42 - Axial Flow Steam Turbine - VI](#)

[Lecture 43 - Hydraulic Turbines - I \(Pelton Wheel\)](#)

[Lecture 44 - Hydraulic Turbines - II \(Illustrations on Pelton Wheel\)](#)

[Lecture 45 - Hydraulic Turbines - III \(Reaction Turbine\)](#)

[Lecture 46 - Hydraulic Turbines - IV \(Cavitation\)](#)

[Lecture 47 - Hydraulic Turbines - V \(Illustrations on Reaction Turbine\)](#)

[Lecture 48 - CFD and Turbomachinery - I](#)

[Lecture 49 - CFD and Turbomachinery - II](#)

[Lecture 50 - CFD and Turbomachinery - III](#)

Lecture 1 - Introduction

Lecture 2 - Joints and Degrees of Freedom

Lecture 3 - Work Volume and Rotation Transformation

Lecture 4 - Transformations

Lecture 5 - Kinematics

Lecture 6 - Bug Algorithms

Lecture 7 - Configuration Space

Lecture 8 - C Obstacle

Lecture 9 - Topology of C Space

Lecture 10 - Road Map Methods

Lecture 11 - Cell Decomposition Methods

Lecture 12 - Sampling Based Planning

Lecture 13 - Potential Field Methods - I

Lecture 14 - Navigation Function and Potential Field in 3D

Lecture 15 - Basic Search Algorithms

Lecture 16 - Motion Planning with Kinematic Constraints

Lecture 17 - Controllability

Lecture 18 - Kinematic Constraints and Multifinger Robot

Lecture 19 - Multifinger Robot Hands

Lecture 20 - Optimization in Motion Planning

- Lecture 1 - Introduction to Metal Additive Manufacturing
- Lecture 2 - Additive Manufacturing Processes: Classification and Challenges
- Lecture 3 - Additive Manufacturing Processes: Applications and Challenges
- Lecture 4 - Metal Additive Manufacturing, Glossary - Part 1
- Lecture 5 - Metal Additive Manufacturing, Glossary - Part 2
- Lecture 6 - CAD for Additive Manufacturing
- Lecture 7 - Basic Processes - Part 1
- Lecture 8 - Basic Processes - Part 2
- Lecture 9 - Laser Based Processes - Part 1
- Lecture 10 - Laser Based Processes - Part 2
- Lecture 11 - Electron Beam Process
- Lecture 12 - Powder/Wire Fed Systems
- Lecture 13 - Solidification of Parts - Part 1
- Lecture 14 - Solidification of Parts - Part 2
- Lecture 15 - Solidification of Parts - Part 3
- Lecture 16 - Process Parameters
- Lecture 17 - MAM Printed Parts: Mechanical Properties, Hardness
- Lecture 18 - MAM Printed Parts: Mechanical Properties, Strength
- Lecture 19 - Common Defects and Post Processing
- Lecture 20 - Design for Additive Manufacturing (DFAM) - Part 1
- Lecture 21 - Design for Additive Manufacturing (DFAM) - Part 2
- Lecture 22 - Topology Optimization Techniques
- Lecture 23 - On-Machine Sensing in MAM - Part 1
- Lecture 24 - On-Machine Sensing in MAM - Part 2
- Lecture 25 - In-situ Control Systems
- Lecture 26 - Additive Manufacturing of Metal Matrix Composites - Part 1
- Lecture 27 - Additive Manufacturing of Metal Matrix Composites - Part 2
- Lecture 28 - Additive Manufacturing of Metal Matrix Composites - Part 3
- Lecture 29 - Additive Manufacturing of Metal Matrix Composites - Part 4
- Lecture 30 - Reverse Engineering in MAM - Part 1
- Lecture 31 - Reverse Engineering in MAM - Part 2

[Lecture 32 - Reverse Engineering in MAM - Laboratory Demonstration - I](#)

[Lecture 33 - Reverse Engineering in MAM - Laboratory Demonstration - II](#)

[Lecture 34 - CAD and Topology Optimization Laboratory Demonstration - I](#)

[Lecture 35 - CAD and Topology Optimization Laboratory Demonstration - II](#)

[Lecture 36 - Non-Destructive Testing - Part 1](#)

[Lecture 37 - Non-Destructive Testing - Part 2](#)

[Lecture 38 - Sustainability in MAM - Part 1](#)

[Lecture 39 - Sustainability in MAM - Part 2](#)

[Lecture 40 - Sustainability in MAM - Part 3](#)

[Lecture 41 - Metal 3D Printing Laboratory Demonstration - I](#)

[Lecture 42 - Metal 3D Printing Laboratory Demonstration - II](#)

[Lecture 43 - Safety in MAM](#)

[Lecture 44 - Costing in MAM - Part 1](#)

[Lecture 45 - Costing in MAM - Part 2](#)

[Lecture 46 - Costing in MAM - Part 3](#)

[Lecture 47 - Industry 4.0 and MAM](#)

[Lecture 1](#)

[Lecture 2](#)

[Lecture 3](#)

[Lecture 4](#)

[Lecture 5](#)

[Lecture 6](#)

[Lecture 7](#)

[Lecture 8](#)

[Lecture 9](#)

[Lecture 10](#)

[Lecture 11](#)

[Lecture 12](#)

[Lecture 13](#)

[Lecture 14](#)

[Lecture 15](#)

[Lecture 16](#)

[Lecture 17](#)

[Lecture 18](#)

[Lecture 19](#)

[Lecture 20](#)

[Lecture 21](#)

[Lecture 22](#)

[Lecture 23](#)

[Lecture 24](#)

[Lecture 25](#)

[Lecture 26](#)

[Lecture 27](#)

[Lecture 28](#)

[Lecture 29](#)

[Lecture 30](#)

[Lecture 31](#)

[Lecture 32](#)

[Lecture 33](#)

[Lecture 34](#)

[Lecture 35](#)

[Lecture 36](#)

[Lecture 37](#)

[Lecture 38](#)

[Lecture 39](#)

[Lecture 1](#)

[Lecture 2](#)

[Lecture 3](#)

[Lecture 4](#)

[Lecture 5](#)

[Lecture 6](#)

[Lecture 7](#)

[Lecture 8](#)

[Lecture 9](#)

[Lecture 10](#)

[Lecture 11](#)

[Lecture 12](#)

[Lecture 13](#)

[Lecture 14](#)

[Lecture 15](#)

[Lecture 16](#)

[Lecture 17](#)

[Lecture 18](#)

[Lecture 19](#)

[Lecture 20](#)

[Lecture 21](#)

[Lecture 22](#)

[Lecture 23](#)

[Lecture 24](#)

[Lecture 25](#)

[Lecture 26](#)

[Lecture 27](#)

[Lecture 28](#)

[Lecture 29](#)

[Lecture 30](#)



[Lecture 1](#)

[Lecture 2](#)

[Lecture 3](#)

[Lecture 4](#)

[Lecture 5](#)

[Lecture 6](#)

[Lecture 7](#)

[Lecture 8](#)

[Lecture 9](#)

[Lecture 10](#)

[Lecture 11](#)

[Lecture 12](#)

[Lecture 13](#)

[Lecture 14](#)

[Lecture 15](#)

[Lecture 16](#)

[Lecture 17](#)

[Lecture 18](#)

[Lecture 19](#)

[Lecture 20](#)

[Lecture 21](#)

[Lecture 22](#)

[Lecture 23](#)

[Lecture 24](#)

[Lecture 25](#)

[Lecture 26](#)

[Lecture 27](#)

[Lecture 28](#)

[Lecture 29](#)

[Lecture 30](#)

[Lecture 31](#)

[Lecture 32](#)

[Lecture 33](#)

[Lecture 34](#)

[Lecture 35](#)

[Lecture 36](#)

[Lecture 37](#)

[Lecture 38](#)

[Lecture 39](#)

[Lecture 40](#)

[Lecture 41](#)

[Lecture 42](#)

[Lecture 43](#)

[Lecture 44](#)

[Lecture 45](#)

[Lecture 46](#)

[Lecture 47](#)

[Lecture 48](#)

[Lecture 49](#)

[Lecture 50](#)

[Lecture 51](#)

[Lecture 52](#)

[Lecture 53](#)

[Lecture 54](#)

[Lecture 55](#)

[Lecture 56](#)

[Lecture 57](#)

[Lecture 58](#)

[Lecture 59](#)

[Lecture 60](#)

[Lecture 61](#)

[Lecture 62](#)

[Lecture 63](#)

[Lecture 64](#)

[Lecture 65](#)

[Lecture 66](#)

[Lecture 67](#)

[Lecture 68](#)

[Lecture 69](#)

[Lecture 70](#)

[Lecture 71](#)

[Lecture 72](#)

[Lecture 73](#)

[Lecture 74](#)

[Lecture 75](#)

[Lecture 76](#)

[Lecture 77](#)

[Lecture 78](#)

[Lecture 79](#)

[Lecture 80](#)

[Lecture 81](#)

[Lecture 82](#)

[Lecture 83](#)

[Lecture 84](#)

[Lecture 85](#)

[Lecture 86](#)

[Lecture 87](#)

[Lecture 88](#)

[Lecture 89](#)

[Lecture 90](#)

[Lecture 91](#)

[Lecture 92](#)

[Lecture 93](#)

[Lecture 94](#)

[Lecture 95](#)

[Lecture 96](#)

[Lecture 97](#)

[Lecture 98](#)

[Lecture 99](#)

[Lecture 100](#)

[Lecture 101](#)

[Lecture 102](#)

[Lecture 103](#)

[Lecture 104](#)

[Lecture 105](#)

[Lecture 106](#)

[Lecture 107](#)

[Lecture 108](#)

[Lecture 109](#)

[Lecture 110](#)

[Lecture 111](#)

[Lecture 112](#)

[Lecture 113](#)

[Lecture 114](#)

[Lecture 115](#)

[Lecture 116](#)

[Lecture 117](#)

[Lecture 118](#)

[Lecture 119](#)

[Lecture 120](#)

[Lecture 121](#)

[Lecture 122](#)

[Lecture 123](#)

[Lecture 124](#)

[Lecture 125](#)

[Lecture 126](#)

[Lecture 127](#)

[Lecture 1](#)

[Lecture 2](#)

[Lecture 3](#)

[Lecture 4](#)

[Lecture 5](#)

[Lecture 6](#)

[Lecture 7](#)

[Lecture 8](#)

[Lecture 9](#)

[Lecture 10](#)

[Lecture 11](#)

[Lecture 12](#)

[Lecture 13](#)

[Lecture 14](#)

[Lecture 15](#)

[Lecture 16](#)

[Lecture 17](#)

[Lecture 18](#)

[Lecture 19](#)

[Lecture 20](#)

[Lecture 21](#)

[Lecture 22](#)

[Lecture 23](#)

[Lecture 24](#)

[Lecture 25](#)

[Lecture 26](#)

[Lecture 27](#)

[Lecture 28](#)

[Lecture 29](#)

[Lecture 30](#)

[Lecture 31](#)

[Lecture 32](#)

[Lecture 33](#)

[Lecture 34](#)

[Lecture 35](#)

[Lecture 36](#)

[Lecture 37](#)

[Lecture 38](#)

[Lecture 39](#)

[Lecture 40](#)

[Lecture 41](#)

[Lecture 42](#)

[Lecture 43](#)

[Lecture 44](#)

[Lecture 45](#)

[Lecture 46](#)

[Lecture 47](#)

[Lecture 48](#)

[Lecture 49](#)

[Lecture 50](#)

[Lecture 51](#)

[Lecture 52](#)

Lecture 1 - Introduction to Computational Fluid Dynamics and Principles of Conservation

Lecture 2 - Conservation of Mass and Momentum: Continuity and Navier Stokes Equation

Lecture 3 - Navier Stokes Equation (Continued.)

Lecture 4 - Energy Equation and General Structure of Conservation Equations

Lecture 5 - Classification of Partial Differential Equations and Physical Behaviour

Lecture 6 - Classification of Partial Differential Equations and Physical Behaviour (Continued.)

Lecture 7 - Approximate Solutions of Differential Equations: Error Minimization Principles

Lecture 8 - Approximate Solutions of Differential Equations: Variational Principles and Weighted Residual Approach

Lecture 9 - Weighted Residual Approach and Introduction to Discretization

Lecture 10 - Fundamentals of Discretization: Finite Element Method

Lecture 11 - Fundamentals of Discretization: Finite Difference and Finite Volume Method

Lecture 12 - Fundamentals of Discretization: Finite Volume Method (Continued.)

Lecture 13 - Finite Volume Method: Some Conceptual Basics and Illustrations through 1-D Steady State Diffusion Problems

Lecture 14 - Finite Volume Method: Boundary Condition Implementation and Discretization of Unsteady State Problems

Lecture 15 - Finite Volume Method: Discretization of Unsteady State Problems

Lecture 16 - Important Consequences of Discretization of Unsteady State Problems

Lecture 17 - Important Consequences of Discretization of Time Dependent Diffusion Type Problems (Continued.) and Stability Analysis

Lecture 18 - Discretization of Hyperbolic Equations: Stability Analysis

Lecture 19 - PART 1 : Stability of Second Order Hyperbolic Equations PART 2 : Mid-Semester Assessment Review (Questions and Answers)

Lecture 20 - PART 1: Mid-Semester Assessment Review (Questions and Answers) (Continued.) PART 2: Finite Volume Discretization of 2-D Unsteady State Diffusion Type

Lecture 21 - Solution of Systems of Linear Algebraic Equations

Lecture 22 - Solution of Systems of Linear Algebraic Equations: Elimination Methods

Lecture 23 - Solution of Systems of Linear Algebraic Equations: Elimination Methods (Continued.)

Lecture 24 - Elimination Methods: Error Analysis

Lecture 25 - Iterative Methods for Numerical Solution of Systems of Linear Algebraic Equations

Lecture 26 - Iterative Methods for Numerical Solution of Systems of Linear Algebraic Equations (Continued.)

Lecture 27 - Iterative Methods: Further Examples

Lecture 28 - PART 1: Combination of Iteration & Elimination Techniques PART 2: Introduction to Gradient Search Methods

Lecture 29 - Gradient Search Methods (Continued.)

Lecture 30 - Discretization of Convection-Diffusion Equations: A Finite Volume Approach

[Lecture 31 - Discretization of Convection-Diffusion Equations: A Finite Volume Approach \(Continued.\)](#)

[Lecture 32 - Discretization of Convection- Diffusion Equations: A Finite Volume Approach \(Continued.\)](#)

[Lecture 33 - Discretization of Convection -Diffusion Equations: A Finite Volume Approach \(Continued.\)](#)

[Lecture 34 - Discretization of Convection-Diffusion Equations: A Finite Volume Approach \( Continued.\)](#)

[Lecture 35 - Discretization of Navier Stokes Equations](#)

[Lecture 36 - Discretization of Navier Stokes Equations \( Continued.\)](#)

[Lecture 37 - Discretization of Navier Stokes Equations \( Continued. \)](#)

[Lecture 38 - PART 1 : Discretization of Navier Stokes Equations \(Continued.\) PART 2 : Fundamentals of Unstructured Grid Formulation](#)

[Lecture 39 - Unstructured Grid Formulation \(Continued.\)](#)

[Lecture 40 - What is there in implementing a CFD Code](#)

[Lecture 41 - Introduction to Turbulence Modeling](#)

[Lecture 42 - Introduction to Turbulence Modeling \(Continued.\)](#)

[Lecture 43 - End Semester Questions Review](#)



Lecture 1 - What is Hydraulic and Pneumatic System

Lecture 2 - Basic Components, Symbols and Circuits

Lecture 3 - Incompressible Fluids - Some Fundamental Properties

Lecture 4 - Incompressible Fluid Flow related to Fluid Drive

Lecture 5 - Capillary Fluid (incompressible) Flow and Hydrodynamic Lubrication

Lecture 6 - Basis for Calculating Hydraulic Systems

Lecture 7 - Different types of Valves - Features and Operations - I

Lecture 8 - Hydraulic Valves (General) Different types of Valves - Features and Operations - II

Lecture 9 - Hydraulic Circuits and Valves

Lecture 10 - Hydraulic Servomechanism and Servo and Proportional Control Valves

Lecture 11 - Basic Spool Valve Design Analysis

Lecture 12 - General Control Valve Analysis

Lecture 13 - Critical Centre Spool Valve Analysis

Lecture 14 - Critical Centre Spool Valve Analysis - Stroking Forces

Lecture 15 - Proportional Solenoid Pilot Operated Two Stage Pressure Relief Valve

Lecture 16 - Proportional Solenoid Pilot Operated Two Stage Pressure Relief Valve (Continued...)

Lecture 17 - Introduction to Positive Displacement Hydrostatic Units (Hydraulic Pumps and Motors)

Lecture 18 - Basic features of some Hydraulic Pumps and Motors

Lecture 19 - Analysis of an axial - Piston Swash Plate type Hydrostatic Pump (Discharge Flow Characteristics)

Lecture 20 - Analysis of an axial - Piston Swash Plate type Hydrostatic Pump (Estimation of Torque on Drive Shaft and Swash Plate)

Lecture 21 - Analysis of an Axial - Piston Swash Plate type Hydrostatic unit (Pressure Ripple and Swash Plate Torque)

Lecture 22 - Design Analysis of Gear Pumps - I

Lecture 23 - Design Analysis of Gear Pumps - II

Lecture 24 - Basic Concept of Hydrostatic Transmission (HST) System

Lecture 25 - Selection of HST units and components

Lecture 26 - Regenerative Circuits

Lecture 27 - Introduction to Fluid Logic

Lecture 28 - Basic Devices, Symbols and Circuits

Lecture 29 - Logic Circuits

Lecture 30 - Design Analysis of ORBIT Motor - I : Basic Design and Feature

Lecture 31 - Design Analysis of ORBIT Motor - II : Geometric Volume Displacement

[Lecture 32 - Design Analysis of ORBIT Motor - III : Output torque and stress, Deformation, Gap at Contacts](#)

[Lecture 33 - Application and Selection of Accumulators - Part I](#)

[Lecture 34 - Application and Selection of Accumulators - Part II](#)

[Lecture 35 - Hydraulic Circuits in Industrial Applications](#)

[Lecture 36 - Air preparation - Compressor and Accessories](#)

[Lecture 37 - Pneumatic Circuits](#)

[Lecture 38 - Analysis of Three - Way \(Spool and Flapper Nozzle Valve\)](#)

[Lecture 39 - Analysis of Flapper Nozzle Valves](#)

[Lecture 40 - Flow Force Compensation and Spool Design \(Electro - hydraulic valves\)](#)

[Lecture 41 - Premier and Guide to Oil - hydraulic fluids ; and Introduction to Fluid Power Symbols](#)

[Lecture 42 - Symbols in Oil Hydraulics](#)

[Lecture 43 - Appendices Tutorial on Basic Calculation on HST System and Hydraulic Fluids](#)

Lecture 1 - Introduction

Lecture 2 - Principles of Maintenance

Lecture 3 - Failure Modes Effects and Criticality Analysis

Lecture 4 - Fault Diagnostics and Prognostics

Lecture 5 - Basics of Machinery Vibration

Lecture 6 - Engineering Applications of Vibration

Lecture 7 - Rotordynamics

Lecture 8 - Time Domain Signal Analysis

Lecture 9 - Frequency Domain Signal Analysis

Lecture 10 - Computer Aided Data Acquisition

Lecture 11 - FFT Analysis

Lecture 12 - Modulation and Sidebands

Lecture 13 - Envelope Analysis

Lecture 14 - Cepstrum Analysis

Lecture 15 - Order Analysis

Lecture 16 - Basics of Instrumentation

Lecture 17 - Sensors and Transducers

Lecture 18 - Data Recording and Transmission

Lecture 19 - Vibration Transducers

Lecture 20 - Vibration Monitoring

Lecture 21 - Basics of Noise and Noise Monitoring

Lecture 22 - Numericals in Noise Vibration and Data Acquisition

Lecture 23 - Unbalance Detection

Lecture 24 - Field Balancing

Lecture 25 - Misalignment Detection

Lecture 26 - Cracked Shaft Detection

Lecture 27 - Looseness and Rub Detection

Lecture 28 - Ball and Journal Bearings

Lecture 29 - Gear Fault Detection

Lecture 30 - Fans, Blowers and Compressors

Lecture 31 - Pumps and Turbines

[Lecture 32 - Contaminant Analysis](#)

[Lecture 33 - Oil Analysis](#)

[Lecture 34 - Fault Detection in Motors and Transformers](#)

[Lecture 35 - Motor Current Signature Analysis](#)

[Lecture 36 - Thermography](#)

[Lecture 37 - Ultrasonics](#)

[Lecture 38 - Acoustic Emission and Eddy Current Testing](#)

[Lecture 39 - Radiography, Dye Penetrant Test and Visual Inspection](#)

[Lecture 40 - Case Studies](#)

**NPTEL : Solar Energy Technology (Mechanical Engineering)**

**Co-ordinators : Prof. V.V. Satyamurty**

Lecture 1 - Energy and Dependence on External Sources and Sun, Physical Descriptions and Reactions

Lecture 2 - Sun - Earth Geometry

Lecture 3 - Terminology Extra - Terrestrial Radiation Terrestria Radiation

Lecture 4 - Measuring Instruments

Lecture 5 - Estimation of Solar Radiation or Details

Lecture 6 - Radiation Processing - Long Term

Lecture 7 - Evaluation of the Apparent Sunrise and Sunset Angles

Lecture 8 - Estimation of Daily/Monthly Average daily Tilt Factor Under Terrestrial Conditions

Lecture 9 - Solar Colector Basics

Lecture 10 - Transmission - Absorptance Product

Lecture 11 - Daily (Or Monthly Average Daily) Transmittance - Absorptance Product Analytical Evaluation

Lecture 12 - Theory of Flat Plate Collectors - Liquid Based (A)

Lecture 13 - Theory of Flat Plate Collectors - Liquid Based (B)

Lecture 14 - Theory of Flat Plate Collectors - Liquid Based (C)

Lecture 15 - Mean temperature and Heat Capacity Effects

Lecture 16 - Theory of Air Based Solar Flat Plate Collectors

Lecture 17 - Theory of Air Based Solar Flat Plate Collectors (Continued.)

Lecture 18 - Other Collector Geometries

Lecture 19 - Concentrating Collectors

Lecture 20 - Concentrating Collectors (Continued.)

Lecture 21 - Concentrating Collectors (Continued.)

Lecture 22 - Compound Parabolic Collectors

Lecture 23 - Exercise - I

Lecture 24 - Exercise - I (Continued.)

Lecture 25 - Device and System Performance

Lecture 26 - Long Term Solar Energy System Performance

Lecture 27 - Exercise - I (Continued.)

Lecture 28 - Long Term Solar Energy System Performance Simplified Design Methods

Lecture 29 - Long Term Solar Energy System Performance Simplified Design Methods (Continued.)

Lecture 30 - Monthly Average Daily Utilizability

Lecture 31 - The  $\bar{\phi}$  - f chart method (Continued.)

[Lecture 32 - The  \$\phi\$ \(bar\) - f chart method Tank Losses and Finite Heat Exchanger](#)

[Lecture 33 - Exercise - 2](#)

[Lecture 34 - Exercise - 2 \(Continued.\)](#)

[Lecture 35 - Exercise - 2 \(Continued.\)](#)

[Lecture 36 - Economic Analysis](#)

[Lecture 37 - Life Cycle Savings : The P1 and P2 Method](#)

[Lecture 38 - Passive Devices](#)

[Lecture 39 - Passive Architecture, Overhangs and Wing Walls](#)

[Lecture 40 - Passive Architecture, Overhangs and Wing Walls \(Continued.\)](#)

[Lecture 41 - Summary](#)

[Lecture 42 - Summary \(Continued.\)](#)

[Lecture 43 - Summary \(Continued.\)](#)

Lecture 1 - Introduction

Lecture 2 - CVD Reaction

Lecture 3 - Adhesion of Surface Coating

Lecture 4 - CVD System

Lecture 5 - CDV of Tic

Lecture 6 - Chemical Vapour Deposition of Nitride Coating

Lecture 7 - Chemical Vapour Deposition of Carbo-Nitride Coating

Lecture 8 - Chemical Vapour Deposition of Chromium

Lecture 9 - Chemical Vapour Deposition of Aluminium Oxide

Lecture 10 - Chemical Vapour Deposition of Diamond

Lecture 11 - Vacuum Evaporation Deposition

Lecture 12 - Reactive Evaporation Deposition

Lecture 13 - Cathodic Arc Evaporation Deposition

Lecture 14 - Sputtering

Lecture 15 - Magnetron Sputtering

Lecture 16 - Unbalanced Magnetron Sputtering

Lecture 17 - Radio frequency and pulsed DC sputtering

Lecture 18 - Sputter Deposition of Nitride Coating

Lecture 19 - Sputter Deposition of Molybdenum Di Sulphide Coating

Lecture 20 - Influence of Architecture of Sputter Deposited Molybdenum Di Sulphide Coating

Lecture 21 - Electro Plating, Anodizing and Electro-Less Plating

Lecture 22 - Coating of Monolayer Abrasive Grain by Electro Plating

Lecture 23 - Mechanism of Wetting

Lecture 24 - Coating on Ceramics by Wetting

Lecture 25 - Coating of Monolayer Abrasive Grain by Wetting

Lecture 26 - Coating on Abrasive Grain

Lecture 27 - Combustion Spray Process

Lecture 28 - Plasma Spray Process

Lecture 29 - Mechanical, Chemical and Ion-Assisted Method

Lecture 30 - Combustion Spray Process

Lecture 31 - Production of Low Vacuum

[Lecture 32 - Production of High Vacuum](#)

[Lecture 33 - Measurement of Low Pressure and Gas Flow in Coating Deposition System](#)

[Lecture 34 - Physical Characterization](#)

[Lecture 35 - Assessment of Coating Hardness](#)

[Lecture 36 - Assessment of Friction and Wear of Coating](#)

[Lecture 37 - Assessment of Surface Roughness and Thickness of Coating](#)

[Lecture 38 - Assessment of Adhesion of Coating](#)

[Lecture 39 - Performance Evaluation of TiN Coated Tool](#)

[Lecture 40 - Performance Evaluation of HFCVD Diamond Coated Tool](#)



- Lecture 1 - Transverse Vibrations of Strings - I
- Lecture 2 - Transverse Vibrations of Strings - II
- Lecture 3 - Axial and Torsional Vibrations of Bars
- Lecture 4 - Variational Formulation - I
- Lecture 5 - Variational Formulation - II
- Lecture 6 - Modal Analysis - I
- Lecture 7 - Modal Analysis - II
- Lecture 8 - Properties of the Eigenvalue Problem
- Lecture 9 - Modal Analysis: Approximate Methods - I
- Lecture 10 - Modal Analysis: Approximate Methods - II
- Lecture 11 - The Initial Value Problem
- Lecture 12 - Forced Vibration Analysis - I
- Lecture 13 - Forced Vibration Analysis - II
- Lecture 14 - Forced Vibration Analysis - III
- Lecture 15 - Damping in Structures
- Lecture 16 - Axially Translating Strings
- Lecture 17 - d' Alembert's Solution - I
- Lecture 18 - d' Alembert's Solution - II
- Lecture 19 - Harmonic Waves and Energetics of Wave Motion
- Lecture 20 - Scattering of Waves
- Lecture 21 - Applications of Wave Solution - I
- Lecture 22 - Applications of Wave Solution - II
- Lecture 23 - Beam Models - I
- Lecture 24 - Beam Models - II
- Lecture 25 - Modal Analysis of Beams
- Lecture 26 - Applications of Modal Solution
- Lecture 27 - Approximate Methods
- Lecture 28 - Topic in Beam Vibration - I
- Lecture 29 - Topic in Beam Vibration - II
- Lecture 30 - Wave Propagation in Beams
- Lecture 31 - Dynamics of Curved Beams

[Lecture 32 - Vibrations of Rings and Arches](#)

[Lecture 33 - Dynamics of Membranes](#)

[Lecture 34 - Vibrations of Rectangular Membrane](#)

[Lecture 35 - Vibrations of Circular Membrane](#)

[Lecture 36 - Special Problems in Membrane Vibrations](#)

[Lecture 37 - Dynamics of Plates](#)

[Lecture 38 - Vibrations of Rectangular Plates](#)

[Lecture 39 - Vibrations of Circular Plates](#)

[Lecture 40 - Special Problems in Plate Vibrations](#)

- Lecture 1 - Introduction and Fundamental Concepts
- Lecture 2 - Zeroth Law and Fundamental Concepts
- Lecture 3 - Different Kind of Energy and First Law - I
- Lecture 4 - First Law - II
- Lecture 5 - First Law - III
- Lecture 6 - Second Law and Its Corollaries - I
- Lecture 7 - Second Law and Its Corollaries - II
- Lecture 8 - Second Law and Its Corollaries - III
- Lecture 9 - Second Law and Its Corollaries - IV
- Lecture 10 - Second Law and Available Energy - I
- Lecture 11 - Second Law and Available Energy - II
- Lecture 12 - Second Law and Available Energy - III
- Lecture 13 - Thermodynamic Property Relations - I
- Lecture 14 - Thermodynamic Property Relations - II
- Lecture 15 - Joule-Kelvin Expansion: Properties of Pure Substances
- Lecture 16 - Properties of Pure Substances - I
- Lecture 17 - Properties of Pure Substances - II
- Lecture 18 - Properties of Pure Substances: Ideal Gases
- Lecture 19 - Properties of Ideal Gases
- Lecture 20 - Vapors Power Cycle - I
- Lecture 21 - Vapor Power Cycle - II
- Lecture 22 - Vapor Power Cycle - III
- Lecture 23 - Vapor Power Cycle - IV
- Lecture 24 - Gas Power Cycle - I
- Lecture 25 - Gas Power Cycle - II
- Lecture 26 - Gas Power Cycle - III
- Lecture 27 - Thermodynamics of Reacting System - I
- Lecture 28 - Thermodynamics of Reacting System - II
- Lecture 29 - Thermodynamics of Reacting System - III
- Lecture 30 - Thermodynamics of Multi Component System - I
- Lecture 31 - Thermodynamics of Multi Component System - II



Lecture 1 - Design Philosophy

Lecture 2 - Design And Manufacturing

Lecture 3 - Engineering Materials

Lecture 4 - Engineering Materials

Lecture 5 - Simple Stresses In Machine Elements

Lecture 6 - Simple Stresses In Machine Elements

Lecture 7 - Compound Stresses In Machine Elements

Lecture 8 - Design For Strength

Lecture 9 - Design for Strength

Lecture 10 - Design For Strength

Lecture 11 - Design for Strength

Lecture 12 - Design for Strength

Lecture 13 - Design of Fasteners - I

Lecture 14 - Design of Fasteners - II

Lecture 15 - Design Of Keys and Splines

Lecture 16 - Threaded Fasteners

Lecture 17 - Design Of Threaded Fasteners

Lecture 18 - Power Screws

Lecture 19 - Design Of Power Screws

Lecture 20 - Shaft Coupling - I

Lecture 21 - Shaft Coupling - II

Lecture 22 - Rivet Joints

Lecture 23 - Design of Welded Joints - I

Lecture 24 - Design of Welded Joints - II

Lecture 25 - Design of Joints With Eccentric Loading

Lecture 26 - Design of Joints With Variable Loading

Lecture 27 - Design of Springs

Lecture 28 - Design Of Springs

Lecture 29 - Design Of Springs

Lecture 30 - Belt Drives

Lecture 31 - Belt Drives

[Lecture 32 - Belt Drives](#)

[Lecture 33 - Design for Strength](#)

[Lecture 34 - Design of Shafts](#)

[Lecture 35 - Design of Machine Elements - I \(V & W\)](#)

[Lecture 36 - Design of Machine Elements - II \(V & W\)](#)

[Lecture 37 - Design of Cylinders & Pressure Vessels - II](#)

[Lecture 38 - Design of Cylinders & Pressure Vessels - III](#)

[Lecture 39 - Design of Brakes - I](#)

[Lecture 40 - Design of Brakes - II](#)

**NPTEL : Manufacturing Processes II (Mechanical Engineering)**

**Co-ordinators : Prof. S. Paul, Prof. A.B. Chattopadhyay, Prof. A.K. Chattopadhyay**

Lecture 1 - Instructional Objectives - I (Manufacturing Process II)

Lecture 2 - Instructional Objectives - II

Lecture 3 - On Tool Geometry

Lecture 4 - Interrelations Among The Tool Angles

Lecture 5 - Mechanism of Chip Formation

Lecture 6 - Orthogonal and Oblique Cutting

Lecture 7 - Use of Chip Breaker in Machining

Lecture 8 - Machining Forces

Lecture 9 - Analytical and Experimental

Lecture 10 - Dynamometers for Measuring Cutting Forces

Lecture 11 - CTCEAC

Lecture 12 - CCTCFA

Lecture 13 - Concept of Machinability and its Improvement

Lecture 14 - Tool Life

Lecture 15 - Conventional Cutting Tool Maths

Lecture 16 - Advanced Tool Materials

Lecture 17 - Kinematics System of Centre Lathe

Lecture 18 - General Purpose Machine Tool Drills

Lecture 19 - Kinematic Systems and Operations

Lecture 20 - Configuration and Kinematic System

Lecture 21 - Mounting of jobs and Cutting Tools in Machine

Lecture 22 - Mounting of jobs and Cutting Tools in Machine

Lecture 23 - Construction, Operation and Tool Layout

Lecture 24 - Use of Attachments In Machine Tools

Lecture 25 - Forces Developing and Acting In Machine Tools

Lecture 26 - Estimation of Machining Time

Lecture 27 - Broaching - Principle Systems and Applications

Lecture 28 - Grinding Principle and Application

Lecture 29 - Abrasive Processes

Lecture 30 - Abrasive Processes (Grinding)

Lecture 31 - Super finishing Processes

[Lecture 32 - Production of Screw Threads](#)

[Lecture 33 - Gear Manufacturing](#)

[Lecture 34 - Jigs and Fixtures For Machine Shops](#)

[Lecture 35 - Design and Applications of Jigs and Fixtures](#)

[Lecture 36 - Non Traditional Manufacturing](#)

[Lecture 37 - Ultrasonic Machining](#)

[Lecture 38 - Water Jet Machining and Abrasive Water Jet](#)

[Lecture 39 - Electro - Chemical Machining](#)

[Lecture 40 - Electro - Discharge Machining](#)

[Lecture 41 - EBM and LBM](#)



**NPTEL : Refrigeration and Air Conditioning (Mechanical Engineering)**

**Co-ordinators : Prof. M. Ramgopal, Prof. R.C. Arora**

Lecture 1 - History of Refrigeration

Lecture 2 - Refrigerant Compressors & Development

Lecture 3 - Applications of RTAC

Lecture 4 - Review of Fundamentals Thermodynamics - I

Lecture 5 - Review of Fundamentals

Lecture 6 - Fundamentals of Fluid Flow

Lecture 7 - Fundamentals of Heat Transfer

Lecture 8 - Methods of Producing low Temperatures

Lecture 9 - Air Cycle Refrigeration Systems

Lecture 10 - Vapour Compression Refrigeration Systems

Lecture 11 - Vapour Compression Refrigeration Systems (Continued...)

Lecture 12 - Vapour Compression Refrigeration Systems (Continued...)

Lecture 13 - Vapour Compression Refrigeration Systems (Continued...)

Lecture 14 - Vapour Absorption Refrigeration Systems

Lecture 15 - Vapour Absorption Refrigeration System

Lecture 16 - Vapour Absorption Refrigeration Systems (Continued...)

Lecture 17 - Vapour Absorption Refrigeration Systems (Continued...)

Lecture 18 - Worked Out Examples - I

Lecture 19 - Worked Out Examples - II

Lecture 20 - Refrigeration System Components : Compressor

Lecture 21 - Refrigeration System Components : Compressor (Continued...)

Lecture 22 - Refrigeration System Components : Compressor (Continued...)

Lecture 23 - Refrigeration System Components : Compressor (Continued...)

Lecture 24 - Refrigeration System Components : Compressor (Continued...)

Lecture 25 - Refrigeration System Components : Compressor (Continued...)

Lecture 26 - Refrigeration System Components : Condensers

Lecture 27 - Refrigeration System Components : Condensers (Continued...)

Lecture 28 - Refrigeration System Components : Evaporators

Lecture 29 - Refrigeration System Components : Evaporators

Lecture 30 - Refrigeration System Components : Expansion Devices

Lecture 31 - Refrigeration System Components : Expansion Devices

- [Lecture 32 - Analysis of Complete Vapour Compression System](#)
- [Lecture 33 - Refrigerants](#)
- [Lecture 34 - Psychrometry](#)
- [Lecture 35 - Psychrometric Processes](#)
- [Lecture 36 - Inside Design Condition Thermal Comfort](#)
- [Lecture 37 - Psychrometry of Air Conditioning Systems](#)
- [Lecture 38 - Air Conditioning Systems](#)
- [Lecture 39 - Cooling and Heating Load Calculation : Solar Radiation](#)
- [Lecture 40 - Cooling and Heating Load Calculations](#)
- [Lecture 41 - Cooling and Heating Load Calculations \(Continued...\)](#)
- [Lecture 42 - Cooling and Heating Load Calculations \(Continued...\)](#)
- [Lecture 43 - Selection of Air Conditioning Systems](#)
- [Lecture 44 - Transmission and Distribution of Air](#)
- [Lecture 45 - Transmission and Distribution of Air \(Continued..\)](#)
- [Lecture 46 - Space Air Distribution](#)

**NPTEL : Fluid Mechanics (Mechanical Engineering)**

**Co-ordinators : Prof. S.K. Som**

Lecture 1 - Introduction and Fundamental Concepts - Part I

Lecture 2 - Introduction and Fundamental Concepts - Part II

Lecture 3 - Introduction and Fundamental Concepts - Part III

Lecture 4 - Fluid Statics - Part I

Lecture 5 - Fluid Statics - Part II

Lecture 6 - Fluid Statics - Part III

Lecture 7 - Fluid Statics - Part IV

Lecture 8 - Fluid Statics - Part V

Lecture 9 - Fluid Statics - Part VI

Lecture 10 - Kinematics of Fluid - Part I

Lecture 11 - Kinematics of Fluid - Part II

Lecture 12 - Kinematics of Fluid - Part III

Lecture 13 - Conservation Equations in Fluid Flow - Part I

Lecture 14 - Conservation Equations in Fluid Flow - Part II

Lecture 15 - Conservation Equations in Fluid Flow - Part III

Lecture 16 - Conservation Equations in Fluid Flow - Part IV

Lecture 17 - Conservation Equations in Fluid Flow - Part V

Lecture 18 - Conservation Equations in Fluid Flow - Part VI

Lecture 19 - Conservation Equations in Fluid Flow - Part VII

Lecture 20 - Conservation Equations in Fluid Flow - Part VIII

Lecture 21 - Conservation Equations in Fluid Flow - Part IX

Lecture 22 - Fluid Flow Applications - Part I

Lecture 23 - Fluid Flow Applications - Part II

Lecture 24 - Fluid Flow Applications - Part III

Lecture 25 - Fluid Flow Applications - Part IV

Lecture 26 - Fluid Flow Applications - Part V

Lecture 27 - Fluid Flow Applications - Part VI

Lecture 28 - Fluid Flow Applications - Part VII

Lecture 29 - Incompressible Viscous Flows - Part I

Lecture 30 - Incompressible Viscous Flows - Part II

Lecture 31 - Incompressible Viscous Flows - Part III

- [Lecture 32 - Incompressible Viscous Flows - Part IV](#)
- [Lecture 33 - Application of ViscousFlow Through Pipes - Part I](#)
- [Lecture 34 - Application of ViscousFlow Through Pipes - Part II](#)
- [Lecture 35 - Application of ViscousFlow Through Pipes - Part III](#)
- [Lecture 36 - Principles of Similarity - Part I](#)
- [Lecture 37 - Principles of Similarity - Part II](#)
- [Lecture 38 - Principles of Similarity - Part III](#)
- [Lecture 39 - Flow of Ideal Fluids - Part I](#)
- [Lecture 40 - Flow of Ideal Fluids - Part II](#)
- [Lecture 41 - Flows with a Free Surface - Part I](#)
- [Lecture 42 - Flows with a Free Surface - Part II](#)
- [Lecture 43 - Flows with a Free Surface - Part III](#)
- [Lecture 44 - A Few Unsteady Flow Phenomena in Practice - Part I](#)
- [Lecture 45 - A Few Unsteady Flow Phenomena in Practice - Part II](#)
- [Lecture 46 - Introduction to Laminar Boundary Layer - Part I](#)
- [Lecture 47 - Introduction to Laminar Boundary Layer - Part II](#)
- [Lecture 48 - Introduction to Turbulent Flow - Part I](#)
- [Lecture 49 - Introduction to Turbulent Flow - Part II](#)

Lecture 1 - Introduction to Fluid Machines I

Lecture 2 - Energy Transfer in Fluid Machines Part - I

Lecture 3 - Energy Transfer in Fluid Machines Part - II

Lecture 4 - Energy Transfer - impulse and Reaction Machines, efficiencies of Fluid Machines

Lecture 5 - Principles of Similarity in Fluid Machines

Lecture 6 - Concept of specific speed and introduction to Impulse Hydraulic Turbine

Lecture 7 - Analysis of force on the Bucket of Pelton wheel and Power Generation

Lecture 8 - Specific speed, Governing and Limitation of a Pelton Turbine

Lecture 9 - Introduction to reaction Type of Hydraulic Turbine - A Francis Turbine

Lecture 10 - Analysis of Force on Francis Runner and Power Generation

Lecture 11 - Axial Flow Machine and Draft Tube

Lecture 12 - Governing of Reaction Turbine

Lecture 13 - Introduction to Rotodynamic Pumps

Lecture 14 - Flow and Energy Transfer in a Centrifugal Pump

Lecture 15 - Characteristics of a Centrifugal Pump

Lecture 16 - Matching of Pump and System Characteristics

Lecture 17 - Diffuser and Cavitation

Lecture 18 - Axial Flow Pump

Lecture 19 - Reciprocating Pump - Part I

Lecture 20 - Reciprocating Pump - Part II

Lecture 21 - Centrifugal Compressor - Part I

Lecture 22 - Centrifugal Compressor - Part II

Lecture 23 - Centrifugal Compressor - Part III

Lecture 24 - Axial Flow Compressor - Part I

Lecture 25 - Axial Flow Compressor - Part II

Lecture 26 - Introduction to Compressible Flow - Part I

Lecture 27 - Introduction to Compressible Flow - Part II

Lecture 28 - Thermodynamic Relations and Speed of Sound

Lecture 29 - Disturbance propagation, Stagnation and Sonic Properties

Lecture 30 - Effects of Area Variation on Properties in an Isentropic Flow

Lecture 31 - Choking in a Converging Nozzle

[Lecture 32 - Isentropic Flow through Convergent - Divergent Duct](#)

[Lecture 33 - Normal Shock - Part I](#)

[Lecture 34 - Normal Shock - Part II](#)

[Lecture 35 - Normal Shock - Part III](#)

[Lecture 36 - Normal Shock - Part IV](#)

[Lecture 37 - Normal Shock - Part V](#)

[Lecture 38 - Oblique Shock - Part I](#)

[Lecture 39 - Oblique Shock - Part II](#)

[Lecture 40 - Introduction to Expansion Wave and Prandtl Meyer Flow](#)

[Lecture 1 - Introductory Concepts](#)

[Lecture 2 - Introductory Concepts \(Continued...\)](#)

[Lecture 3 - Introductory Concepts \(Continued...\)](#)

[Lecture 4 - Viscosity](#)

[Lecture 5 - Viscosity \(Continued...\)](#)

[Lecture 6 - Viscosity \(Continued...\) and Surface Tension](#)

[Lecture 7 - Surface Tension \(Continued...\) and Fluid Statics](#)

[Lecture 8 - Fluid Statics \(Continued...\)](#)

[Lecture 9 - Fluid Statics \(Continued...\)](#)

[Lecture 10 - Fluid Statics \(Continued...\) and Fluid Under Rigid Body Motion](#)

[Lecture 11 - Fluid Kinematics](#)

[Lecture 12 - Fluid Kinematics \(Continued...\)](#)

[Lecture 13 - Fluid Kinematics \(Continued...\)](#)

[Lecture 14 - Fluid Kinematics \(Continued...\)](#)

[Lecture 15 - Fluid Kinematics \(Continued...\)](#)

[Lecture 16 - Dynamics of Inviscid Flows](#)

[Lecture 17 - Dynamics of Inviscid Flows \(Continued...\)](#)

[Lecture 18 - Dynamics of Inviscid Flows \(Continued...\)](#)

[Lecture 19 - Dynamics of Inviscid Flows \(Continued...\)](#)

[Lecture 20 - Dynamics of Inviscid Flows \(Continued...\)](#)

[Lecture 21 - Integral Forms of Control Volume Conservation Equations \(Reynolds Transport Theorem\)](#)

[Lecture 22 - Integral Forms of Control Volume Conservation Equations \(Reynolds Transport Theorem\) \(Continued...\)](#)

[Lecture 23 - Integral Forms of Control Volume Conservation Equations \(Reynolds Transport Theorem\) \(Continued...\)](#)

[Lecture 24 - Integral Forms of Control Volume Conservation Equations \(Reynolds Transport Theorem\) \(Continued...\)](#)

[Lecture 25 - Integral Forms of Control Volume Conservation Equations \(Reynolds Transport Theorem\) \(Continued...\)](#)

[Lecture 26 - Integral Forms of Control Volume Conservation Equations \(Reynolds Transport Theorem\) \(Continued...\)](#)

[Lecture 27 - Integral Forms of Control Volume Conservation Equations \(Reynolds Transport Theorem\) \(Continued...\)](#)

[Lecture 28 - Dynamics of Viscous Flows : Navier Stokes Equation](#)

[Lecture 29 - Dynamics of Viscous Flows : Navier Stokes Equation \(Continued...\)](#)

[Lecture 30 - Some Exact Solutions of Navier Stokes Equation](#)

[Lecture 31 - Some Exact Solutions of Navier Stokes Equation \(Continued...\)](#)

- [Lecture 32 - Some Exact Solutions of Navier Stokes Equation \(Continued...\)](#)
- [Lecture 33 - Introduction to Turbulence](#)
- [Lecture 34 - Introduction to Turbulence \(Continued...\)](#)
- [Lecture 35 - Introduction to Turbulence \(Continued...\)](#)
- [Lecture 36 - Introduction to Turbulence \(Continued...\)](#)
- [Lecture 37 - Boundary Layer Theory](#)
- [Lecture 38 - Boundary Layer Theory \(Continued...\)](#)
- [Lecture 39 - Boundary Layer Theory \(Continued...\)](#)
- [Lecture 40 - Boundary Layer Theory \(Continued...\) and Flow Past Immersed Bodies](#)
- [Lecture 41 - Flow past Immersed Bodies \(Continued...\)](#)
- [Lecture 42 - Potential Flow Past Immersed Bodies](#)
- [Lecture 43 - Potential Flow \(Continued...\) and Flow Past Immersed Bodies of Special Shapes](#)
- [Lecture 44 - Flow Past Immersed Bodies \(Continued...\) and Sports Ball Aerodynamics](#)
- [Lecture 45 - Pipe Flow](#)
- [Lecture 46 - Pipe Flow \(Continued...\)](#)
- [Lecture 47 - Pipe Flow \(Continued...\)](#)
- [Lecture 48 - Principles of Similarity and Dimensional Analysis](#)
- [Lecture 49 - Introduction to Fluid Machines](#)
- [Lecture 50 - Introduction to Fluid Machines \(Continued...\)](#)
- [Lecture 51 - Introduction to Fluid Machines \(Continued...\)](#)
- [Lecture 52 - Introduction to Fluid Machines \(Continued...\)](#)
- [Lecture 53 - Introduction to Fluid Machines \(Continued...\)](#)
- [Lecture 54 - Compressible Flows](#)
- [Lecture 55 - Compressible Flows \(Continued...\)](#)
- [Lecture 56 - Compressible Flows \(Continued...\)](#)
- [Lecture 57 - Compressible Flows \(Continued...\)](#)
- [Lecture 58 - Compressible Flows \(Continued...\)](#)



**NPTEL : Micro fluidics (Mechanical Engineering)**

**Co-ordinators : Prof. S. Chakraborty**

[Lecture 1 - Introduction to Microfluidics](#)

[Lecture 2 - Microfluidics: Some Application Examples](#)

[Lecture 3 - Microfluidics: Some More Application Examples](#)

[Lecture 4 - Equations of Conservation](#)

[Lecture 5 - Navier Stokes Equation](#)

[Lecture 6 - Navier Stokes Equation \(Continued...\)](#)

[Lecture 7 - Energy Equation](#)

[Lecture 8 - Energy Equation \(Continued...\) and Species Conservation Equation](#)

[Lecture 9 - Pressure-driven Microflows](#)

[Lecture 10 - Pressure-driven Microflows \(Continued...\)](#)

[Lecture 11 - Pressure-driven Microflows \(Continued...\)](#)

[Lecture 12 - Pressure-driven Microflows \(Continued...\)](#)

[Lecture 13 - Pressure -driven Microflows \(Continued...\)](#)

[Lecture 14 - Some Examples of Unsteady Flows](#)

[Lecture 15 - Some Examples of Unsteady Flows \(Continued...\)](#)

[Lecture 16 - Some Examples of Unsteady Flows \(Continued...\)](#)

[Lecture 17 - Stokes Drag on a Sphere](#)

[Lecture 18 - Stokes Drag on a Sphere \(Continued...\) and Introduction to Lubrication Theory](#)

[Lecture 19 - Lubrication Theory \(Continued...\)](#)

[Lecture 20 - Lubrication Theory \(Continued...\)](#)

[Lecture 21 - Boundary Condition in Fluid Mechanics: Slip or No-slip?](#)

[Lecture 22 - Boundary Condition in Fluid Mechanics: Slip or No-slip? \(Continued...\)](#)

[Lecture 23 - Surface Tension Driven Flows](#)

[Lecture 24 - Surface Tension Driven Flows \(Continued...\)](#)

[Lecture 25 - Surface Tension Driven Flows \(Continued...\)](#)

[Lecture 26 - Surface Tension Driven Flows \(Continued...\)](#)

[Lecture 27 - Surface Tension Driven Flows \(Continued...\) and Modulating Surface Tension](#)

[Lecture 28 - Modulating Surface Tension \(Continued...\)](#)

[Lecture 29 - Thin Film Dynamics](#)

[Lecture 30 - Thin Film Dynamics \(Continued...\)](#)

[Lecture 31 - Thin Film Dynamics \(Continued...\)](#)

[Lecture 32 - Thin Film Dynamics \(Continued...\)](#)

[Lecture 33 - Lab on a CD](#)

[Lecture 34 - Lab on a CD \(Continued...\)](#)

[Lecture 35 - Introduction to Microfabrication](#)

[Lecture 36 - Electrokinetics](#)

[Lecture 37 - Electrokinetics \(Continued...\)](#)

[Lecture 38 - Electrokinetics \(Continued...\)](#)

[Lecture 39 - Electrokinetics \(Continued...\)](#)

[Lecture 40 - Electrokinetics \(Continued...\)](#)

[Lecture 41 - Electrokinetics \(Continued...\)](#)

[Lecture 42 - Dispersion](#)

[Lecture 43 - Introduction to Nanofluidics](#)

[Lecture 44 - Introduction to Nanofluidics \(Continued...\) and Molecular Dynamics Simulations](#)

[Lecture 45 - Introduction to Molecular Dynamics Simulations \(Continued...\)](#)

[Lecture 46 - Biomicrofluidics](#)

[Lecture 47 - Biomicrofluidics \(Continued...\)](#)

[Lecture 48 - Nanofluidic Energy Conversion](#)

Lecture 1 - Introduction and Fundamental Concepts - I

Lecture 2 - Introduction and Fundamental Concepts - II

Lecture 3 - Heat Conduction Equation

Lecture 4 - Heat Conduction Equation and Different Types of Boundary Conditions

Lecture 5 - 1D Steady State Heat Conduction In Plane Wall Without Generation of Thermal Energy

Lecture 6 - 1D Steady State Heat Conduction In Plane Wall With Generation of Thermal Energy

Lecture 7 - Problems on 1D Steady State Heat Conduction In Plane Wall

Lecture 8 - 1D Steady State Heat Conduction In Cylindrical Geometry

Lecture 9 - 1D Steady State Heat Conduction In Cylindrical Geometry (Continued...)

Lecture 10 - 1D Steady State Heat Conduction in Spherical Geometry

Lecture 11 - Heat Transfer from Extended Surfaces (Fins)

Lecture 12 - Heat Transfer from Extended Surfaces (Continued...)

Lecture 13 - Two-dimensional Steady State Heat Conduction

Lecture 14 - Unsteady State Heat Conduction

Lecture 15 - Unsteady State Heat Conduction (Continued...)

Lecture 16 - One Dimensional Unsteady State Heat Conduction - I

Lecture 17 - One Dimensional Unsteady State Heat Conduction - II

Lecture 18 - Introduction to Convection

Lecture 19 - Convection - I

Lecture 20 - Review of Fluid Mechanics - I

Lecture 21 - Review of Fluid Mechanics - II

Lecture 22 - Review of Fluid Mechanics - III

Lecture 23 - Review of Fluid Mechanics - IV

Lecture 24 - Review of Fluid Mechanics - V

Lecture 25 - Review of Fluid Mechanics - VI

Lecture 26 - Review of Fluid Mechanics - VIII

Lecture 27 - Energy Equation - I

Lecture 28 - Energy Equation - II and Thermal Boundary Layer - I

Lecture 29 - Thermal Boundary Layer - II

Lecture 30 - Integral Method for Thermal BL Analysis

Lecture 31 - Internal Forced Convection - I

[Lecture 32 - Internal Forced Convection - II](#)

[Lecture 33 - Internal Forced Convection - III](#)

[Lecture 34 - Internal Forced Convection - IV](#)

[Lecture 35 - Free Convection - I \(Natural Convection\)](#)

[Lecture 36 - Free Convection - II \(Natural Convection\)](#)

[Lecture 37 - Boiling and Condensation - I](#)

[Lecture 38 - Boiling and Condensation - II](#)

[Lecture 39 - Heat Exchanger - I](#)

[Lecture 40 - Heat Exchanger - II](#)

[Lecture 41 - Heat Exchanger - II \(Continued...\)](#)

- Lecture 1 - Transverse Vibrations of Strings - I
- Lecture 2 - Transverse Vibrations of Strings - II
- Lecture 3 - Axial and Torsional Vibrations of Bars
- Lecture 4 - Variational Formulation - I
- Lecture 5 - Variational Formulation - II
- Lecture 6 - Modal Analysis - I
- Lecture 7 - Modal Analysis - II
- Lecture 8 - Properties of the Eigenvalue Problem
- Lecture 9 - Modal Analysis: Approximate Methods - I
- Lecture 10 - Modal Analysis: Approximate Methods - II
- Lecture 11 - The Initial Value Problem
- Lecture 12 - Forced Vibration Analysis - I
- Lecture 13 - Forced Vibration Analysis - II
- Lecture 14 - Forced Vibration Analysis - III
- Lecture 15 - Damping in Structures - I
- Lecture 16 - Damping in Structures - II
- Lecture 17 - Beam Models - I
- Lecture 18 - Beam Models - II
- Lecture 19 - Modal Analysis of Beams
- Lecture 20 - Application of Modal Solution
- Lecture 21 - Approximate Methods
- Lecture 22 - Topics in Beam Vibrations - I
- Lecture 23 - Topics in Beam Vibrations - II
- Lecture 24 - Dynamics of Curved Beams
- Lecture 25 - Vibrations of Rings and Arches - I
- Lecture 26 - Vibrations of Rings and Arches - II
- Lecture 27 - Dynamics of Membranes
- Lecture 28 - Vibrations of Rectangular Membranes
- Lecture 29 - Vibrations of Circular Membranes - I
- Lecture 30 - Vibrations of Circular Membranes - II
- Lecture 31 - Dynamics of Plates

[Lecture 32 - Vibrations of Rectangular Plates](#)

[Lecture 33 - Vibrations of Circular Plates](#)

[Lecture 34 - Special Problems in Plate Vibrations - I](#)

[Lecture 35 - Special Problems in Plate Vibrations - II](#)

Lecture 1 - Definition of Fluid Machines and Energy Transfer in Fluid Machines - Part I

Lecture 2 - Energy Transfer in Fluid Machines - Part II

Lecture 3 - Impulse and Reaction Machines: Introductory Concepts

Lecture 4 - Principles of Similarity in Fluid Machine

Lecture 5 - Concept of Specific Speed

Lecture 6 - Basic Principles, Analysis of Force and Power Generation - Part I

Lecture 7 - Basic Principles, Analysis of Force and Power Generation - Part II

Lecture 8 - Specific Speed Governing and Limitations of Impulse Turbine

Lecture 9 - Tutorial - I

Lecture 10 - Tutorial - II

Lecture 11 - Introduction and Analysis of Force on Francis Turbine (Radial Flow) - Part I

Lecture 12 - Analysis of Force (Part-II) and Power Generation

Lecture 13 - Draft Tube

Lecture 14 - Tutorial - III

Lecture 15 - Tutorial - IV

Lecture 16 - Axial Flow Turbine

Lecture 17 - Governing of Reaction Turbine

Lecture 18 - Introduction to Rotodynamic Pumps

Lecture 19 - Flow and Energy Transfer to Centrifugal Pumps

Lecture 20 - Tutorial - V

Lecture 21 - Characteristics of a Centrifugal Pump

Lecture 22 - Matching of Pump and System Characteristics

Lecture 23 - Diffuser and Cavitation

Lecture 24 - Tutorial - VI

Lecture 25 - Tutorial - VIII

Lecture 26 - Axial Flow Pump

Lecture 27 - Reciprocating Pump - Part I

Lecture 28 - Reciprocating Pump - Part II

Lecture 29 - Tutorial - VIII

Lecture 30 - Basic Principles and Energy Transfer in Centrifugal Compressor - Part I

Lecture 31 - Basic Principles and Energy Transfer in Centrifugal Compressor - Part II

[Lecture 32 - Basic Principles and Energy Transfer in Centrifugal Compressor - Part III](#)

[Lecture 33 - Basic Principles and Energy Transfer in Centrifugal Compressor - Part IV and Losses in Centrifugal Compressors](#)

[Lecture 34 - Performance Characteristics of Centrifugal Compressors - Part I](#)

[Lecture 35 - Performance Characteristics of Centrifugal Compressors - Part II](#)

[Lecture 36 - Basic Principles and Energy Transfer in Axial Flow Compressor - Part I](#)

[Lecture 37 - Basic Principles and Energy Transfer in Axial Flow Compressor - Part II](#)

[Lecture 38 - Fans and Blowers - Part I](#)

[Lecture 39 - Fans and Blowers - Part II](#)



Lecture 1 - Introduction to computer control – role of computers in automation

Lecture 2 - Introduction (Continued...) - binary logic and logic gates

Lecture 3 - Classification of Computer numerical control (CNC) – Point to point and continuous control

Lecture 4 - Classification (Continued...) - Closed loop and open loop control

Lecture 5 - Tutorial involving simple calculations on different aspects of CNC controls

Lecture 6 - Questions, MCQ Discussions on Motors, Encoders, Decoders and Programming Practice

Lecture 7 - Stepper motors, Permanent magnet DC motors

Lecture 8 - Binary circuits and decoders

Lecture 9 - Tachogenerator, printed circuit motors, Encoders

Lecture 10 - Programming Practice - I

Lecture 11 - Programming Practice - II

Lecture 12 - Computer Aided Offline Programming

Lecture 13 - Interpolators - Linear

Lecture 14 - Interpolators - Curvilinear

Lecture 15 - Questions on Programming and Interpolation

Lecture 16 - 3-D Machining - Basic Concepts

Lecture 17 - Curved Surface Geometry

Lecture 18 - Cutter Path Generation for Curved Surfaces

Lecture 19 - Cutter Path Generation (Concluding Part) and Current Status - CNC Machining and Related Processes

Lecture 20 - Questions and Discussions on Curved Surface Machining

**NPTEL : NOC:Non Traditional Abrasive Machining Processes - Ultrasonic, Abrasive Jet and Abrasive Water Jet Machining  
(Mechanical Engineering)**

**Co-ordinators : Prof. Asimava Roy Choudhury**

Lecture 1 - Non-traditional abrasive machining : Ultrasonic, Abrasive jet and abrasive water jet machining

Lecture 2 - Ultrasonic Machining

Lecture 3 - Ultrasonic Machining (Continued...)

Lecture 4 - Ultrasonic Machining - Free Impacts and Problem Solving

Lecture 5 - Ultrasonic Machining - Problems and MCQs

Lecture 6 - USM - Horn Design

Lecture 7 - USM - Horn Design (Continued...)

Lecture 8 - Ultrasonic Machining - Feed Mechanism, Head design and other aspects

Lecture 9 - Ultrasonic Machining - Effects of Various Inputs on the Output

Lecture 10 - Ultrasonic Machining - Numerical and MCQs

Lecture 11 - A JM (Abrasive jet machining)

Lecture 12

Lecture 13 - A JM - Numerical problems

Lecture 14 - A JM - Process Parameters and Response Characteristics take - home assignment discussing

Lecture 15 - A JM - MCQs

Lecture 16

Lecture 17 - AWJM - Equipment

Lecture 18 - AWJM - Numerical Problems

Lecture 19 - AWJM - Application Equipment Details

Lecture 20 - AWJM - MCQs

- Lecture 1 - Lagrangian and Eulerian Approach, Types of fluid flow
- Lecture 2 - Streamlines, Streakline and Pathline
- Lecture 3 - Acceleration of fluid flow
- Lecture 4 - Deformation and Conservation of mass of fluid a element
- Lecture 5 - Angular deformation of a fluid element, vorticity and streamfunction and velocity potential
- Lecture 6 - Euler's equation
- Lecture 7 - Bernoulli's Equation - Part I
- Lecture 8 - Bernoulli's Equation - Part II
- Lecture 9 - Reynolds Transport Theorem (RTT)
- Lecture 10 - Application of Conservation of Mass
- Lecture 11 - Application of RTT: Conservation of Linear Momentum
- Lecture 12 - Application of RTT in Accelerating Reference Frames
- Lecture 13 - Navier's Equation of Motion
- Lecture 14 - Derivation of Navier-Stokes Equation
- Lecture 15 - Derivation of Navier-Stokes Equation (Continued...)
- Lecture 16 - Derivation of Navier-Stokes Equation (Continued...)
- Lecture 17 - Fully developed flow between two parallel plates
- Lecture 18 - Force on a surface immersed in fluid - Part III, Stability of solid bodies in fluid - Part I
- Lecture 19 - Couette flow
- Lecture 20 - Flow with interfaces
- Lecture 21 - Thin film flow on an inclined plane and Hagen-Poiseuille flow
- Lecture 22 - Hagen-Poiseuille flow (Continued...)
- Lecture 23 - Flow between two rotating cylinders
- Lecture 24 - Stokes 1st problem
- Lecture 25 - Stokes 2nd problem
- Lecture 26 - Introduction to turbulence: basic concepts
- Lecture 27 - Eddies
- Lecture 28 - Eddies (Continued...) and Vortex shredding
- Lecture 29 - Statistical description of turbulent flows
- Lecture 30 - Reynolds stress
- Lecture 31 - Reynolds averaged Navier Stokes equation (RANS)

- Lecture 32 - Bernoulli's equation - Part I
- Lecture 33 - Bernoulli's equation - Part II
- Lecture 34 - Bernoulli's equation - Part III
- Lecture 35 - Euler's equation in streamline coordinates
- Lecture 36 - Flow over a flat plate: Blasius equation
- Lecture 37 - Momentum integral method for boundary layer analysis
- Lecture 38 - Approximate solution of the momentum integral equation
- Lecture 39 - Displacement and Momentum thickness
- Lecture 40 - Illustrative examples
- Lecture 41 - Boundary layer separation
- Lecture 42 - Resultant force on a body immersed in a fluid under motion
- Lecture 43 - Potential flow
- Lecture 44 - Examples of Potential flow
- Lecture 45 - Some more examples of Potential flows, Lift and Drag force
- Lecture 46 - Applications of lift and drag force
- Lecture 47 - Some examples of flow past immersed bodies
- Lecture 48 - Sports Ball aerodynamics
- Lecture 49 - Introduction to compressible flows
- Lecture 50 - Significance of Mach number
- Lecture 51 - Navier-Stokes equation - Part I
- Lecture 52 - Navier-Stokes equation - Part II
- Lecture 53 - Navier-Stokes equation - Part III
- Lecture 54 - Navier-Stokes equation - Part IV
- Lecture 55 - Pipe Flow - Part I
- Lecture 56 - Pipe Flow - Part II
- Lecture 57 - Pipe Flow - Part III
- Lecture 58 - Pipe Flow - Part IV
- Lecture 59 - Principle of Similarity and Dynamical Analysis - Part I
- Lecture 60 - Principle of Similarity and Dynamical Analysis - Part II

Lecture 1 - Introduction

Lecture 2 - Simple Gear Calculations

Lecture 3 - Gear Geometry

Lecture 4 - Helical Gear Problems

Lecture 5 - Numerical Problem MCQ

Lecture 6 - Numerical Problem Milling of Helical Gears

Lecture 7 - Simple and Compound Indexing

Lecture 8 - Differential Indexing

Lecture 9 - Helical Gear Cutting on Milling Machine

Lecture 10 - Numerical Problems on Gear Milling

Lecture 11 - Gear Shaping - I

Lecture 12 - Gear Shaping - II

Lecture 13 - Gear Shaping - III

Lecture 14 - Gear Shaping - IV

Lecture 15 - Gear Hobbing - I

Lecture 16 - Gear Hobbing - II

Lecture 17 - Gear Hobbing - III

Lecture 18 - Gear Hobbing - IV

Lecture 19 - Gear Hobbing - V

Lecture 20 - Gear Hobbing - VI

Lecture 1 - Introduction, Definition of System, Properties and State of a System

Lecture 2 - Properties of pure substances

Lecture 3 - Properties of pure substances (Continued...)

Lecture 4 - Heat and Work

Lecture 5 - Tutorial 1: Properties of pure substances, heat and work

Lecture 6 - Zeroth Law of Thermodynamics

Lecture 7 - First law of thermodynamics for closed systems - Part I

Lecture 8 - First law of thermodynamics for closed systems - Part II, some examples

Lecture 9 - Tutorial 2: First law of thermodynamics for closed systems

Lecture 10 - First law of thermodynamics for open systems

Lecture 11 - Tutorial 3: First law of thermodynamics for open systems

Lecture 12 - Second law and its corollaries - Part I

Lecture 13 - Second law and its corollaries - Part II

Lecture 14 - Second law and its corollaries - Part III

Lecture 15 - Definition of entropy and entropy change in closed systems

Lecture 16 - Entropy change in closed systems (Continued...)

Lecture 17 - Tutorial 4: Entropy

Lecture 18 - Entropy and its transport

Lecture 19 - Tutorial 5: Entropy and its transport

Lecture 20 - Introduction to Third Law

Lecture 21 - Review of learning concepts

Lecture 1 - Introduction to waste heat recovery

Lecture 2 - Introduction to waste heat recovery (Continued...)

Lecture 3 - Introduction to waste heat recovery (Continued...)

Lecture 4 - Introduction to waste heat recovery (Continued...)

Lecture 5 - Thermodynamic principles of waste heat recovery

Lecture 6 - Thermodynamic principles of waste heat recovery (Continued...)

Lecture 7 - Thermodynamic principles of waste heat recovery (Continued...)

Lecture 8 - Thermodynamic principles of waste heat recovery (Continued...)

Lecture 9 - Reversible Cycles

Lecture 10 - Reversible Cycles (Continued...)

Lecture 11 - Entropy

Lecture 12 - Entropy (Continued...)

Lecture 13 - Entropy (Continued...), Exergy

Lecture 14 - Exergy, Second Law efficiency

Lecture 15 - Second Law efficiency (Continued...)

Lecture 16 - Recapitulation of common power cycles

Lecture 17 - Recapitulation of common power cycles (Continued...)

Lecture 18 - Recapitulation of common power cycles (Continued...)

Lecture 19 - Recapitulation of common power cycles (Continued...)

Lecture 20 - Recapitulation of common power cycles (Continued...)

Lecture 21 - Recapitulation of common power cycles (Continued...)

Lecture 22 - Gas Turbine cycle

Lecture 23 - Combined cycle

Lecture 24 - Combined cycle (Continued...)

Lecture 25 - Combined Cycle (Continued...)

Lecture 26 - Heat recovery steam generator

Lecture 27 - Thermodynamic cycles for low temperature application

Lecture 28 - Thermodynamic cycles for low temperature application (Continued...), Cogeneration

Lecture 29 - Heat Exchanger

Lecture 30 - Heat Exchanger (Continued...)

Lecture 31 - Heat Exchanger (Continued...)

[Lecture 32](#)

[Lecture 33](#)

[Lecture 34](#)

[Lecture 35](#)

[Lecture 36](#)

[Lecture 37 - Heat Pipe - Part I](#)

[Lecture 38 - Heat Pipe - Part II](#)

[Lecture 39 - Heat Pipe - Part III](#)

[Lecture 40 - Direct Conversion - Introduction to TEG](#)

[Lecture 41 - Thermoelectric Generators - Functioning and Applications](#)

[Lecture 42 - TEG - performance analysis](#)

[Lecture 43 - TEG - performance optimization](#)

[Lecture 44 - Direct Conversion - Magneto Hydro dynamics \(MHD\)](#)

[Lecture 45 - Direct Conversion - Thermo-Ionic generation](#)

[Lecture 46 - Direct Conversion - Thermo Photo Voltaic generation \(TPV\)](#)

[Lecture 47 - Heat Pumps - I](#)

[Lecture 48 - Heat Pumps - II](#)

[Lecture 49 - Heat Pumps - III](#)

[Lecture 50 - Waste Heat Recovery from Incinerator Plants](#)

[Lecture 51 - Energy Storage Systems - I](#)

[Lecture 52 - Energy Storage Systems - II](#)

[Lecture 53 - Energy Storage Systems - III](#)

[Lecture 54 - Energy Storage Systems - IV](#)

[Lecture 55 - Energy Storage Systems - V](#)

[Lecture 56 - Energy Storage Systems - VI](#)

[Lecture 57](#)

[Lecture 58](#)

[Lecture 59](#)

[Lecture 60](#)

[Lecture 61](#)

[Lecture 62](#)

[Lecture 63](#)

[Lecture 64](#)



[Lecture 65](#)

[Lecture 66](#)

[Lecture 67](#)

[Lecture 68 - Corrigendum](#)

[Lecture 1 - Introduction](#)

[Lecture 2 - Introduction \(Continued...\)](#)

[Lecture 3 - Introduction \(Continued...\)](#)

[Lecture 4 - Introduction \(Continued...\)](#)

[Lecture 5 - Introduction \(Continued...\)](#)

[Lecture 6 - Introduction \(Continued...\)](#)

[Lecture 7 - Scaling Laws](#)

[Lecture 8 - Scaling laws \(Continued...\)](#)

[Lecture 9 - Scaling laws \(Continued...\)](#)

[Lecture 10 - Difference between macro and micro machining](#)

[Lecture 11 - Difference between macro and micro machining \(Continued...\)](#)

[Lecture 12 - Difference between micro and macro machining \(Continued...\)](#)

[Lecture 13 - Difference between micro and macro machining \(Continued...\)](#)

[Lecture 14 - Difference between macro and micro machining \(Continued...\)](#)

[Lecture 15 - Difference between macro and micro machining \(Continued...\)](#)

[Lecture 16 - Difference between macro and micro machining \(Continued...\)](#)

[Lecture 17 - Difference between macro and micro machining \(Continued...\)](#)

[Lecture 18 - Difference between macro and micro machining \(Continued...\)](#)

[Lecture 19 - Difference between macro and micro machining \(Continued...\)](#)

[Lecture 20 - Difference between macro and micro machining \(Continued...\)](#)

[Lecture 21 - Difference between macro and micro machining \(Continued...\)](#)

[Lecture 22 - Component of the machine tool](#)

[Lecture 23 - Components of the machine tool \(Continued...\)](#)

[Lecture 24 - Components of the machine tool \(Continued...\)](#)

[Lecture 25 - Components of the machine tool \(Continued...\)](#)

[Lecture 26 - Components of the machine tool \(Continued...\)](#)

[Lecture 27 - Errors in machine tool \(Continued...\)](#)

[Lecture 28 - Errors in machine tool \(Continued...\)](#)

[Lecture 29 - Errors in machine tool \(Continued...\)](#)

[Lecture 30 - Errors in machine tool \(Continued...\)](#)

[Lecture 31 - Components of machine tool](#)

- [Lecture 32 - Components of machine tool \(Continued...\)](#)
- [Lecture 33 - Components of machine tool \(Continued...\)](#)
- [Lecture 34 - Components of machine tool \(Continued...\)](#)
- [Lecture 35 - Components of machine tool \(Continued...\)](#)
- [Lecture 36 - Components of machine tool \(Continued...\)](#)
- [Lecture 37 - Components of machine tool \(Continued...\)](#)
- [Lecture 38 - Components of machine tool \(Continued...\)](#)
- [Lecture 39 - Components of machine tool \(Continued...\)](#)
- [Lecture 40 - Components of machine tool \(Continued...\)](#)
- [Lecture 41 - Components of machine tool \(Continued...\)](#)
- [Lecture 42 - Components of machine tool \(Continued...\)](#)
- [Lecture 43 - Components of machine tool \(Continued...\)](#)
- [Lecture 44 - Components of machine tool \(Continued...\)](#)
- [Lecture 45 - Components of machine tool \(Continued...\)](#)
- [Lecture 46 - Components of machine tool \(Continued...\)](#)
- [Lecture 47 - Components of machine tool \(Continued...\)](#)
- [Lecture 48 - Components of machine tool \(Continued...\)](#)
- [Lecture 49 - Micro tools](#)
- [Lecture 50 - Micro tools \(Continued...\)](#)
- [Lecture 51 - Micro tools \(Continued...\)](#)
- [Lecture 52 - Fabrication of micro tool by EDM process](#)
- [Lecture 53 - Micro tools \(Continued...\)](#)
- [Lecture 54 - Micro machines](#)
- [Lecture 55 - Micro machines \(Continued...\)](#)
- [Lecture 56 - Diamond turning](#)
- [Lecture 57 - Diamond turning \(Continued...\)](#)
- [Lecture 58 - Diamond turning \(Continued...\)](#)
- [Lecture 59 - Diamond turning \(Continued...\)](#)
- [Lecture 60 - Sensors and metrology for micro machining](#)
- [Lecture 61 - Sensors and metrology for micro machining \(Continued...\)](#)
- [Lecture 62 - Sensors and metrology for micro machining \(Continued...\)](#)
- [Lecture 63 - 3D surface measurement using interferometer](#)

Lecture 1 - Introduction

Lecture 2 - Maintenance Principles

Lecture 3 - FMECA

Lecture 4 - Fault Diagnostics and Prognostics

Lecture 5 - Machine Learning in CBM

Lecture 6 - Basics of Vibration

Lecture 7 - Free and Forced Response

Lecture 8 - Vibration and Shock Isolation

Lecture 9 - Rotordynamics

Lecture 10 - Practical Examples of Vibration

Lecture 11 - Time Domain Analysis

Lecture 12 - Frequency Domain Analysis

Lecture 13 - Non Stationary Signal Analysis

Lecture 14 - Modulation and Beats

Lecture 15 - Orbit and Order Analysis

Lecture 16 - Computer aided data acquisition

Lecture 17 - Orbit and Order Analysis

Lecture 18 - Data Recording

Lecture 19 - Cepstrum Analysis

Lecture 20 - Hilbert Transform in Condition Monitoring

Lecture 21 - Introduction to MATLAB

Lecture 22 - Signal Processing using MATLAB

Lecture 23 - Numericals in Signal Processing and Data Acquisition

Lecture 24 - Signal Hetrodnying

Lecture 25 - Practical Signals

Lecture 26 - Basics Of Instrumentation

Lecture 27 - Signal Conditioning And Filtering

Lecture 28 - Errors In Measurements

Lecture 29 - Dynamic Range And Frequency Response

Lecture 30 - Overview Of Transducers For Cbm

Lecture 31 - Accelerometers

- [Lecture 32 - Vibration Monitoring](#)
- [Lecture 33 - Rotational Speed Measurements](#)
- [Lecture 34 - Basics of Noise](#)
- [Lecture 35 - Noise Monitoring](#)
- [Lecture 36 - Introduction to Faults in Rotating Machines](#)
- [Lecture 37 - Unbalance Detection](#)
- [Lecture 38 - Field Balancing](#)
- [Lecture 39 - Misalignment](#)
- [Lecture 40 - Crack and Looseness](#)
- [Lecture 41 - Journal and Anti-Friction Bearings](#)
- [Lecture 42 - Gears](#)
- [Lecture 43 - Pumps and Cavitation](#)
- [Lecture 44 - IC Engines](#)
- [Lecture 45 - Machinery Diagnostic Chart](#)
- [Lecture 46 - Principles of Motor Current Signature Analysis](#)
- [Lecture 47 - Faults in Electrical Machines](#)
- [Lecture 48 - Thermography](#)
- [Lecture 49 - Wear Debris Analysis](#)
- [Lecture 50 - Oil Analysis](#)
- [Lecture 51 - Ultrasonics](#)
- [Lecture 52 - Eddy Current and Acoustic Emission](#)
- [Lecture 53 - Radiography, Dye Penetrant Tests](#)
- [Lecture 54 - Tool Condition Monitoring](#)
- [Lecture 55 - Experimental Modal Analysis](#)
- [Lecture 56 - Introduction to Failure Analysis](#)
- [Lecture 57 - Railway Locomotive Noise and Vibration Monitoring](#)
- [Lecture 58 - Paper Mill Vibration Monitoring](#)
- [Lecture 59 - Overview of CBM facilities at IIT Kharagpur](#)
- [Lecture 60 - Future of Condition based Monitoring](#)

Lecture 1 - Introduction

Lecture 2 - Geometry of single point turning tools - 1

Lecture 3 - Geometry of turning tools - 2

Lecture 4 - Geometry of single point turning tools - 3

Lecture 5 - Geometry of cutting tools and numerical problems

Lecture 6 - Different types of tools and mcq

Lecture 7 - Mechanism of chip formation

Lecture 8 - Mechanics of material removal

Lecture 9 - Measurement of Cutting Forces

Lecture 10 - Numerical problems and MCQ

Lecture 11 - Tool wear and Tool life

Lecture 12 - Wear and life of cutting tools - 2

Lecture 13 - The lathe

Lecture 14 - Calculations on mechanisms in machine tools

Lecture 15 - Numerical problems on lathe

Lecture 16 - Milling machines

Lecture 17 - Milling machine - indexing

Lecture 18 - Gear cutting CNC and non traditional machining

Lecture 19 - CNC and non-traditional machining methods

Lecture 20 - Numerical problems for week 4

Lecture 21 - Live Session

Lecture 1 - Introduction - Motivation and Theme of the Course

Lecture 2 - Laws of Gearing, Kinematics and Geometry - Part I

Lecture 3 - Laws of Gearing, Kinematics and Geometry - Part II

Lecture 4 - Involute Toothed Gear- Properties and Terminology

Lecture 5 - Tutorial

Lecture 6 - Involute Straight Tooth Spur Gear

Lecture 7 - Helical Tooth Spur Gear and Loads on Gear Shaft

Lecture 8 - Design of Bevel Gear

Lecture 9 - Crossed Helical Gear - I

Lecture 10 - Crossed Helical Gear - II and Worm Gear

Lecture 11 - Gear Unit Design - Selection of Stage Ratios, Pinion and Gear Teeth Numbers

Lecture 12 - Gear Unit Design - First Stage Pinion and Gear Design- I (Module on Beam Strength Basis)

Lecture 13 - Gear Unit Design - Failure of Gear Tooth (Probable Dynamic Load and Wear Load Capacity)

Lecture 14 - Gear Unit Design - 1st. Stage Pinion and Gear Design-II (Probable Dynamic Load and Wear Load Capacity and Finalizing 1st. Stage Pinion and Gear set)

Lecture 15 - Gear Unit Design - 1st. Layout (After Gear Design)

Lecture 16 - Bearing Arrangement - Gear Box Shafts

Lecture 17 - Bearing Load Calculation - Intermediate Shaft

Lecture 18 - Bearing Selection and Introduction to Shaft Design Verification

Lecture 19 - Design Verification of Gear Box Shafts

Lecture 20 - Development (Layout) of Intermediate Shaft

Lecture 21 - Development (Layout) of Input Shaft and Integral Pinion

Lecture 22 - Development (Layout) of Output Shaft and 2nd. Stage (Output) Gear

Lecture 23 - Development (Layout) of Output Shaft (Continued...), Loads on Shaft and Bearings

Lecture 24 - Output Shaft-Bearing Lives

Lecture 25 - Design Verification of Output Shaft

Lecture 26 - Design Verification of Input Shaft (including Bearing Life Estimation)

Lecture 27 - Finalizing Design including the Sizes of the Keys

Lecture 28 - Development of Plan and Elevation of Gear Reduction Unit - I

Lecture 29 - Development of Plan and Elevation of Gear Reduction Unit - II

Lecture 30 - Development of Plan and Elevation of Gear Reduction Unit - III

[Lecture 31](#)

[Lecture 32](#)

[Lecture 33 - Involute Spur Gear Tooth Correction : Part I](#)

[Lecture 34 - Involute Spur Gear Tooth Correction : Part II](#)

[Lecture 35 - Involute Spur Gear Tooth Correction : Part III](#)

[Lecture 36 - Involute Spur Gear Tooth Correction : Tutorial \(Workout Example\)](#)

[Lecture 37 - Involute Spur Gear Tooth Correction : Tutorial \(Workout Example-2\)](#)

[Lecture 38 - Tooth Tip Interference, Avoidance and Contact Ratio in Involute Internal Gearing](#)

[Lecture 39](#)

[Lecture 40](#)

[Lecture 41](#)

[Lecture 42](#)

[Lecture 43](#)

[Lecture 44](#)

[Lecture 45 - Live Session](#)



Lecture 1 - Principle of Optimization

Lecture 2 - Traditional Methods of Optimization

Lecture 3 - Traditional Methods of Optimization (Continued...)

Lecture 4 - Binary-Coded Genetic Algorithm (BCGA)

Lecture 5 - Binary-Coded Genetic Algorithm (BCGA) (Continued...)

Lecture 6 - Binary-Coded Genetic Algorithm (BCGA) (Continued...)

Lecture 7 - Binary-Coded Genetic Algorithm (BCGA) (Continued...)

Lecture 8 - Binary-Coded Genetic Algorithm (BCGA) (Continued...)

Lecture 9 - Schema Theorem of BCGA

Lecture 10 - Schema Theorem of BCGA (Continued...)

Lecture 11 - Constraint Handling

Lecture 12 - Real-Coded GA

Lecture 13 - Faster Genetic Algorithms

Lecture 14 - Faster Genetic Algorithms (Continued...)

Lecture 15 - Faster Genetic Algorithms (Continued...)

Lecture 16 - Faster Genetic Algorithms (Continued...)

Lecture 17 - Scheduling GA

Lecture 18 - Scheduling GA (Continued...)

Lecture 19 - Scheduling GA (Continued...)

Lecture 20 - Simulated Annealing

Lecture 21 - Particle Swarm Optimization

Lecture 22 - Multi-Objective Optimization

Lecture 23 - Multi-Objective Optimization (Continued...)

Lecture 24 - Multi-Objective Optimization (Continued...)

Lecture 25 - Multi-Objective Optimization (Continued...)

Lecture 26 - Multi-Objective Optimization (Continued...)

Lecture 27 - Intelligent Optimization Toolture

Lecture 28 - A Practical Optimization Problem

Lecture 29 - A Practical Optimization Problem (Continued...)

Lecture 30 - A Practical Optimization Problem (Continued...)

Lecture 31 - A Practical Optimization Problem (Continued...)

[Lecture 32 - A Practical Optimization Problem \(Continued...\)](#)

[Lecture 33 - A Practical Optimization Problem \(Continued...\)](#)

[Lecture 34 - A Practical Optimization Problem \(Continued...\)](#)

[Lecture 35 - A Practical Optimization Problem \(Continued...\)](#)

[Lecture 36 - A Practical Optimization Problem \(Continued...\)](#)

[Lecture 37 - Genetic Algorithm as Evolution Tool](#)

[Lecture 38 - Genetic Algorithm as Evolution Tool \(Continued...\)](#)

[Lecture 39 - Genetic Algorithm as Evolution Tool \(Continued...\)](#)

[Lecture 40 - Genetic Algorithm as Evolution Tool \(Continued...\)](#)

[Lecture 41 - Genetic Algorithm as Evolution Tool \(Continued...\)](#)

[Lecture 42 - Genetic Algorithm as Evolution Tool \(Continued...\)](#)

[Lecture 43 - Summary 1](#)

[Lecture 44 - Summary 2](#)

[Lecture 45 - Summary 3](#)

Lecture 1 - Introduction

Lecture 2 - Nomenclature

Lecture 3 - Kinematic Diagram

Lecture 4 - Degree of Freedom - I

Lecture 5 - Degree of Freedom - II

Lecture 6 - Degree of Freedom - Failure

Lecture 7 - Grashof Criteria - I

Lecture 8 - Grashof Criteria - II

Lecture 9 - Geometry and Representation of Vectors

Lecture 10 - Displacement Analysis: constrained mechanism - I

Lecture 11 - Displacement Analysis: constrained mechanism - II

Lecture 12 - Displacement Analysis: constrained mechanism - III

Lecture 13 - Displacement Analysis: constrained mechanism - IV

Lecture 14 - Displacement Analysis: open chain robot - I

Lecture 15 - Displacement Analysis: open chain robot - II

Lecture 16 - Displacement Analysis: open chain robot - III

Lecture 17 - Displacement Analysis: open chain robot - IV

Lecture 18 - Displacement Analysis: closed chain robot - I

Lecture 19 - Displacement Analysis: closed chain robot - II

Lecture 20 - Velocity Analysis: geometric concepts - I

Lecture 21 - Velocity Analysis: geometric concepts - II

Lecture 22 - Velocity Analysis: geometric concepts - III

Lecture 23 - Velocity Analysis: application of geometric concepts - I

Lecture 24 - Velocity Analysis: application of geometric concepts - II

Lecture 25 - Velocity Analysis: application of geometric concepts - III

Lecture 26 - Velocity Analysis: analytical approach - I

Lecture 27 - Velocity Analysis: analytical approach - II

Lecture 28 - Velocity Analysis: analytical approach - III

Lecture 29 - Serial Manipulator Velocity Analysis - I

Lecture 30 - Serial Manipulator Velocity Analysis - II

Lecture 31 - Serial Manipulator Velocity Analysis - III

[Lecture 32 - Parallel Manipulator Velocity Analysis](#)

[Lecture 33 - Path Generation Problem](#)

[Lecture 34 - Acceleration Analysis - I](#)

[Lecture 35 - Acceleration Analysis - II](#)

[Lecture 36 - Force Analysis - I](#)

[Lecture 37 - Force Analysis - II](#)

[Lecture 38 - Coordinate transformation - I](#)

[Lecture 39 - Coordinate transformation - II](#)

[Lecture 40 - Coordinate transformation - III](#)

Lecture 1 - Introduction

Lecture 2 - Applications of Heat Exchangers

Lecture 3 - Classification of Heat Exchangers

Lecture 4 - Classification of Heat Exchangers (Continued...)

Lecture 5 - Design and Simulation of Heat Exchangers

Lecture 6 - Design and Simulation

Lecture 7 - Design and Simulation of Heat Exchangers - Numerical Problem

Lecture 8 - Design and Simulation of Heat Exchangers - Numerical Problem (Continued...)

Lecture 9 - Design and Simulation of Heat Exchangers - Numerical Problem (Continued...)

Lecture 10 - Tubular Heat Exchanger Types

Lecture 11 - Tubular Heat Exchanger Types : Heat Transfer Co-efficient

Lecture 12 - Tubular Heat Exchanger : Double Pipe

Lecture 13 - Tubular Heat Exchanger : Shell - and - Tube

Lecture 14 - Tubular Heat Exchanger : Shell - and - Tube Design

Lecture 15 - Tubular Heat Exchanger : Shell - and - Tube Design (Continued...)

Lecture 16 - Enhancement of Heat Transfer compact Heat Exchangers

Lecture 17 - Extended Surface Heat Transfer

Lecture 18 - Extended Surface Heat Transfer: Some Example

Lecture 19 - Extended Surface Heat Exchangers: Some Example

Lecture 20 - Analysis of fin plates of finned tube heat exchanger

Lecture 21 - Finned tube heat exchanger

Lecture 22 - Finned tube heat exchanger (Continued...)

Lecture 23 - Finned tube heat exchanger (Continued...)

Lecture 24 - Plate fin heat exchanger

Lecture 25 - Plate fin heat exchanger (Continued...)

Lecture 26 - Plate fin heat exchanger (Continued...)

Lecture 27 - Plate fin heat exchanger : Analysis

Lecture 28 - Plate fin heat exchanger : Pressure drop

Lecture 29 - Plate fin heat exchanger : Numerical

Lecture 30 - Plate fin heat exchanger : Numerical (Continued...)

Lecture 31 - Plate fin heat exchanger : Numerical (Continued...)

- [Lecture 32 - Plate fin heat exchanger : Multistream](#)
- [Lecture 33 - Plate fin heat exchanger : Multistream \(Continued...\)](#)
- [Lecture 34 - Plate fin heat exchanger : Multistream Analysis](#)
- [Lecture 35 - Plate fin heat exchanger : Layer Stacking](#)
- [Lecture 36 - Phase change heat exchangers](#)
- [Lecture 37 - Phase change heat exchangers \(Continued...\)](#)
- [Lecture 38 - Surface Condenser](#)
- [Lecture 39 - Surface Condenser \(Continued...\)](#)
- [Lecture 40 - Surface Condenser \(Continued...\)](#)
- [Lecture 41 - Surface Condenser \(Continued...\)](#)
- [Lecture 42 - In tube condensation](#)
- [Lecture 43 - Heat pipes and Heat pipe heat exchangers](#)
- [Lecture 44 - Heat pipes and Heat pipe heat exchangers \(Continued...\)](#)
- [Lecture 45 - Heat pipes and Heat exchangers](#)
- [Lecture 46 - Heat pipes and Heat exchangers \(Continued...\)](#)
- [Lecture 47 - Micro Heat Exchanger Introduction](#)
- [Lecture 48 - Micro scale Heat Transfer](#)
- [Lecture 49 - Micro scale Heat Transfer \(Continued...\)](#)
- [Lecture 50 - Micro Channel](#)
- [Lecture 51 - Micro Heat Exchanger](#)
- [Lecture 52 - Regenerators](#)
- [Lecture 53 - Fixed Bed Regenerator Analysis](#)
- [Lecture 54 - Design and Simulation of Regenerator \(Fixed Bed\)](#)
- [Lecture 55 - Fixed Bed Regenerator \(Numerical\)](#)
- [Lecture 56 - Fixed Bed Regenerator \(Numerical\) \(Continued...\)](#)
- [Lecture 57 - Fouling in Heat Exchangers](#)
- [Lecture 58 - Fouling in Heat Exchangers \(Continued...\)](#)
- [Lecture 59 - Fouling in Heat Exchangers \(Continued...\)](#)
- [Lecture 60 - Direct Contact heat exchanger](#)
- [Lecture 61 - Direct Contact heat exchanger \(Continued...\)](#)
- [Lecture 62 - Heat exchanger network synthesis](#)
- [Lecture 63 - Heat exchanger network](#)
- [Lecture 64 - Heat exchanger network \(Continued...\)](#)

[Lecture 65 - Heat Exchanger Testing](#)

[Lecture 66 - Heat Exchanger Testing \(Continued...\)](#)

- Lecture 1 - Introduction to Robots and Robotics
- Lecture 2 - Introduction to Robots and Robotics (Continued...)
- Lecture 3 - Introduction to Robots and Robotics (Continued...)
- Lecture 4 - Introduction to Robots and Robotics (Continued...)
- Lecture 5 - Introduction to Robots and Robotics (Continued...)
- Lecture 6 - Introduction to Robots and Robotics (Continued...)
- Lecture 7 - Introduction to Robots and Robotics (Continued...)
- Lecture 8 - Introduction to Robots and Robotics (Continued...)
- Lecture 9 - Introduction to Robots and Robotics (Continued...)
- Lecture 10 - Introduction to Robots and Robotics (Continued...)
- Lecture 11 - Robot Kinematics
- Lecture 12 - Robot Kinematics (Continued...)
- Lecture 13 - Robot Kinematics (Continued...)
- Lecture 14 - Robot Kinematics (Continued...)
- Lecture 15 - Robot Kinematics (Continued...)
- Lecture 16 - Robot Kinematics (Continued...)
- Lecture 17 - Robot Kinematics (Continued...)
- Lecture 18 - Robot Kinematics (Continued...)
- Lecture 19 - Robot Kinematics (Continued...)
- Lecture 20 - Robot Kinematics (Continued...)
- Lecture 21 - Trajectory Planning
- Lecture 22 - Trajectory Planning (Continued...)
- Lecture 23 - Singularity Checking
- Lecture 24 - Robot Dynamics
- Lecture 25 - Robot Dynamics (Continued...)
- Lecture 26 - Robot Dynamics (Continued...)
- Lecture 27 - Robot Dynamics (Continued...)
- Lecture 28 - Robot Dynamics (Continued...)
- Lecture 29 - Robot Dynamics (Continued...)
- Lecture 30 - Control Scheme
- Lecture 31 - Sensors



[Lecture 32 - Sensors \(Continued...\)](#)

[Lecture 33 - Sensors \(Continued...\)](#)

[Lecture 34 - Robot Vision](#)

[Lecture 35 - Robot Vision \(Continued...\)](#)

[Lecture 36 - Robot Vision \(Continued...\)](#)

[Lecture 37 - Robot Motion Planning](#)

[Lecture 38 - Robot Motion Planning \(Continued...\)](#)

[Lecture 39 - Robot Motion Planning \(Continued...\)](#)

[Lecture 40 - Robot Motion Planning \(Continued...\)](#)

[Lecture 41 - Intelligent Robot](#)

[Lecture 42 - Biped Walking](#)

[Lecture 43 - Biped Walking \(Continued...\)](#)

[Lecture 44 - Summary](#)

[Lecture 45 - Summary \(Continued...\)](#)

Lecture 1 - Introduction to CFD

Lecture 2 - Classification of partial differential equations

Lecture 3 - Examples of partial differential equations

Lecture 4 - Examples of partial differential equations (Continued...)

Lecture 5 - Nature of the characteristics of partial differential equation

Lecture 6 - Euler-Lagrangian equation

Lecture 7 - Approximate Solutions of Differential Equations

Lecture 8 - Variational formulation

Lecture 9 - Example of variational formulation and introduction to weighted residual method

Lecture 10 - Weighted residual method (Continued...)

Lecture 11 - Point Collocation method, the Galerkin's method and the 'M' form

Lecture 12 - Finite element method (FEM) of discretization

Lecture 13 - Finite element method of discretization (Continued...)

Lecture 14 - Finite difference method (FDM) of discretization

Lecture 15 - Well posed boundary value problem

Lecture 16 - Finite volume method (FVM) of discretization

Lecture 17 - Illustrative examples of finite volume method

Lecture 18 - Illustrative examples of finite volume method (Continued...)

Lecture 19 - Basic rules of finite volume discretization

Lecture 20 - Implementation of boundary conditions in FVM

Lecture 21 - Implementation of boundary conditions in FVM (Continued...)

Lecture 22 - 1-D Unsteady state diffusion problem

Lecture 23 - 1-D Unsteady state diffusion problem (Continued...)

Lecture 24 - Consequences of Discretization of Unsteady State Problems

Lecture 25 - FTCS scheme

Lecture 26 - CTCS scheme (Leap frog scheme) and Dufort-Frankel scheme

Lecture 27 - Part 1: FV Discretization of 2-D Unsteady State Diffusion Type problems; Part 2: Solution to linear algebraic equations

Lecture 28 - Solution to linear algebraic equations (Continued...)

Lecture 29 - Elimination methods

Lecture 30 - Gaussian elimination and LU Decomposition methods

Lecture 31 - Illustrative example of elimination method

- Lecture 32 - Tri-Diagonal Matrix Algorithm (TDMA)
- Lecture 33 - Elimination Methods: Error Analysis
- Lecture 34 - Elimination Methods: Error Analysis (Continued...)
- Lecture 35 - Iteration methods
- Lecture 36 - Generalized analysis of Iteration method
- Lecture 37 - Further discussion on Iterative methods
- Lecture 38 - Illustrative examples of Iterative methods
- Lecture 39 - Gradient Search based methods
- Lecture 40 - Steepest descent method (Continued...)
- Lecture 41 - Conjugate gradient method
- Lecture 42 - Convection diffusion equation
- Lecture 43 - Central difference scheme applied to convection-diffusion equation
- Lecture 44 - Upwind scheme
- Lecture 45 - Illustrative examples
- Lecture 46 - Exact solution of 1-D steady state convection diffusion equation (Continued...)
- Lecture 47 - Exponential scheme
- Lecture 48 - Generalized convection diffusion formulation
- Lecture 49 - 2-D convection diffusion problem
- Lecture 50 - False (numerical) diffusion scheme and the QUICK scheme
- Lecture 51 - Discretization of Navier Stokes equation
- Lecture 52 - Discretization of Navier Stokes equation (Continued...)
- Lecture 53 - Concept of staggered grid
- Lecture 54 - SIMPLE algorithm
- Lecture 55 - Salient features of SIMPLE algorithm
- Lecture 56 - Illustrative examples on the use of SIMPLE algorithm
- Lecture 57 - SIMPLER algorithm
- Lecture 58 - Illustrative examples of SIMPLER algorithm
- Lecture 59 - What is there in implementing a CFD Code
- Lecture 60 - Some representative case studies

Lecture 1 - Introductory Concepts

Lecture 2 - Properties of Pure Substances

Lecture 3 - Properties of Pure Substances (Continued...)

Lecture 4 - Introduction to Property Tables

Lecture 5 - Properties of Pure Substances: Example problems (Continued...)

Lecture 6 - Properties of Pure Substances: Example problems (Continued...)

Lecture 7 - Use of Computer as Means of Learning Thermodynamics

Lecture 8 - Properties of Pure Substances (Continued...)

Lecture 9 - Properties of Pure Substances Spring - Piston Problem

Lecture 10 - Heat and Work

Lecture 11 - Heat and Work : Representative Problems

Lecture 12 - Heat and Work : Representative Problems (Continued...)

Lecture 13 - Heat and Work : Representative Problems (Continued...)

Lecture 14 - First Law of Thermodynamics for a Control Mass System

Lecture 15 - Enthalpy and Specific Heats

Lecture 16 - First Law for a Control Mass System : Representative Examples

Lecture 17 - First Law for a Control Mass System : Representative Examples (Continued...)

Lecture 18 - First Law for a Control Mass System : Representative Examples (Continued...)

Lecture 19 - Control Volume Conservation Reynolds Transport Theorem

Lecture 20 - Control Volume Mass and Energy Balance

Lecture 21 - Supplementary Lecture: Problem solving with the aid of a computer

Lecture 22 - First Law for Steady State Steady Flow (SSSF) Process

Lecture 23 - First Law for SSSF Process : Example Problem

Lecture 24 - First Law for SSSF Process : Example Problem (Continued...)

Lecture 25 - First Law for SSSF Process : Example Problem (Continued...)

Lecture 26 - First Law for SSSF Process : Example Problem (Continued...)

Lecture 27 - Supplementary Lecture: Problem solving with the aid of a computer

Lecture 28 - First Law of Thermodynamics for Unsteady Processes in a Control Volume

Lecture 29 - First Law for Unsteady Problems - Examples

Lecture 30 - First Law for Unsteady Problems - Examples (Continued...)

Lecture 31 - First Law for Unsteady Problems - Examples (Continued...)

- Lecture 32 - Supplementary Lecture : Problem Solving with the Aid of a Computer
- Lecture 33 - Introduction to Second Law of Thermodynamics
- Lecture 34 - Statements of the Second Law of Thermodynamics
- Lecture 35 - Perpetual Motion Machines; Reversible and Irreversible Processes
- Lecture 36 - Factors for Irreversibility and Introduction to Reversible Cycles
- Lecture 37 - Carnot Theorem and Absolute Temperature Scale
- Lecture 38 - Second Law: Illustrative Problems
- Lecture 39 - Clausius Inequality and Introduction to Entropy
- Lecture 40 - Thermodynamic Property Relationships; Entropy change for Solids, Liquids and Ideal gases
- Lecture 41 - Entropy balance for Reversible and Irreversible Processes
- Lecture 42 - What is Entropy ?
- Lecture 43 - Entropy Change in closed system: Examples
- Lecture 44 - Entropy Change in closed system: Examples
- Lecture 45 - Supplementary Lecture: Problem solving with the aid of a computer
- Lecture 46 - Supplementary Lecture: Problem solving with the aid of a computer
- Lecture 47 - Entropy Transport for a flow process
- Lecture 48 - Entropy Transport for flow process: Examples
- Lecture 49 - Entropy Transport for flow process: Examples
- Lecture 50 - Entropy Transport for flow process: Examples
- Lecture 51 - Entropy Transport for flow process: Examples
- Lecture 52 - Supplementary Lecture: Problem solving with the aid of a computer
- Lecture 53 - Exergy (Availability)
- Lecture 54 - Exergy (Availability) (Continued...)
- Lecture 55 - Exergy Analysis : Examples
- Lecture 56 - Exergy Analysis : Examples (Continued...)
- Lecture 57 - Thermodynamic Relationships
- Lecture 58 - Thermodynamic Relationships (Continued...)
- Lecture 59 - Otto Cycle
- Lecture 60 - Diesel Cycle
- Lecture 61 - Example Problems : Otto Cycle and Diesel Cycle
- Lecture 62 - Brayton Cycle
- Lecture 63 - Carnot Cycle and Rankine Cycle
- Lecture 64 - Carnot Cycle and Rankine Cycle (Continued...)

[Lecture 65 - Vapour Compression Refrigeration Cycle](#)

[Lecture 66 - Review of Learning Concepts](#)

[Lecture 67 - Supplementary Lecture: Problem solving with the aid of a computer](#)

[Lecture 68 - Supplementary Lecture: Problem solving with the aid of a computer](#)

Lecture 1 - Introduction - 1

Lecture 2 - Introduction - 2

Lecture 3 - Introduction - 3

Lecture 4 - Semiconductors and Components - 1

Lecture 5 - Semiconductors and Components - 2

Lecture 6 - 1st Level Packaging - I

Lecture 7 - 1st Level Packaging - II

Lecture 8 - Area Array Packages - I

Lecture 9 - Area Array Packages - II

Lecture 10 - Area Array Packages - III

Lecture 11 - Flip Chip Technology

Lecture 12 - 1st Level Interconnections - I

Lecture 13 - 1st Level Interconnections - II

Lecture 14 - 1st Level Interconnections - III

Lecture 15 - Advanced Packaging

Lecture 16 - 2nd Level Packaging: PCB - I

Lecture 17 - 2nd Level Packaging: PCB - II

Lecture 18 - 2nd Level Packaging: PCB - III

Lecture 19 - 2nd Level Packaging: PCB - IV

Lecture 20 - 2nd Level Packaging: PCB - V

Lecture 21 - System Integration

Lecture 22 - Thermal Management 1: Introduction

Lecture 23 - Thermal Management 2: Concepts

Lecture 24 - Thermal Management 3: Thermal Resistance

Lecture 25 - Thermal Management 4: Heat Sink

Lecture 26 - Thermal Management 5: Heat Sink Characterization

Lecture 27 - Thermal Management 6: Heat Transfer Correlations

Lecture 28 - Thermal Management 7: Practice Problems

Lecture 29 - Thermal Management 8: Thermal Technologies

Lecture 30 - Thermal Management 9: Novel Cooling Technologies

Lecture 31 - Shock and Vibration - 1

[Lecture 32 - Shock and Vibration - 2](#)

[Lecture 33 - Shock and Vibration - 3](#)

[Lecture 34 - Shock and Vibration - 4](#)

[Lecture 35 - Electronic Packaging Reliability - 1](#)

[Lecture 36 - Electronic Packaging Reliability - 2](#)

[Lecture 37 - Electronic Packaging Reliability - 3](#)

[Lecture 38 - Electronic Packaging Reliability - 4](#)

[Lecture 39 - Power Electronics Packaging](#)

[Lecture 40 - Special Topics](#)



Lecture 1 - Introduction and Motivation

Lecture 2 - Nomenclature and Classification

Lecture 3 - Kinematic Diagram

Lecture 4 - Degree of Freedom

Lecture 5 - Constrained and Robotic Mechanisms

Lecture 6 - Failure of DOF Calculation

Lecture 7 - Grashof Criterion - I

Lecture 8 - Grashof Criterion - II

Lecture 9 - Grashof Criterion - Problems

Lecture 10 - Displacement Analysis - I

Lecture 11 - Displacement Analysis - II

Lecture 12 - Displacement Analysis Example - I

Lecture 13 - Displacement Analysis Example - II

Lecture 14 - Steering Mechanisms

Lecture 15 - Displacement Analysis of Robots - I

Lecture 16 - Displacement Analysis of Robots - II

Lecture 17 - Displacement Analysis of Robots - III

Lecture 18 - Geometric Velocity Analysis - I

Lecture 19 - Geometric Velocity Analysis - II

Lecture 20 - Geometric Velocity Analysis - III

Lecture 21 - Velocity Analysis: Method of IC - I

Lecture 22 - Velocity Analysis: Method of IC - II

Lecture 23 - Velocity Analysis: Method of IC - III

Lecture 24 - Analytical Velocity Analysis - I

Lecture 25 - Analytical Velocity Analysis - II

Lecture 26 - Analytical Velocity Analysis - III

Lecture 27 - Velocity Analysis Examples

Lecture 28 - Robot Velocity Analysis - I

Lecture 29 - Robot Velocity Analysis - II

Lecture 30 - Robot Velocity Analysis - III

Lecture 31 - Robot Path Generation

[Lecture 32 - Acceleration Analysis - I](#)

[Lecture 33 - Acceleration Analysis - II](#)

[Lecture 34 - Force Analysis - I](#)

[Lecture 35 - Force Analysis - II](#)

[Lecture 36 - Force Analysis Examples](#)

[Lecture 37 - Gear Kinematics](#)

[Lecture 38 - Gear trains - I](#)

[Lecture 39 - Gear trains - II](#)

[Lecture 40 - Gear trains - III](#)

Lecture 1 - Motivations of studying fluid mechanics

Lecture 2 - Macroscopic and microscopic point of views

Lecture 3 - Concept of traction vector

Lecture 4 - Cauchy's theorem

Lecture 5 - Concept of pressure in a fluid

Lecture 6 - Density, Bulk Modulus, Viscosity

Lecture 7 - Viscosity, Newtonian fluid

Lecture 8 - Kinematic viscosity, Reynolds number

Lecture 9 - Non-Newtonian fluids

Lecture 10 - Some illustrative examples solved

Lecture 11 - Problems and Solutions

Lecture 12 - Surface Tension - Part I

Lecture 13 - Surface Tension - Part II

Lecture 14 - Governing equation of fluid statics

Lecture 15 - Manometers

Lecture 16 - Force on a surface immersed in fluid - Part I

Lecture 17 - Force on a surface immersed in fluid - Part II

Lecture 18 - Force on a surface immersed in fluid - Part III, Stability of solid bodies in fluid - Part I

Lecture 19 - Stability of solid bodies in fluid - Part II

Lecture 20 - Fluid under rigid body motion

Lecture 21 - Lagrangian and Eulerian approaches

Lecture 22 - Concept of different flow lines

Lecture 23 - Acceleration of fluid flow

Lecture 24 - Deformation of fluid elements - Part I

Lecture 25 - Derivation of continuity equation

Lecture 26 - Problems and Solutions

Lecture 27 - Deformation of fluid elements - Part II

Lecture 28 - Deformation of fluid elements - Part III

Lecture 29 - Stream Function

Lecture 30 - Circulation, Velocity Potential

Lecture 31 - Euler's equation

- Lecture 32 - Bernoulli's equation - Part I
- Lecture 33 - Bernoulli's equation - Part II
- Lecture 34 - Bernoulli's equation - Part III
- Lecture 35 - Euler's equation in streamline coordinates
- Lecture 36 - Problems and Solutions
- Lecture 37 - Problems and Solutions
- Lecture 38 - Application of Bernoulli's equation - Part I
- Lecture 39 - Application of Bernoulli's equation - Part II
- Lecture 40 - Application of Bernoulli's equation - Part III
- Lecture 41 - Reynolds Transport Theorem (RTT)
- Lecture 42 - Application of RTT: Conservation of mass
- Lecture 43 - Problems and Solutions
- Lecture 44 - Problems and Solutions
- Lecture 45 - Application of RTT: Conservation of linear momentum
- Lecture 46 - Problems and Solutions
- Lecture 47 - Problems and Solutions
- Lecture 48 - Problems and Solutions
- Lecture 49 - Application of RTT: Conservation of angular momentum
- Lecture 50 - Problems and Solutions
- Lecture 51 - Navier-Stokes equation - Part I
- Lecture 52 - Navier-Stokes equation - Part II
- Lecture 53 - Navier-Stokes equation - Part III
- Lecture 54 - Navier-Stokes equation - Part IV
- Lecture 55 - Pipe Flow - Part I
- Lecture 56 - Pipe Flow - Part II
- Lecture 57 - Pipe Flow - Part III
- Lecture 58 - Pipe Flow - Part IV
- Lecture 59 - Principle of Similarity and Dynamical Analysis - Part I
- Lecture 60 - Principle of Similarity and Dynamical Analysis - Part II

Lecture 1 - Introduction To Conduction

Lecture 2 - 1-D Steady State Conduction

Lecture 3 - Introduction To Convection

Lecture 4 - Conduction Equation:Internal Energy Form

Lecture 5 - Conduction Equation:C-P Form

Lecture 6 - Conduction Equation:Boundary Conditions And Problems

Lecture 7 - 1-D Steady State Conduction

Lecture 8 - Concept Of Thermal Resistance

Lecture 9 - 1-D Steady State Conduction - II

Lecture 10 - 1-D Steady State Conduction - II (Continued...)

Lecture 11 - Problems On 1-D Steady State Conduction - I

Lecture 12 - Problems On 1-D Steady State Conduction - I (Continued....)

Lecture 13 - Problems On 1-D Steady State Conduction - II

Lecture 14 - Conduction In Cylindrical Geometry

Lecture 15 - Critical Insulation Thickness

Lecture 16 - Critical Insulation Thickness (Continued...)

Lecture 17 - Problems On Conduction In Cylindrical Geometry - I

Lecture 18 - Problems On Conduction In Cylindrical Geometry - I (Continued...)

Lecture 19 - Problems On Conduction In Cylindrical Geometry - II and Conduction in Spherical Geometry

Lecture 20 - Heat Transfer From Extended surfaces

Lecture 21 - Boundary Conditions at the FIN tip

Lecture 22 - Boundary Conditions at the FIN tip

Lecture 23 - Problems on Heat Transfer from Extended Surfaces

Lecture 24 - 2D Steady State Conduction

Lecture 25 - Separation of Variables Method for 2-D Steady State Conduction

Lecture 26 - Superposition Method for 2-D Steady State Conduction

Lecture 27 - Transient Conduction: Lumped Parameter Approach

Lecture 28 - Problems on Lumped Parameter Approach

Lecture 29 - Transient Conduction: Infinite Slab

Lecture 30 - Transient Conduction: Semi - Infinite Slab - I

Lecture 31 - Transient Conduction: Semi - Infinite Slab - II

[Lecture 32 - Introduction to Convection](#)

[Lecture 33 - Review of Fluid Mechanics - I](#)

[Lecture 34 - Review of Fluid Mechanics - II](#)

[Lecture 35 - Review of Fluid Mechanics - III](#)

[Lecture 36 - Review of Fluid Mechanics - IV](#)

[Lecture 37 - Review of Fluid Mechanics - V](#)

[Lecture 38 - Energy Conservation Equation - I](#)

[Lecture 39 - Energy Conservation Equation - II](#)

[Lecture 40 - Energy Conservation Equation - III](#)

[Lecture 41 - Thermal Boundary Layer - I](#)

[Lecture 42 - Thermal Boundary Layer - II](#)

[Lecture 43 - Energy Integral Equation - I](#)

[Lecture 44 - Energy Integral Equation - II](#)

[Lecture 45 - Internal Forced Convection - 1](#)

[Lecture 46 - Internal Forced Convection - 2](#)

[Lecture 47 - Internal Forced Convection - 3](#)

[Lecture 48 - Internal Forced Convection - 4](#)

[Lecture 49 - Internal Forced Convection - 5](#)

[Lecture 50 - Internal Forced Convection - 6](#)

[Lecture 51 - Viscous Dissipation - 1](#)

[Lecture 52 - Viscous Dissipation - 2](#)

[Lecture 53 - Natural Convection - 1](#)

[Lecture 54 - Natural Convection - 2](#)

[Lecture 55 - Natural Convection - 3](#)

[Lecture 56 - Natural Convection - 4](#)

[Lecture 57 - Condensation - I](#)

[Lecture 58 - Condensation - II](#)

[Lecture 59 - Boiling](#)

[Lecture 60 - Heat Exchangers - I](#)

[Lecture 61 - Heat Exchangers - II](#)

[Lecture 62 - Heat Exchangers - III](#)

[Lecture 63 - Heat Exchangers - IV](#)

[Lecture 64 - Heat Exchangers - V](#)



- Lecture 1 - Eulerian and Lagrangian Description of Fluid Motion
- Lecture 2 - Lines of Flow Visualization and Acceleration of Flow
- Lecture 3 - Angular Deformation of Fluid Elements
- Lecture 4 - Linear and Volumetric Deformation; Perspectives from Mass Conservation
- Lecture 5 - Continuity Equation in Integral Form : Stream Function and Velocity Potential
- Lecture 6 - Euler Equation for Inviscid Flow
- Lecture 7 - Bernoulli's Equation
- Lecture 8 - Examples of Bernoulli's Equation
- Lecture 9 - Reynolds Transport Equation
- Lecture 10 - Reynolds Transport Theorem : Mass and Linear Momentum Conservation
- Lecture 11 - Reynolds transport theorem : arbitrarily moving control volume
- Lecture 12 - Reynolds transport theorem : angular momentum conservation
- Lecture 13 - Introduction to traction vector and stress tensor
- Lecture 14 - Cauchy/Navier equation
- Lecture 15 - Navier Stokes equation
- Lecture 16 - Navier Stokes equation (Continued...)
- Lecture 17 - Some exact solutions of the Navier Stokes equation
- Lecture 18 - Interfacial boundary conditions and example of thin film flows
- Lecture 19 - Exact solutions of the Navier Stokes equations in cylindrical polar coordinates
- Lecture 20 - Exact solutions of the Navier Stokes equation for some unsteady flows
- Lecture 21 - Confined oscillatory flows
- Lecture 22 - Introduction to Turbulence
- Lecture 23 - Statistical Treatment of Turbulence and Near - Wall Velocity Profiles
- Lecture 24 - Introduction to Boundary Layer Theory
- Lecture 25 - Similarity Solution of Boundary Layer Equation
- Lecture 26 - Momentum Integral Method
- Lecture 27 - Application of Momentum Integral Method and Boundary Layer Separation
- Lecture 28 - Potential Flow
- Lecture 29 - Potential Flow (Continued...)
- Lecture 30 - Potential Flow (Continued...)
- Lecture 31 - Potential Flow (Continued...)



- [Lecture 32 - Potential Flow \(Continued...\)](#)
- [Lecture 33 - Potential Flow \(Continued...\)](#)
- [Lecture 34 - Stokes Flow past a Sphere](#)
- [Lecture 35 - Stokes Flow past a Sphere \(Continued...\)](#)
- [Lecture 36 - Stokes Flow past a Sphere \(Continued...\)](#)
- [Lecture 37 - Lubrication Theory](#)
- [Lecture 38 - Lubrication Theory \(Continued...\)](#)
- [Lecture 39 - Lubrication Theory \(Continued...\)](#)
- [Lecture 40 - Thin Film Dynamics](#)
- [Lecture 41 - Thin Film Dynamics \(Continued...\)](#)
- [Lecture 42 - Thin Film Dynamics \(Continued...\)](#)
- [Lecture 43 - Thin Film Dynamics \(Continued...\)](#)
- [Lecture 44 - Thin Film Dynamics \(Continued...\)](#)
- [Lecture 45 - Thin Film Dynamics \(Continued...\)](#)
- [Lecture 46 - Thin Film Dynamics \(Continued...\)](#)
- [Lecture 47 - Thin Film Dynamics \(Continued...\)](#)
- [Lecture 48 - Compressible Flows](#)
- [Lecture 49 - Compressible Flows \(Continued...\)](#)
- [Lecture 50 - Compressible Flows \(Stagnation Properties\)](#)
- [Lecture 51 - Compressible Flows \(Stagnation Properties, Variable Area\)](#)
- [Lecture 52 - Compressible Flows \(Variable Area\)](#)
- [Lecture 53 - Compressible Flows \(Variable Area\)](#)
- [Lecture 54 - Compressible Flows \(Normal Shock\)](#)
- [Lecture 55 - Compressible Flows \(Normal Shock\) \(Continued...\)](#)
- [Lecture 56 - Compressible Flows \(Converging Nozzle\)](#)
- [Lecture 57 - Compressible Flows \(Converging Diverging Nozzle\)](#)
- [Lecture 58 - Compressible Flows \(Converging Diverging Nozzle\) \(Continued...\)](#)
- [Lecture 59 - Compressible Flows with Friction](#)

- Lecture 1 - Introduction to High Performance Computing
- Lecture 2 - Architecture for Parallel Computing
- Lecture 3 - Architecture for Parallel Computing (Continued...)
- Lecture 4 - Architecture for Parallel Computing (Continued...)
- Lecture 5 - Shared Memory and Distributed Memory in Parallel Computing
- Lecture 6 - Shared Memory and Distributed Memory in Parallel Computing (Continued...)
- Lecture 7 - Parallel Algorithms
- Lecture 8 - Parallel Algorithms (Continued...)
- Lecture 9 - Parallel Algorithms (Continued...)
- Lecture 10 - Performance Metrics of Parallel Systems
- Lecture 11 - Performance Metrics of Parallel Systems (Continued...)
- Lecture 12 - Introduction to OpenMP
- Lecture 13 - Introduction to OpenMP (Continued...)
- Lecture 14 - Introduction to OpenMP (Continued...)
- Lecture 15 - Essentials of OpenMP Programming
- Lecture 16 - Essentials of OpenMP Programming (Continued...)
- Lecture 17 - Data sharing and synchronization
- Lecture 18 - Efficient OpenMP programming for matrix computing
- Lecture 19 - Introduction to MPI and Distributed Memory Parallel Programming
- Lecture 20 - Introduction to MPI and Distributed Memory Parallel Programming (Continued...)
- Lecture 21 - Communication using MPI
- Lecture 22 - Communication using MPI (Continued...)
- Lecture 23 - Communication using MPI (Continued...)
- Lecture 24 - Matrix Representation of Physical Systems - Matrix Solvers
- Lecture 25 - Domain Decomposition Technique
- Lecture 26 - Domain decomposition based parallelization of matrix solvers
- Lecture 27 - Domain decomposition based parallelization of matrix solvers (Continued...)
- Lecture 28 - Domain decomposition based parallelization of matrix solvers (Continued...)
- Lecture 29 - MPI routines for parallel matrix solvers
- Lecture 30 - Introduction to GPGPU and CUDA
- Lecture 31 - Introduction to GPGPU and CUDA (Continued...)

[Lecture 32 - Introduction to GPGPU and CUDA \(Continued...\)](#)

[Lecture 33 - Introduction to GPGPU and CUDA \(Continued...\)](#)

[Lecture 34 - Introduction to CUDA programming](#)

[Lecture 35 - Introduction to CUDA programming \(Continued...\)](#)

[Lecture 36 - Thread execution in CUDA program - scheduling and memory access](#)

[Lecture 37 - Thread execution in CUDA program \(Continued...\)](#)

[Lecture 38 - Matrix multiplications in CUDA](#)

[Lecture 39 - OpenACC programming for GPU-s](#)

[Lecture 40 - Hybrid parallelization and exascale computing](#)

[Lecture 1 - Introduction - I](#)

[Lecture 2 - Introduction - II](#)

[Lecture 3 - Introduction - III](#)

[Lecture 4 - Introduction - IV](#)

[Lecture 5 - Introduction - V](#)

[Lecture 6 - Introduction - VI](#)

[Lecture 7 - Conic Sections - I](#)

[Lecture 8 - Conic Sections - II](#)

[Lecture 9 - Practice - I](#)

[Lecture 10 - Practice - II](#)

[Lecture 11 - Conic Sections - III](#)

[Lecture 12 - Conic Sections - IV](#)

[Lecture 13 - Conic Sections - V](#)

[Lecture 14 - Conic Sections - VI](#)

[Lecture 15 - Conic Sections - VII](#)

[Lecture 16 - Conic Sections - VIII](#)

[Lecture 17 - Conic Sections - IX](#)

[Lecture 18 - Conic Sections - X](#)

[Lecture 19 - Conic Sections - XI](#)

[Lecture 20 - Conic Sections - XII](#)

[Lecture 21 - Orthographic Projections I - Part 1](#)

[Lecture 22 - Orthographic Projections I - Part 2](#)

[Lecture 23 - Orthographic Projections I - Part 3](#)

[Lecture 24 - Orthographic Projections I - Part 4](#)

[Lecture 25 - Orthographic Projections I - Part 5](#)

[Lecture 26 - Orthographic Projections I - Part 6](#)

[Lecture 27 - Orthographic Projections I - Part 7](#)

[Lecture 28 - Orthographic Projections I - Part 8](#)

[Lecture 29 - Orthographic Projections I - Part 9](#)

[Lecture 30 - Orthographic Projections I - Part 10](#)

[Lecture 31 - Orthographic Projections II - Part 1](#)

[Lecture 32 - Orthographic Projections II - Part 2](#)

[Lecture 33 - Orthographic Projections II - Part 3](#)

[Lecture 34 - Orthographic Projections II - Part 4](#)

[Lecture 35 - Orthographic Projections II - Part 5](#)

[Lecture 36 - Orthographic Projections II - Part 6](#)

[Lecture 37 - Orthographic Projections II - Part 7](#)

[Lecture 38 - Orthographic Projections II - Part 8](#)

[Lecture 39 - Orthographic Projections II - Part 9](#)

[Lecture 40 - Orthographic Projections II - Part 10](#)

[Lecture 41 - Orthographic Projections II - Part 11](#)

[Lecture 42 - Projection of Solids - I](#)

[Lecture 43 - Projection of Solids - II](#)

[Lecture 44 - Projection of Solids - III](#)

[Lecture 45 - Sections and Sectional Views](#)

[Lecture 46 - Sections and Sectional Views \(Continued...\)](#)

[Lecture 47 - Sections and Sectional Views \(Continued...\)](#)

[Lecture 48 - Isometric Projections](#)

[Lecture 49 - Isometric Projections \(Continued...\)](#)

[Lecture 50 - Isometric Projections \(Continued...\)](#)

[Lecture 51 - Overview of Computer Graphics - I](#)

[Lecture 52 - Overview of Computer Graphics - II](#)

[Lecture 53 - Overview of Computer Graphics - III](#)

[Lecture 54 - Overview of Computer Graphics - IV](#)

[Lecture 55 - Solidworks](#)

[Lecture 56 - Solidworks \(Continued...\)](#)

[Lecture 57 - Solidworks \(Continued...\)](#)

[Lecture 58 - Solidworks \(Continued...\)](#)

[Lecture 59 - Solidworks \(Continued...\)](#)

[Lecture 60 - Solidworks \(Continued...\)](#)

[Lecture 61 - Assembly Drawing](#)

[Lecture 62 - Assembly Drawing \(Continued...\)](#)

[Lecture 63 - Assembly Drawing \(Continued...\)](#)

[Lecture 64 - Assembly Drawing \(Continued...\)](#)

[Lecture 65 - Assembly Drawing \(Continued...\)](#)

Lecture 1 - Preliminaries and Data types

Lecture 2 - Loops and Conditionals Implementation of bubble sort

Lecture 3 - Commonly used Functions

Lecture 4 - Matrix Manipulations Mohr's circle

Lecture 5 - Nonlinear algebraic equations - Visualizing convergence

Lecture 6 - Nonlinear algebraic equations - system of equation and Newton's basin of attraction

Lecture 7 - Overview of Jupyterlab, Octave GUI, Spyder GUI

Lecture 8 - Interactivity with Python - Ipywidgets

Lecture 9 - Geometric Interpretations of ODEs

Lecture 10 - Bifurcation: Saddle node bifurcation

Lecture 11 - Bifurcation: Transcritical bifurcation

Lecture 12 - Bifurcation: Pitchfork bifurcation

Lecture 13 - Imperfect bifurcations and catastrophies

Lecture 14 - 2D flows - linear systems

Lecture 15 - 2D flows - Trajectories: spirals, star and degeneracy

Lecture 16 - Phase portraits - nonlinear systems

Lecture 17 - 2D phase portraits - limit cycles

Lecture 18 - Bifurcations and 3D flows

Lecture 19 - 1D Maps

Lecture 20 - Probability density functions and sampling

Lecture 21 - Monte-carlo simulations: Darts and Buffon's needle

Lecture 22 - 1D Random walks

Lecture 23 - 2D Random walks

Lecture 24 - Boundary Value Problems - Part 1

Lecture 25 - Boundary Value Problems - Part 2

Lecture 26 - Regular Perturbation for ODE

Lecture 27 - Singular Perturbation for ODE

Lecture 28 - 2D Boundary Values Problems

Lecture 29 - PETSc and MPI basics

Lecture 30 - PETSc - Creating Vectors and Matrices

Lecture 31 - KSP object and solving a system

[Lecture 32 - Poisson equation in PETSc](#)

[Lecture 33 - Nonlinear Solver of PETSc](#)

[Lecture 34 - Nonlinear solver with Jacobian in PETSc](#)

[Lecture 35 - Reaction-diffusion system in PETSc](#)

[Lecture 36 - Time stepping in PETSc](#)

[Lecture 37 - Heat transport using PETSc](#)

[Lecture 38 - Solving nonlinear PDE on a periodic domain yielding different patterns](#)

[Lecture 39 - Audio analysis - Determine motor RPM](#)

[Lecture 40 - Spectrogram and Doppler shift](#)

[Lecture 41 - Image processing - Preliminaries](#)

[Lecture 42 - Balloon problem and viscous fingers](#)

[Lecture 43 - Analyzing data files and 2D interpolation](#)



Lecture 1 - Coordinate Systems - I

Lecture 2 - Coordinate Systems - II

Lecture 3 - Relative Motion - I

Lecture 4 - Relative Motion - II

Lecture 5 - Relative Motion - III

Lecture 6 - Particle kinetics - I

Lecture 7 - Particle kinetics - II

Lecture 8 - Particle kinetics - III

Lecture 9 - Particle kinetics - IV

Lecture 10 - Particle kinetics - V

Lecture 11 - Work-energy relation - I

Lecture 12 - Work-energy relation - II

Lecture 13 - Impulse-momentum relation - I

Lecture 14 - Impulse-momentum relation - II

Lecture 15 - Particle impact - I

Lecture 16 - Particle impact - II

Lecture 17 - Central force motion - I

Lecture 18 - Central force motion - II

Lecture 19 - Central force motion - III

Lecture 20 - Central force motion - IV

Lecture 21 - Systems with Mass Flow - I

Lecture 22 - Systems with Mass Flow - II

Lecture 23 - Kinetics of a System of Particles - I

Lecture 24 - Kinetics of a System of Particles - II

Lecture 25 - Kinetics of a System of Particles - III

Lecture 26 - Kinetics of a System of Particles: Extension to Rigid Bodies

Lecture 27 - Planar Kinetics of Rigid Bodies - I

Lecture 28 - Planar Kinetics of Rigid Bodies - II

Lecture 29 - Planar Kinetics: Work-Energy Relations - I

Lecture 30 - Planar Kinetics: Work-Energy Relations - II

Lecture 31 - Planar kinetics: impulse-momentum relations - I

- Lecture 32 - Planar kinetics: impulse-momentum relations - II
- Lecture 33 - Spatial kinematics of rigid bodies - I
- Lecture 34 - Spatial kinematics of rigid bodies - II
- Lecture 35 - Spatial kinetics of rigid bodies - I
- Lecture 36 - Spatial kinetics of rigid bodies - II
- Lecture 37 - Spatial kinetics of rigid bodies - III
- Lecture 38 - Gyroscopic motion - I
- Lecture 39 - Gyroscopic motion - II
- Lecture 40 - Gyroscopic motion - III
- Lecture 41 - Kinematics of rotation - I
- Lecture 42 - Kinematics of rotation - II
- Lecture 43 - Kinematics of rotation - III
- Lecture 44 - Kinematics of rotation - IV
- Lecture 45 - Kinematics of rotation - V
- Lecture 46 - Introduction to Analytical Dynamics: generalized coordinates - I
- Lecture 47 - Introduction to Analytical Dynamics: generalized coordinates - II
- Lecture 48 - Hamilton's principle and Lagrange's equation of motion - I
- Lecture 49 - Hamilton's principle and Lagrange's equation of motion - II
- Lecture 50 - Hamilton's principle and Lagrange's equation of motion - III
- Lecture 51 - Hamilton's principle and Lagrange's equation of motion - IV
- Lecture 52 - Systems with constraints - I
- Lecture 53 - Systems with constraints - II
- Lecture 54 - Systems with constraints - III
- Lecture 55 - Systems with constraints - IV
- Lecture 56 - Symmetries and conservation laws - I
- Lecture 57 - Symmetries and conservation laws - II
- Lecture 58 - Symmetries and conservation laws - III
- Lecture 59 - Symmetries and conservation laws - IV
- Lecture 60 - Intermediate axis theorem

Lecture 1 - General Introduction to the Course

Lecture 2 - Musculoskeletal System

Lecture 3 - Synovial Joints

Lecture 4 - The Hip Joint

Lecture 5 - The Knee Joint

Lecture 6 - The Shoulder and Elbow Joints

Lecture 7 - The Spine

Lecture 8 - Biomechanics of the Hip Joint

Lecture 9 - Biomechanics of the Knee Joint

Lecture 10 - Biomechanics of the Shoulder Joint

Lecture 11 - Biomechanics of the Elbow Joint - Part I

Lecture 12 - Biomechanics of the Elbow Joint - Part II

Lecture 13 - Biomechanics of the Spine

Lecture 14 - Gait Cycle

Lecture 15 - Gait Analysis and Abnormalities

Lecture 16 - Measurement Techniques of Gait Analysis - Part I

Lecture 17 - Measurement Techniques of Gait Analysis - Part II

Lecture 18 - Motion Capture System

Lecture 19 - Fundamentals of Joint Kinematics

Lecture 20 - Joint Kinematics and Kinetics

Lecture 21 - Introduction to Musculoskeletal Modelling

Lecture 22 - Inverse Dynamics in Musculoskeletal Modelling

Lecture 23 - Muscle Force Estimation Using Static Optimization

Lecture 24 - Concepts of Stress and Strain

Lecture 25 - Stress Transformation

Lecture 26 - Bone Structure and Mechanical Behaviour

Lecture 27 - Bone Adaptation and Viscoelastic Behaviour

Lecture 28 - Anisotropic Nature of Bone

Lecture 29 - Implant Classification and Failure Mechanisms

Lecture 30 - Introduction to Finite Element Modelling of Bone and Implant

Lecture 31 - Finite Element Modelling and Analysis of Hip and Shoulder

[Lecture 32 - Modelling and Analysis of Intact and Implanted Lumbar Spine](#)

[Lecture 33 - Experimental Validation of Pre-Clinical Analysis](#)

[Lecture 34 - Adaptive Bone Remodelling](#)

[Lecture 35 - Bone Remodelling Around Resurfaced Femur and Pelvic Bone](#)

[Lecture 36 - Design Optimization of HIP Implant](#)

[Lecture 37 - Orthotropic Bone Remodelling](#)

[Lecture 38 - Biomaterials and Design of Orthopaedic Implants](#)

[Lecture 39 - Bone Fracture Healing](#)

[Lecture 40 - Bone Ingrowth and Mechanoregulatory Principles](#)

[Lecture 41 - Mathematical Modelling of Tissue Differentiation](#)

[Lecture 42 - Bone Ingrowth around Porous Coated Femoral Implant](#)

[Lecture 43 - Tissue Differentiation around Porous Coated Acetabular Implant](#)

[Lecture 44 - Concluding Remarks](#)

# DIGIMAT - The No.1 Autonomous Learning Platform for Creative Learning

**NPTEL : NOC:Elements of Metal Cutting, Machine tools, Gear Cutting and CNC Machining (Mechanical Engineering)**

**Co-ordinators : Prof. Asimava Roy Choudhury**

Lecture 1 - Introduction

Lecture 2 - Geometry of single point turning tools - 1

Lecture 3 - Geometry of turning tools - 2

Lecture 4 - Geometry of single point turning tools -3

Lecture 5 - Geometry of cutting tools and numerical problems

Lecture 6 - Different types of tools and mcq

Lecture 7 - Mechanism of chip formation

Lecture 8 - Mechanics of material removal

Lecture 9 - Measurement Of Cutting Forces

Lecture 10 - Numerical problems and MCQ

Lecture 11 - Tool wear and Tool life

Lecture 12 - Wear and life of cutting tools - 2

Lecture 13 - The lathe

Lecture 14 - Calculations on mechanisms in machine tools

Lecture 15 - Numerical problems on lathe

Lecture 16 - milling machines

Lecture 17 - Milling machine - indexing

Lecture 18 - Gear cutting CNC and non traditional machining

Lecture 19 - CNC and non-traditional machining methods

Lecture 20 - Numerical problems for week 4

Lecture 21 - Introduction

Lecture 22 - Simple Gear Calculations

Lecture 23 - Gear Geometry

Lecture 24 - Helical Gear Problems

Lecture 25 - Numerical Problem MCQ

Lecture 26 - Numerical Problem Milling of Helical Gears

Lecture 27 - Simple and Compound Indexing

Lecture 28 - Differential Indexing

Lecture 29 - Helical Gear Cutting on Milling Machine

Lecture 30 - Numerical Problems on Gear Milling

Lecture 31 - Gear Shaping - I

[Lecture 32 - Gear Shaping - II](#)

[Lecture 33 - Gear Shaping - III](#)

[Lecture 34 - Gear Shaping - IV](#)

[Lecture 35 - Gear Hobbing - I](#)

[Lecture 36 - Gear Hobbing - II](#)

[Lecture 37 - Gear Hobbing - III](#)

[Lecture 38 - Gear Hobbing - IV](#)

[Lecture 39 - Gear Hobbing - V](#)

[Lecture 40 - Gear Hobbing - VI](#)

[Lecture 41 - Introduction to computer control role of computers in automation](#)

[Lecture 42 - Introduction \(Continued...\) binary logic and logic gates](#)

[Lecture 43 - Classification of Computer numerical control \(CNC\) Point to point and continuous control](#)

[Lecture 44 - Classification \(Continued...\) : Closed loop and open loop control](#)

[Lecture 45 - Tutorial involving simple calculations on different aspects of CNC controls](#)

[Lecture 46 - Questions, MCQ Discussions on Motors, Encoders, Decoders and Programming Practice](#)

[Lecture 47 - Stepper motors, Permanent magnet DC motors](#)

[Lecture 48 - Binary circuits and decoders](#)

[Lecture 49 - Tachogenerator, printed circuit motors, Encoders](#)

[Lecture 50 - Programming Practice - I](#)

[Lecture 51 - Programming Practice - II](#)

[Lecture 52 - Computer Aided Offline Programming](#)

[Lecture 53 - Interpolators - Linear](#)

[Lecture 54 - Interpolators - Curvilinear](#)

[Lecture 55 - Questions on Programming and Interpolation](#)

[Lecture 56 - 3-D Machining - Basic Concepts](#)

[Lecture 57 - Curved Surface Geometry](#)

[Lecture 58 - Cutter Path Generation for Curved Surfaces](#)

[Lecture 59 - Cutter Path Generation \(Concluding Part\) and Current Status - CNC Machining and Related Processes](#)

[Lecture 60 - Questions and Discussions on Curved Surface Machining](#)

Lecture 1 - Introduction

Lecture 2 - Introduction (Continued...)

Lecture 3 - Introduction (Continued...)

Lecture 4 - Introduction (Continued...)

Lecture 5 - Introduction (Continued...)

Lecture 6 - Elements of Calculation of Variations - I

Lecture 7 - Elements of Calculation of Variations - II

Lecture 8 - Elements of Calculation of Variations - III

Lecture 9 - Strong Form and Weak Form

Lecture 10 - Rayleigh - Ritz Method - I

Lecture 11 - Rayleigh - Ritz Method - II

Lecture 12 - Weighted Residual Method

Lecture 13 - Weighted Residual Method - Example

Lecture 14 - Concepts of Element and Axial Bar Problem

Lecture 15 - Axial Bar Problem

Lecture 16 - Axial Bar - II

Lecture 17 - Beam Formulation

Lecture 18 - Beam Stiffness Matrix

Lecture 19 - Problems

Lecture 20 - Beam Column

Lecture 21 - Problem

Lecture 22 - Share Deformable Beam Theory

Lecture 23 - Weak Form and Discretization

Lecture 24 - Reduced Integration Based Stiffness Matrix

Lecture 25 - Problem

Lecture 26 - Problem (Continued...)

Lecture 27 - Element of Formulation

Lecture 28 - Analysis of Plane Truss

Lecture 29 - Analysis of Plane Truss (Computer Implementation)

Lecture 30 - Analysis of Euler-Bernoulli Beam (Computer Implementation)

Lecture 31 - Analysis of Plane Frame (Computer Implementation)

- Lecture 32 - Introduction to FEM in 2D
- Lecture 33 - Continuity and Completeness
- Lecture 34 - Shape Functions
- Lecture 35 - Numerical Integration (Gaussian Quadrature)
- Lecture 36 - Gaussian Quadrature in two dimension
- Lecture 37 - Weak Form
- Lecture 38 - Example
- Lecture 39 - Iso-Parametric Formulation
- Lecture 40 - Example with Quadrilateral Element
- Lecture 41 - Computer Implementation
- Lecture 42 - 2D Elasticity and Weak Form
- Lecture 43 - Weak Form and Matrix Formulation
- Lecture 44 - Weak Form to Matrix Form
- Lecture 45 - Problems
- Lecture 46 - Thermoelastic Problem
- Lecture 47 - Torsion
- Lecture 48 - Triangular Elements
- Lecture 49 - Triangular Elements (Continued...)
- Lecture 50 - Examples and Computer Implementation
- Lecture 51 - Examples and Computer Implementation (Continued...)
- Lecture 52 - Shear Locking
- Lecture 53 - Selective reduced Integration and Modes of Q4 Element
- Lecture 54 - Incompatible Elements
- Lecture 55 - Nearly Incompressible Material
- Lecture 56
- Lecture 57 - B-Bar Method
- Lecture 58 - Different Elements
- Lecture 59 - Iso-parametric Formulation and Gauss Quadrature
- Lecture 60 - Closure



Lecture 1 - Introduction to product engineering

Lecture 2 - Introduction to Product design

Lecture 3 - Introduction to Design Thinking

Lecture 4 - Conceptual Design

Lecture 5 - Design Planning and Innovation Engineering

Lecture 6 - FFE Interface with HLD and DT

Lecture 7 - High Level Design in the Context of Front End Innovation

Lecture 8 - Functional and Physical Decomposition and QFD

Lecture 9 - Product Design Specification

Lecture 10 - FAST in Functional Design

Lecture 11 - Design Thinking and Product Conceptualization and Development

Lecture 12 - Product specification and related methods

Lecture 13 - Conceptual design stemmed from Idea generation

Lecture 14 - Conceptual design: tools and techniques

Lecture 15 - Quality Function Deployment (QFD): Example

Lecture 16 - Kano Model and Analysis

Lecture 17 - Concept Generation methods

Lecture 18 - Concept evaluation methods

Lecture 19 - Concept testing methods

Lecture 20 - Morphological Design Concept

Lecture 21 - Embodiment, Architectural, Configuration, and Parametric Design

Lecture 22 - Pugh Method (Concept Selection leading to Embodiment Design)

Lecture 23 - Introduction to Sustainability

Lecture 24 - Sustainability and Eco-design

Lecture 25 - LCA and design thinking on LCA

Lecture 26 - Introduction to Additive Manufacturing

Lecture 27 - Design for Rapid prototyping, DFAM

Lecture 28 - Introduction to Design for Manufacturing (DFM) and Assembly (DFA)

Lecture 29 - Rapid: Digital Prototyping

Lecture 30 - A Primer on Design for Quality: Robust and Reliability Engineering

Lecture 31 - Tolerance Design: Taguchi Robust Engineering

[Lecture 32 - Complexity Mitigation in Multidisciplinary, System: Concurrent Engineering Precepts](#)

[Lecture 33 - Design Thinking steps](#)

[Lecture 34 - Design Thinking Methodologies and Tools](#)

[Lecture 35 - Frugal Engineering-A Disruptive Innovation Paradigm in Product Design and Development](#)

[Lecture 36 - Design-Driven Innovation](#)

[Lecture 37 - User interface and Experience \(UI/UX\) Design in Product Engineering](#)

[Lecture 38 - Industrial Design: Aesthetics and Ergonomics](#)

[Lecture 39 - Design Thinking in Industrial Design - Case Studies](#)

[Lecture 40 - Product Engineering'- Led Technology Entrepreneurship](#)

[Lecture 1 - Introduction to Microfluidics](#)

[Lecture 2 - Introduction to Microfluidics \(Continued...\)](#)

[Lecture 3 - Introduction to Microfluidics \(Continued...\)](#)

[Lecture 4 - Introduction to Microfluidics \(Continued...\)](#)

[Lecture 5 - Introduction to Microfluidics \(Continued...\)](#)

[Lecture 6 - Introduction to Microfluidics \(Continued...\)](#)

[Lecture 7 - Introduction to Microfluidics \(Continued...\)](#)

[Lecture 8 - Introduction to Microfluidics \(Continued...\)](#)

[Lecture 9 - Introduction to Microfluidics \(Continued...\)](#)

[Lecture 10 - Introduction to Microfluidics \(Continued...\)](#)

[Lecture 11 - Introduction to Microfluidics \(Continued...\)](#)

[Lecture 12 - Foundations of Fluid Dynamics](#)

[Lecture 13 - Foundations of Fluid Dynamics \(Continued...\)](#)

[Lecture 14 - Foundations of Fluid Dynamics \(Continued...\)](#)

[Lecture 15 - Foundations of Fluid Dynamics \(Continued...\)](#)

[Lecture 16 - Foundations of Fluid Dynamics \(Continued...\)](#)

[Lecture 17 - Foundations of Fluid Dynamics \(Continued...\)](#)

[Lecture 18 - Foundations of Fluid Dynamics \(Continued...\)](#)

[Lecture 19 - Foundations of Fluid Dynamics \(Continued...\)](#)

[Lecture 20 - Foundations of Fluid Dynamics \(Continued...\)](#)

[Lecture 21 - Foundations of Fluid Dynamics \(Continued...\)](#)

[Lecture 22 - Pressure-driven Microchannel Flows](#)

[Lecture 23 - Pressure-driven Microchannel Flows \(Continued...\)](#)

[Lecture 24 - Pressure-driven Microchannel Flows \(Continued...\)](#)

[Lecture 25 - Pressure-driven Microchannel Flows \(Continued...\)](#)

[Lecture 26 - Pressure-driven Microchannel Flows \(Continued...\)](#)

[Lecture 27 - Insights on Inertia-free Flows](#)

[Lecture 28 - Inertia-free Flow in Circular Capillaries and Generalizing the Force balance](#)

[Lecture 29 - Inertia-free flows for general fluids - Concepts for Microelectric Materials](#)

[Lecture 30 - Microelectric Fluid Flow through Microchannel](#)

[Lecture 31 - Fluid Flow through Deformable Microchanel](#)

[Lecture 32 - Fluid Flow through Deformable Microchanel \(Continued...\)](#)

[Lecture 33 - Lubrication Theory](#)

[Lecture 34 - Lubrication Theory \(Continued...\)](#)

[Lecture 35 - Lubrication Theory \(Continued...\)](#)

[Lecture 36 - Lubrication Theory \(Continued...\)](#)

[Lecture 37 - Lubrication Theory \(Continued...\)](#)

[Lecture 38 - Lubrication Theory - 2 Dimensional Problems](#)

[Lecture 39 - Unsteady Flows](#)

[Lecture 40 - Unsteady Flows \(Continued...\)](#)

[Lecture 41 - Unsteady Flows: Stoke's 1st problem \(Continued...\)](#)

[Lecture 42 - Unsteady Flows: Stoke's 1st problem \(Continued...\)](#)

[Lecture 43 - Unsteady Flows: Stoke's 2nd Problem](#)

[Lecture 44 - Unsteady Flows: Stoke's 2nd Problem \(Continued...\)](#)

[Lecture 45 - Unsteady Flows: Stoke's 2nd Problem \(Continued...\)](#)

[Lecture 46 - Stokes Flow Past a Sphere](#)

[Lecture 47 - Stokes Flow Past a Sphere](#)

[Lecture 48 - Stokes Flow Past a Sphere - The Drag Force](#)

[Lecture 49 - Surface Tension and Its Implications in Mircrofluidics](#)

[Lecture 50 - Equilibrium of a Droplet](#)

[Lecture 51 - Equilibrium of a Droplet \(Continued...\)](#)

[Lecture 52 - Capillary Rise](#)

[Lecture 53 - Capillary Filling Dynamics](#)

[Lecture 54 - Capillary Filling Dynamics \(Continued...\)](#)

[Lecture 55 - Capillary Filling Dynamics \(Continued...\)](#)

[Lecture 56 - Capillary Filling Dynamics \(Continued...\)](#)

[Lecture 57 - Factors affecting Capillary and Wetting](#)

[Lecture 58 - Electrowetting](#)

[Lecture 59 - Slip Boundary Condition](#)

[Lecture 60 - Apparent Slip](#)

[Lecture 61 - Thin Film Flows](#)

[Lecture 62 - Thin Film Flows \(Continued...\)](#)

[Lecture 63 - Electrokinetics and Electric Double Layer](#)

[Lecture 64 - Equilibrium within Electrical Double Layer Poisson Boltzmann model](#)

[Lecture 65 - Poisson - Nernst - Plank Model](#)

[Lecture 66 - Maxwell Stress and Electroosmosis](#)

[Lecture 67 - Electroosmosis](#)

[Lecture 68 - Electrophoresis and Streaming Potential](#)

Lecture 1 - Introduction to and Industrial Robots

Lecture 2 - Anatomy of an Industrial Robot

Lecture 3 - Technical Specifications of an Industrial Robot

Lecture 4 - Classification of Robots

Lecture 5 - Fixed Installation Robots - Serial and Parallel Robots

Lecture 6 - Introduction to Industrial Controllers, Drives and Systems

Lecture 7 - DC Motors/Actuators and Drives

Lecture 8 - Stepper Motors

Lecture 9 - Brushless DC Motors/Actuators

Lecture 10 - AC Servo Motors

Lecture 11 - Introduction to Sensor and Transducers, Position Sensors

Lecture 12 - Position Sensors: Potentiometers, and Hall-effect. Velocity Sensors

Lecture 13 - Acceleration Sensors, AC Sensors (Resolvers and Synchros)

Lecture 14 - Non-contact (Inductive and Capacitive), Force/Torque Sensors

Lecture 15 - Limit Switches, Classification and Characteristics of Sensors

Lecture 16 - Degrees of Freedom and Kinematic Transformations : Translation

Lecture 17 - Pure Rotation, Arbitrary Axis Rotations, Euler Angles

Lecture 18 - Link and Joint Parameters (DH Notations), 2 and 3 DoF Robots

Lecture 19 - 3 DoF Cylindrical Robot (Spatial), SphericalWrist, Cylindrical Robot with Wrist

Lecture 20 - Forward Kinematics of 6-DoF Industrial Robot

Lecture 21 - Inverse Kinematics: 2 and 3 DoF Planar Manipulator

Lecture 22 - Spatial Robots - 3R, Cylindrical (RPP), 4-DoF SCARA Robot

Lecture 23 - Inverse Kinematics of a 6-DoF Industrial Robot

Lecture 24 - Differential Motion Analysis, Velocity, and Robot Jacobian

Lecture 25 - Jacobian (2R), Jacobian Inverse, Singularity, and Acceleration Analysis

Lecture 26 - Installing the Mechanical Arm and Test Run

Lecture 27 - Mastering an Industrial Robot

Lecture 28 - TCP Calibration using 4-Point method and External reference method

Lecture 29 - TCP Orientation Calibration using World Frame and Two-Point method

Lecture 30 - Worksurface Calibration

Lecture 31 - Fixed Tool Calibration: External TCP and Workpiece Calibration

Lecture 32 - Base Linear Track and External Turn-Table Calibration

Lecture 33 - Link Forces and Moments

Lecture 34 - Gravity Compensation and External Forces/Torques

Lecture 35 - Kinetostatic Measures for Robot Design

Lecture 36 - Introduction to Dynamics, LE Approach, Dynamics of 1DoF System

Lecture 37 - Equation of Motion (EoM) for a Two-Link Manipulator using LE

Lecture 38 - Newton-Euler (NE) Approach

Lecture 39 - Equation of motion of a Two-Link manipulator using NE Approach

Lecture 40 - Payload and Supplementary Load Calibration

Lecture 41 - Identification Experiments

Lecture 42 - Repeatability Tests and ISO 9283:1998

Lecture 43 - Introduction to Control, Linear Control, Second Order System

Lecture 44 - Response of a Second Order Linear System

Lecture 45 - Transfer Function and State-space representation, ODE

Lecture 46 - A Robot Joint : DC Motor Model

Lecture 47 - Feedback control of a robot arm, PID Control, Gain Tuning

Lecture 48 - Workspace and Operator Safety

Lecture 49 - Industrial Robot Programming

Lecture 50 - Course Conclusion and Suggestions

- Lecture 1 - Introduction to Gas Dynamics & Review of Basic Thermodynamics
- Lecture 2 - Review of Basic Thermodynamics Continued
- Lecture 3 - An introduction to Normal Shocks
- Lecture 4 - The Mach Number and Compressible Flow
- Lecture 5 - The relation of physical properties across a normal shock
- Lecture 6 - Normal Shock in a duct: Throat and Reservoir conditions
- Lecture 7 - Example Problems in Normal Shocks
- Lecture 8 - An introduction to Oblique Shocks
- Lecture 9 - The relation of physical properties across an oblique shock
- Lecture 10 - Example Problems in Oblique Shocks
- Lecture 11 - Pressure - Deflection relationship of Shocks
- Lecture 12 - An introduction to Expansion waves
- Lecture 13 - Area - Mach Relationship
- Lecture 14 - Unsteady Shock Waves: The Shock Tube
- Lecture 15 - The Shock Tube: Propagating Normal Shock and its reflection from end wall
- Lecture 16 - A review of wave propagation
- Lecture 17 - Wave propagation: Small Perturbation Theory
- Lecture 18 - Finite Wave Theory: An introduction to the Method of Characteristics
- Lecture 19 - The Shock Tube: Propagating Expansion Fan
- Lecture 20 - The Method of Characteristics
- Lecture 21 - Application of The Method of Characteristics: Design of a minimum length nozzle
- Lecture 22 - Application of The Method of Characteristics: Flow through a diverging channel
- Lecture 23 - Flow over a Wavy wall: Formulation using Perturbation Theory
- Lecture 24 - Subsonic Flow over a Wavy wall
- Lecture 25 - Supersonic Flow over a Wavy wall
- Lecture 26 - Supersonic Flow past a 3D Cone: Axisymmetric/Quasi 2D Flow
- Lecture 27 - Quasi 2D Flow - I
- Lecture 28 - Quasi 2D Flow - II
- Lecture 29 - Similarity Rules and Transformed Coordinate System
- Lecture 30 - Critical Mach Number and Thin Airfoil Theory
- Lecture 31 - Example Problem using Thin Airfoil Theory



[Lecture 32 - Example Problems - 1](#)

[Lecture 33 - Example Problems - 2](#)

[Lecture 34 - Example Problems - 3](#)

[Lecture 35 - Supersonic Flow past a 3D Cone at an angle of attack](#)

[Lecture 36 - Supersonic Flow past a 3D Cone at an angle of attack: Flow Visualization - I](#)

[Lecture 37 - Supersonic Flow past a 3D Cone at an angle of attack: Flow Visualization - II](#)

[Lecture 38 - Supersonic Flow past a 3D Cone at an angle of attack: Governing Equations](#)

[Lecture 39 - Supersonic Flow past a 3D Cone at an angle of attack: Numerical Procedure](#)

[Lecture 40 - Supersonic Flow past a 3D Bluff Body at an angle of attack](#)

Lecture 1 - Introduction to Optimization

Lecture 2 - System Design and Analysis

Lecture 3 - Workable system

Lecture 4 - System simulation

Lecture 5 - Information flow diagrams

Lecture 6 - Successive substitution method

Lecture 7 - Successive substitution method (Continued.)

Lecture 8 - Successive substitution method and Newton-Raphson method

Lecture 9 - Newton-Raphson method (Continued.)

Lecture 10 - Convergence characteristics of Newton-Raphson method

Lecture 11 - Newton-Raphson method for multiple variables

Lecture 12 - Solution of system of linear equations

Lecture 13 - Introduction to Curve fitting

Lecture 14 - Example for Lagrange interpolation

Lecture 15 - Lagrange interpolation (Continued.)

Lecture 16 - Best fit

Lecture 17 - Least Square Regression

Lecture 18 - Least Square Regression (Continued.)

Lecture 19 - Least Square Regression (Continued.)

Lecture 20 - Non-linear Regression (Gauss - Newton Algorithm)

Lecture 21 - Optimization- Basic ideas

Lecture 22 - Properties of objective function and cardinal ideas in optimization

Lecture 23 - Unconstrained optimization

Lecture 24 - Constrained optimization problems

Lecture 25 - Mathematical proof of the Lagrange multiplier method

Lecture 26 - Test for Maxima / Minima

Lecture 27 - Handling in-equality constraints

Lecture 28 - Kuhn-Tucker conditions (Continued.)

Lecture 29 - Uni-modal function and search methods

Lecture 30 - Dichotomous search

Lecture 31 - Fibonacci search method

[Lecture 32 - Reduction ratio of Fibonacci search method](#)

[Lecture 33 - Introduction to multi-variable optimization](#)

[Lecture 34 - The Conjugate gradient method](#)

[Lecture 35 - The Conjugate gradient method \(Continued.\)](#)

[Lecture 36 - Linear programming](#)

[Lecture 37 - Dynamic programming](#)

[Lecture 38 - Genetic Algorithms](#)

[Lecture 39 - Genetic Algorithms \(Continued.\)](#)

[Lecture 40 - Simulated Annealing and Summary](#)

Lecture 1 - EFM Course Outline

Lecture 2 - Spectacular Failures

Lecture 3 - Lessons from Spectacular Failures

Lecture 4 - LEFM and EPFM

Lecture 5 - Fracture Mechanics is Holistic

Lecture 6 - Fatigue Crack Growth Model

Lecture 7 - Crack Growth and Fracture Mechanisms

Lecture 8 - Elastic Strain Energy

Lecture 9 - Fracture Strength by Griffith

Lecture 10 - Energy Release Rate

Lecture 11 - Utility of Energy Release Rate

Lecture 12 - Pop-in Phenomenon

Lecture 13 - Displacement and Stress Formulations

Lecture 14 - Forms of Stress Functions

Lecture 15 - Airy's Stress Function for Mode-I

Lecture 16 - Westergaard Solution of Stress Field for Mode-I

Lecture 17 - Displacement Field for Mode-I

Lecture 18 - Relation between KI and GI

Lecture 19 - Stress Field in Mode-II

Lecture 20 - Generalised Westergaard Approach

Lecture 21 - Williams's Eigen Function Approach

Lecture 22 - Multi-parameter Stress Field Equations

Lecture 23 - Validation of Multi-parameter Field Equations

Lecture 24 - Discussion Session - I

Lecture 25 - Evaluation of SIF for Various Geometries

Lecture 26 - SIF for Embedded Cracks

Lecture 27 - SIF for Surface Cracks

Lecture 28 - Modeling of Plastic Deformation

Lecture 29 - Irwin's Model

Lecture 30 - Dugdale Model

Lecture 31 - Fracture Toughness Testing

[Lecture 32 - Plane Strain Fracture Toughness Testing](#)

[Lecture 33 - Plane Stress Fracture Toughness Testing](#)

[Lecture 34 - Paris Law and Sigmoidal Curve](#)

[Lecture 35 - Crack Closure](#)

[Lecture 36 - Crack Growth Models](#)

[Lecture 37 - J-Integral](#)

[Lecture 38 - HRR Field and CTOD](#)

[Lecture 39 - FAD and Mixed Mode Fracture](#)

[Lecture 40 - Crack Arrest and Repair Methodologies](#)

[Lecture 41 - Discussion Session - II](#)

Lecture 1 - Overview of Experimental Stress Analysis

Lecture 2 - Optical Methods Work as Optical Computers

Lecture 3 - Stress, Strain and Displacement Fields

Lecture 4 - Physical Principle of Strain Gauges, Photoelasticity and Moiré

Lecture 5 - Introduction to Moiré, Brittle Coatings and Holography

Lecture 6 - Hologram Interferometry, Speckle Methods

Lecture 7 - Introduction to Shearography, TSA, DIC and Caustics

Lecture 8 - Fringe Patterns – Richness of Qualitative Information

Lecture 9 - Multi-Scale Analysis in Experimental Mechanics

Lecture 10 - Selection of an Experimental Technique

Lecture 11 - Introduction to Transmission Photoelasticity

Lecture 12 - Ordinary and Extraordinary Rays

Lecture 13 - Light Ellipse, Passage of Light Through a Crystal Plate

Lecture 14 - Retardation Plates, Stress-optic Law

Lecture 15 - Plane Polariscopes

Lecture 16 - Jones Calculus

Lecture 17 - Circular Polariscopes

Lecture 18 - Determination of Photoelastic Parameters at an Arbitrary Point

Lecture 19 - Tardy's Method of Compensation

Lecture 20 - Calibration of Photo elastic Materials

Lecture 21 - Fringe Thinning Methodologies

Lecture 22 - Fringe Ordering in Photoelasticity

Lecture 23 - Miscellaneous Topics in Transmission Photoelasticity

Lecture 24 - Three Dimensional Photoelasticity

Lecture 25 - Overview of Digital Photoelasticity

Lecture 26 - Introduction to Photoelastic Coatings

Lecture 27 - Correction Factors for Photoelastic Coatings

Lecture 28 - Coating Materials, Selection of Coating Thickness, Industrial Application of Photoelastic Coatings

Lecture 29 - Calibration of Photoelastic Coatings, Introduction to Brittle Coatings

Lecture 30 - Analysis of Brittle Coatings

Lecture 31 - Introduction to Strain Gauges

[Lecture 32 - Strain Sensitivity of a Strain Gauge, Bridge Sensitivity, Rosettes](#)

[Lecture 33 - Strain Gauge Alloys, Carriers and Adhesives](#)

[Lecture 34 - Performance of Strain Gauge System](#)

[Lecture 35 - Temperature Compensation, Two-wire and Three-wire Circuits](#)

[Lecture 36 - Strain Gauge Selection](#)

[Lecture 37 - Bonding of a Strain Gauge](#)

[Lecture 38 - Soldering, Accounting for Transverse Sensitivity Effects](#)

[Lecture 39 - Correction Factors for Special Applications](#)

[Lecture 40 - Special Gauges](#)

[Lecture 41 - Questions and Answers](#)

**NPTEL : Rocket Propulsion (Mechanical Engineering)**

**Co-ordinators : Prof. K. Ramamurthi**

Lecture 1 - Introduction

Lecture 2 - Motion in Space

Lecture 3 - Rotational Frame of Reference and Orbital Velocities

Lecture 4 - Velocity Requirements

Lecture 5 - Theory of Rocket Propulsion

Lecture 6 - Rocket Equation and Staging of Rockets

Lecture 7 - Review of Rocket Principles; Propulsion Efficiency

Lecture 8 - Examples Illustrating Theory of Rocket Propulsion and Introduction to Nozzles

Lecture 9 - Theory of Nozzles

Lecture 10 - Nozzle Shape

Lecture 11 - Area Ratio of Nozzles; Under-expansion and Over-expansion

Lecture 12 - Characteristic Velocity and Thrust Coefficient

Lecture 13 - Divergence Loss in Conical Nozzles and the Bell Nozzle

Lecture 14 - Unconventional Nozzles and Problems in Nozzles

Lecture 15 - Criterion for Choice of Chemical Propellants

Lecture 16 - Choice of Fuel-Rich Propellants

Lecture 17 - Performance Prediction Analysis

Lecture 18 - Dissociation of Products of Combustion

Lecture 19 - Shifting Equilibrium and Frozen Flow in Nozzles

Lecture 20 - Factors Influencing Choice of Chemical Propellants

Lecture 21 - Low Energy Liquid Propellants and Hybrid Propellants

Lecture 22 - Introduction to Solid Propellant Rockets

Lecture 23 - Burn Rate of Solid Propellants and Equilibrium Pressure in Solid Propellant Rockets

Lecture 24 - Design Aspects of Solid Propellant Rockets

Lecture 25 - Burning Surface Area of Solid Propellant Grains

Lecture 26 - Ignition of Solid Propellant Rockets

Lecture 27 - Review of Solid Propellant Rockets

Lecture 28 - Feed Systems for Liquid Propellant Rockets

Lecture 29 - Feed System Cycles for Pump Fed Liquid Propellant Rockets

Lecture 30 - Analysis of Gas Generator and Staged Combustion Cycles and Introduction to Injectors

Lecture 31 - Injectors, Cooling of Chamber and Mixture Ratio Distribution



[Lecture 32 - Efficiencies due to Mixture Ratio Distribution and Incomplete Vaporization](#)

[Lecture 33 - Pumps and Turbines; Propellant Feed System at Zero  \$\Omega\$  Conditions](#)

[Lecture 34 - Review of Liquid Bi-propellant Rockets and Introduction to Mono-propellant Rockets](#)

[Lecture 35 - Introduction to Hybrid Rockets and a Simple Illustration of Combustion Instability in Liquid Propellant Rockets](#)

[Lecture 36 - Combustion Instability in Solid Propellant and Liquid Propellant Rockets – Bulk and Wave Modes](#)

[Lecture 37 - Wave modes of Oscillation](#)

[Lecture 38 - Mechanisms Causing Instabilities and Strategies for Avoiding Combustion Instability](#)

[Lecture 39 - Electric and Magnetic Fields and the Electrostatic Thruster](#)

[Lecture 40 - Electrical Thrusters](#)

[Lecture 41 - Advances in Rocket Propulsion](#)

- Lecture 1 - Advanced Finite Elements Analysis
- Lecture 2 - Advanced Finite Elements Analysis
- Lecture 3 - Advanced Finite Elements Analysis
- Lecture 4 - Advanced Finite Elements Analysis
- Lecture 5 - Advanced Finite Elements Analysis
- Lecture 6 - Advanced Finite Elements Analysis
- Lecture 7 - Advanced Finite Elements Analysis
- Lecture 8 - Advanced Finite Elements Analysis
- Lecture 9 - Advanced Finite Elements Analysis
- Lecture 10 - Advanced Finite Elements Analysis
- Lecture 11 - Advanced Finite Elements Analysis
- Lecture 12 - Advanced Finite Elements Analysis
- Lecture 13 - Advanced Finite Elements Analysis
- Lecture 14 - Advanced Finite Elements Analysis
- Lecture 15 - Advanced Finite Elements Analysis
- Lecture 16 - Advanced Finite Elements Analysis
- Lecture 17 - Advanced Finite Elements Analysis
- Lecture 18 - Advanced Finite Elements Analysis
- Lecture 19 - Advanced Finite Elements Analysis
- Lecture 20 - Advanced Finite Elements Analysis
- Lecture 21 - Advanced Finite Elements Analysis
- Lecture 22 - Advanced Finite Elements Analysis
- Lecture 23 - Advanced Finite Elements Analysis
- Lecture 24 - Advanced Finite Elements Analysis
- Lecture 25 - Advanced Finite Elements Analysis
- Lecture 26 - Advanced Finite Elements Analysis
- Lecture 27 - Advanced Finite Elements Analysis
- Lecture 28 - Advanced Finite Elements Analysis
- Lecture 29 - Advanced Finite Elements Analysis
- Lecture 30 - Advanced Finite Elements Analysis

Lecture 1 - Introduction and Linear Programming

Lecture 2 - Revised Simplex Algorithm

Lecture 3 - Simplex Method for Bounded Variables

Lecture 4 - One Dimensional Cutting Stock Problem

Lecture 5 - One Dimensional Cutting Stock Problem (Continued.)

Lecture 6 - Dantzig-Wolfe Decomposition Algorithm

Lecture 7 - Dantzig-Wolfe Decomposition Algorithm Primal-Dual Algorithm

Lecture 8 - Primal-Dual Algorithm

Lecture 9 - Goal Programming-Formulations

Lecture 10 - Goal Programming Solutions Complexity of Simplex Algorithm

Lecture 11 - Complexity of Simplex Algorithm (Continued.) Integer Programming

Lecture 12 - Integer Programming-Formulations

Lecture 13 - Solving Zero-One Problems

Lecture 14 - Solving Zero-One Problems (Continued.)

Lecture 15 - Branch And Bond Algorithm For Integer Programming

Lecture 16 - Cutting Plane Algorithm

Lecture 17 - All Integer Primal Algorithm

Lecture 18 - All Integer Dual Algorithm

Lecture 19 - Network Models

Lecture 20 - Shortest Path Problem

Lecture 21 - Successive Shortest Path Problem

Lecture 22 - Maximum Flow Problem

Lecture 23 - Minimum Cost Flow Problem

Lecture 24 - Traveling Salesman Problem (TSP)

Lecture 25 - Branch and Bound Algorithms for TSP

Lecture 26 - Heuristics for TSP

Lecture 27 - Heuristics for TSP (Continued.)

Lecture 28 - Chinese Postman Problem

Lecture 29 - Vehicle Routeing Problem

Lecture 30 - Queueing Models

Lecture 31 - Single Server Queueing Models

[Lecture 32 - Multiple Server Queueing Models](#)

[Lecture 33 - Game Theory](#)

[Lecture 34 - Critical Path Method](#)

[Lecture 35 - Quadratic Programming](#)

[Lecture 36 - Integer Programming \(Continued.\)](#)

[Lecture 37 - All Integer Dual Algorithm](#)

[Lecture 38 - Mixed Integer Linear Programming](#)

[Lecture 39 - Benders Partitioning Algorithm](#)

Lecture 1 - Introduction to Linear Programming Formulations

Lecture 2 - Linear Programming Formulations (Continued...)

Lecture 3 - Linear Programming Solutions- Graphical Methods

Lecture 4 - Linear Programming Solutions - Simplex Algorithm

Lecture 5 - Simplex Algorithm-Minimization Problems

Lecture 6 - Simplex Algorithm - Initialization and Iteration

Lecture 7 - Simplex Algorithm - Termination

Lecture 8 - Introduction to Duality

Lecture 9 - Primal Dual Relationships, Duality Theorems

Lecture 10 - Dual Variables and the Simplex Tables

Lecture 11 - Simplex Algorithm in Matrix Form Introduction to Sensitivity Analysis

Lecture 12 - Sensitivity Analysis Transportation Problem (Introduction)

Lecture 13 - Transportation Problem, Methods for Initial Basic Feasible Solutions

Lecture 14 - Transportation Problem-Optimal Solutions

Lecture 15 - Transportation Problem - Other Issues

Lecture 16 - Assignment Problem - Hungarian Algorithm

Lecture 17 - Assignment Problem - Other Issues Introduction to Dynamic Programming

Lecture 18 - Dynamic Programming - Examples Involving Discrete Variables

Lecture 19 - Dynamic Programming - Continuous Variables

Lecture 20 - Dynamic Programming - Examples to Solve Linear & Integer Programming Problems

Lecture 21 - Inventory Models - Deterministic Models

Lecture 22 - Inventory Models - Discount Models, Constrained Inventory Problems, Lagrangean Multipliers, Conclusions

[Lecture 1 - Introduction to Finite Element Method](#)

[Lecture 2 - Introduction to Finite Element Method](#)

[Lecture 3 - Introduction to Finite Element Method](#)

[Lecture 4 - Introduction to Finite Element Method](#)

[Lecture 5 - Introduction to Finite Element Method](#)

[Lecture 6 - Introduction to Finite Element Method](#)

[Lecture 7 - Introduction to Finite Element Method](#)

[Lecture 8 - Introduction to Finite Element Method](#)

[Lecture 9 - Introduction to Finite Element Method](#)

[Lecture 10 - Introduction to Finite Element Method](#)

[Lecture 11 - Introduction to Finite Element Method](#)

[Lecture 12 - Introduction to Finite Element Method](#)

[Lecture 13 - Introduction to Finite Element Method](#)

[Lecture 14 - Introduction to Finite Element Method](#)

[Lecture 15 - Introduction to Finite Element Method](#)

[Lecture 16 - Introduction to Finite Element Method](#)

[Lecture 17 - Introduction to Finite Element Method](#)

[Lecture 18 - Introduction to Finite Element Method](#)

[Lecture 19 - Introduction to Finite Element Method](#)

[Lecture 20 - Introduction to Finite Element Method](#)

[Lecture 21 - Introduction to Finite Element Method](#)

[Lecture 22 - Introduction to Finite Element Method](#)

[Lecture 23 - Introduction to Finite Element Method](#)

[Lecture 24 - Introduction to Finite Element Method](#)

[Lecture 25 - Introduction to Finite Element Method](#)

[Lecture 26 - Introduction to Finite Element Method](#)

[Lecture 27 - Introduction to Finite Element Method](#)

[Lecture 28 - Introduction to Finite Element Method](#)

[Lecture 29 - Introduction to Finite Element Method](#)

[Lecture 30 - Introduction to Finite Element Method](#)

[Lecture 31 - Introduction to Finite Element Method](#)

[Lecture 32 - Introduction to Finite Element Method](#)

[Lecture 33 - Introduction to Finite Element Method](#)

[Lecture 1 - Introduction to the Study of Mechanical Measurement](#)

[Lecture 2 - Errors in Measurement](#)

[Lecture 3 - Errors in Measurement \(Continued...\)](#)

[Lecture 4 - Propagation of Errors](#)

[Lecture 5 - Regression Analysis](#)

[Lecture 6 - Regression Analysis \(Continued...\)](#)

[Lecture 7 - Design of Experiments](#)

[Lecture 8 - Design of Experiments \(Continued...\)](#)

[Lecture 9 - Temperature Measurement](#)

[Lecture 10 - Overview of Thermometry](#)

[Lecture 11 - Thermoelectric Thermometry](#)

[Lecture 12 - Thermoelectric Thermometry \(Continued...\)](#)

[Lecture 13 - Measurement of Temperature Under Various Conditions](#)

[Lecture 14 - Errors in Temperature Measurement](#)

[Lecture 15 - Measurement of Transient Temperature and Resistance Thermometry](#)

[Lecture 16 - Resistance Thermometry \(Continued...\)](#)

[Lecture 17 - Resistance Thermometry \(Continued...\) and pyrometry](#)

[Lecture 18 - pyrometry \(Continued...\)](#)

[Lecture 19 - pyrometry \(Continued...\)](#)

[Lecture 20 - Pressure Measurement \(Continued...\)](#)

[Lecture 21 - Pressure Measurement \(Continued...\)](#)

[Lecture 22 - Pressure Measurement \(Continued...\)](#)

[Lecture 23 - Pressure Measurement \(Continued...\)](#)

[Lecture 24 - Transient Response of Pressure Transducers](#)

[Lecture 25 - Transient Response of Pressure Transducers](#)

[Lecture 26 - Measurement of High Vacuum](#)

[Lecture 27 - Measurement of Fluid Velocity](#)

[Lecture 28 - Hot Wire Anemometry and Laser Doppler Velocimetry](#)

[Lecture 29 - Laser Doppler Velocimetry and Ultrasonic Methods](#)

[Lecture 30 - Measurement of Heat Flux](#)

[Lecture 31 - Measurement of Heat Flux \(Continued...\)](#)



- [Lecture 32 - Transient Method of Heat Flux Measurement](#)
- [Lecture 33 - Measurement of Volume and Mass Flow Rate of Fluid](#)
- [Lecture 34 - Flow Measuring Devices](#)
- [Lecture 35 - Measurement of Stagnation and Bulk Mean Temperature](#)
- [Lecture 36 - Measurement of Thermo-Physical Properties](#)
- [Lecture 37 - Measurement of Thermal Conductivity](#)
- [Lecture 38 - Measurement of Heat Capacity and Heating Value](#)
- [Lecture 39 - Measurement of Viscosity](#)
- [Lecture 40 - Measurement of Viscosity \(Continued...\)](#)
- [Lecture 41 - Integrating Sphere and Measurement of Emissivity](#)
- [Lecture 42 - Measurements of Gas Composition](#)
- [Lecture 43 - Measurements of Gas Composition \(Continued...\)](#)
- [Lecture 44 - Measurements of Gas Composition and Smoke](#)
- [Lecture 45 - Measurement of Force](#)
- [Lecture 46 - Force Measurement](#)
- [Lecture 47 - Vibration and Acceleration Measurement](#)
- [Lecture 48 - Laser Doppler Accelerometer, Speed, Torque](#)
- [Lecture 49 - General Issues in Mechanical Measurement](#)
- [Lecture 50 - Case Studies](#)

- [Lecture 1 - Principles Of Mechanical Measurements](#)
- [Lecture 2 - Principles Of Mechanical Measurements](#)
- [Lecture 3 - Principles Of Mechanical Measurements](#)
- [Lecture 4 - Principles Of Mechanical Measurements](#)
- [Lecture 5 - Principles Of Mechanical Measurements](#)
- [Lecture 6 - Principles Of Mechanical Measurements](#)
- [Lecture 7 - Principles Of Mechanical Measurements](#)
- [Lecture 8 - Principles Of Mechanical Measurements](#)
- [Lecture 9 - Principles Of Mechanical Measurements](#)
- [Lecture 10 - Principles of Mechanical Measurements](#)
- [Lecture 11 - Principles Of Mechanical Measurements](#)
- [Lecture 12 - Principles Of Mechanical Measurements](#)
- [Lecture 13 - Principles Of Mechanical Measurements](#)
- [Lecture 14 - Principles Of Mechanical Measurements](#)
- [Lecture 15 - Principles Of Mechanical Measurements](#)
- [Lecture 16 - Principles Of Mechanical Measurements](#)
- [Lecture 17 - Principles Of Mechanical Measurements](#)
- [Lecture 18 - Principles Of Mechanical Measurements](#)
- [Lecture 19 - Principles Of Mechanical Measurements](#)
- [Lecture 20 - Principles Of Mechanical Measurements](#)
- [Lecture 21 - Principles Of Mechanical Measurements](#)
- [Lecture 22 - Principles Of Mechanical Measurements](#)
- [Lecture 23 - Principles Of Mechanical Measurements](#)
- [Lecture 24 - Principles Of Mechanical Measurements](#)
- [Lecture 25 - Principles Of Mechanical Measurements](#)
- [Lecture 26 - Principles Of Mechanical Measurements](#)

- Lecture 1 - Introduction to sprays and their applications
- Lecture 2 - Spatial versus Temporal Sampling
- Lecture 3 - Spatial Vs Temporal Sampling example problem
- Lecture 4 - Steady vs unsteady spray
- Lecture 5 - Statistical measures on spray
- Lecture 6 - Discussion on pdf and moments
- Lecture 7 - Size velocity correlation
- Lecture 8 - Discussion on Interfacial tension
- Lecture 9 - Introduction to Atomizers and their design - 1
- Lecture 10 - Introduction to Atomizers and their design - 2
- Lecture 11 - Simple measurement techniques
- Lecture 12 - Selection of atomizers
- Lecture 13 - Spray measurement characteristics
- Lecture 14 - Spray measurements techniques
- Lecture 15 - Non-intrusive spray measurements techniques
- Lecture 16 - Non-intrusive spray measurements techniques
- Lecture 17 - Linear stability analysis “ Introduction
- Lecture 18 - Linear stability analysis- Kelvin-Helmholtz instability - 1
- Lecture 19 - Linear stability analysis- Kelvin-Helmholtz instability - 2
- Lecture 20 - Linear stability analysis- Kelvin-Helmholtz instability - 3
- Lecture 21 - Linear stability analysis procedure
- Lecture 22 - Linear stability analysis - Cylindrical jet instability - 1
- Lecture 23 - Linear stability analysis - Cylindrical jet instability - 2
- Lecture 24 - Linear stability analysis - Planar Liquid Sheet instability - 1
- Lecture 25 - Linear stability analysis - Planar Liquid Sheet instability - 2
- Lecture 26 - Design of pressure swirl atomizer - 1
- Lecture 27 - Design of pressure swirl atomizer - 2
- Lecture 28 - Design of pressure swirl atomizer - 3
- Lecture 29 - Design of pressure swirl atomizer - 4
- Lecture 30 - Secondary atomization-Dimensionless parameters
- Lecture 31 - Secondary atomization-Modes of breakup - 1

[Lecture 32 - Secondary atomization-Modes of breakup - 2](#)

[Lecture 33 - Multiphase modelling](#)

[Lecture 34 - Multiphase modelling](#)

[Lecture 35 - Multiphase flow modelling basics](#)

[Lecture 36 - Multiphase modelling “ Selection of model - 1](#)

[Lecture 37 - Multiphase modelling “ Selection of model - 2](#)

[Lecture 38 - Multiphase modelling - Governing equations](#)

[Lecture 39 - Droplet evaporation](#)

[Lecture 40 - Droplet combustion](#)

[Lecture 41 - Spray combustion](#)

Lecture 1 - Importance of Thermal Radiation

Lecture 2 - Blackbody definition

Lecture 3 - Solid angle, spectral radiation intensity

Lecture 4 - Radiation pressure and radiation energy density

Lecture 5 - Relationship between  $\epsilon_{\lambda}$  and  $\epsilon_{T\lambda}$  and Candidate blackbody distribution functions

Lecture 6 - Candidate blackbody distribution functions (Continued...)

Lecture 7 - Planck's blackbody radiation distribution function

Lecture 8 - Planck's distribution and Wien's displacement law

Lecture 9 - Universal blackbody function

Lecture 10 - Emissivity

Lecture 11 - Emissivity (Continued...)

Lecture 12 - Emissivity (Continued...)

Lecture 13 - Kirchoff law, Absorptivity

Lecture 14 - Kirchoff law, Absorptivity (Continued...)

Lecture 15 - Problems on emissivity, absorptivity

Lecture 16 - Reflectivity

Lecture 17 - Transmissivity

Lecture 18 - Problems on reflectivity and transmissivity

Lecture 19 - Radiation heat transfer between surfaces

Lecture 20 - View factor

Lecture 21 - View factor (Continued...)

Lecture 22 - View factor (Continued...)

Lecture 23 - Enclosure analysis

Lecture 24 - Enclosure analysis (Continued...)

Lecture 25 - Enclosure analysis - Gray surface

Lecture 26 - Enclosure analysis - Non gray surfaces

Lecture 27 - Radiation in participating media

Lecture 28 - Solution to the RTE

Lecture 29 - Concept of mean beam length

Lecture 30 - Enclosure analysis in the presence of absorbing / emitting gas

Lecture 31 - Emissivities and absorptivities of Gas mixtures

[Lecture 32 - Conduction - Introduction](#)

[Lecture 33 - Conduction - Energy equation](#)

[Lecture 34 - Conduction - 1D, steady state](#)

[Lecture 35 - Conduction - 1D, heat generation](#)

[Lecture 36 - Fin heat transfer - I](#)

[Lecture 37 - Fin heat transfer - II](#)

[Lecture 38 - Conduction - Cylindrical and Spherical geometries](#)

[Lecture 39 - Transient conduction](#)

[Lecture 40 - Transient conduction \(Continued...\)](#)

[Lecture 41 - Two dimensional steady state conduction](#)

[Lecture 42 - Analytical solution for Laplace equation](#)

[Lecture 43 - Numerical methods in conduction](#)

[Lecture 44 - Numerical methods in conduction \(Continued...\)](#)

[Lecture 45 - Conduction with change of phase](#)

[Lecture 46 - Conduction with change of phase \(Continued...\)](#)

Lecture 1 - Introduction

Lecture 2 - Introduction / Fundamental Ideas

Lecture 3 - Fundamental Ideas

Lecture 4 - Fundamental Ideas

Lecture 5 - Fundamental Ideas / Normal Shock Waves

Lecture 6 - Normal Shock Waves

Lecture 7 - Normal Shock Waves / Rayleigh Flow

Lecture 8 - Rayleigh Flow

Lecture 9 - Rayleigh Flow

Lecture 10 - Rayleigh Flow / Fanno Flow

Lecture 11 - Fanno Flow

Lecture 12 - Fanno Flow

Lecture 13 - Fanno Flow / Quasi One Dimensional Flows

Lecture 14 - Quasi One Dimensional Flows

Lecture 15 - Quasi One Dimensional Flows

Lecture 16 - Quasi One Dimensional Flows

Lecture 17 - Quasi One Dimensional Flows

Lecture 18 - Quasi One Dimensional Flows

Lecture 19 - Quasi One Dimensional Flows

Lecture 20 - Oblique Shock Waves

Lecture 21 - Oblique Shock Waves

Lecture 22 - Oblique Shock Waves

Lecture 23 - Oblique Shock Waves / Prandtl Meyer Waves

Lecture 24 - Prandtl Meyer Waves

Lecture 25 - Prandtl Meyer Waves

Lecture 26 - Propulsion - an Introduction

Lecture 27 - Components of the Gas Turbine Engine

Lecture 28 - Components of the Gas Turbine Engine

Lecture 29 - Components of the Gas Turbine Engine

Lecture 30 - Components of the Gas Turbine Engine

Lecture 31 - Components of the Gas Turbine Engine / Thermodynamic Analysis of the Engine

[Lecture 32 - Thermodynamic Analysis of the Engine](#)

[Lecture 33 - Thermodynamic Analysis of the Engine](#)

[Lecture 34 - Calculations for Thrust and Fuel Consumption](#)

[Lecture 35 - Calculations for Thrust and Fuel Consumption](#)

[Lecture 36 - Calculations for Thrust and Fuel Consumption / Emerging Trends](#)

[Lecture 37 - Emerging Trends / Ramjets](#)

[Lecture 38 - Ramjets](#)

[Lecture 39 - Ramjets / Scramjets](#)

[Lecture 40 - Scramjets](#)



[Lecture 1 - Introduction and Scaling](#)

[Lecture 2 - Scaling](#)

[Lecture 3 - Micro-scale fluid mechanics](#)

[Lecture 4 - Micro-scale fluid mechanics \(Continued...\)](#)

[Lecture 5 - Micro-scale fluid mechanics \(Continued...\)](#)

[Lecture 6 - Micro-scale fluid mechanics \(Continued...\)](#)

[Lecture 7 - Micro-scale fluid mechanics \(Continued...\)](#)

[Lecture 8 - Micro-scale fluid mechanics \(Continued...\)](#)

[Lecture 9 - Micro-scale fluid mechanics \(Continued...\)](#)

[Lecture 10 - Micro-scale fluid mechanics \(Continued...\)](#)

[Lecture 11 - Capillary Flows](#)

[Lecture 12 - Capillary Flows \(Continued...\)](#)

[Lecture 13 - Capillary Flows and Electrokinetics](#)

[Lecture 14 - Electrokinetics](#)

[Lecture 15 - Electrokinetics \(Continued...\)](#)

[Lecture 16 - Electrokinetics \(Continued...\)](#)

[Lecture 17 - Electrokinetics \(Continued...\)](#)

[Lecture 18 - Electrokinetics \(Continued...\)](#)

[Lecture 19 - Electrokinetics \(Continued...\)](#)

[Lecture 20 - Electrokinetics and Magnetophoresis](#)

[Lecture 21 - Microfabrication Techniques](#)

[Lecture 22 - Microfabrication Techniques \(Continued...\)](#)

[Lecture 23 - Microfabrication Techniques \(Continued...\)](#)

[Lecture 24 - Microfabrication Techniques \(Continued...\)](#)

[Lecture 25 - Microfabrication Techniques \(Continued...\)](#)

[Lecture 26 - Microfabrication Techniques \(Continued...\)](#)

[Lecture 27 - Microfabrication Techniques \(Continued...\)](#)

[Lecture 28 - Microfabrication Techniques \(Continued...\)](#)

[Lecture 29 - Micropump](#)

[Lecture 30 - Micropump \(Continued...\)](#)

[Lecture 31 - Microvalve](#)

[Lecture 32 - Microvalve \(Continued...\)](#)

[Lecture 33 - Microvalve \(Continued...\)](#)

[Lecture 34 - Micro Flow Sensor and Micro mixers](#)

[Lecture 35 - Micro mixers](#)

[Lecture 36 - Micro mixers \(Continued...\)](#)

[Lecture 37 - Micro droplets](#)

[Lecture 38 - Micro reactors \(Continued...\)](#)

[Lecture 39 - Micro needles and Microparticle separation](#)

[Lecture 40 - Few applications of microfluidics](#)

[Lecture 41 - Lab Demo](#)

- Lecture 1 - Introduction to convective heat transfer - Part 1
- Lecture 2 - Introduction to convective heat transfer - Part 2
- Lecture 3 - Continuity Equation
- Lecture 4 - Momentum and Energy Equations
- Lecture 5 - Energy Equation
- Lecture 6 - Reynolds Transport Theorem
- Lecture 7 - Entropy Generation and streamfunction-vorticity formulation
- Lecture 8 - Couette flow - Part 1
- Lecture 9 - Couette flow - Part 2
- Lecture 10 - Couette flow - Part 3
- Lecture 11 - Boundary layer approximation
- Lecture 12 - Laminar External flow past flat plate (Blasius Similarity Solution)
- Lecture 13 - Numerical solution to the Blasius equation and similarity solution to heat transfer
- Lecture 14 - Pohlhausen similarity solution and flows including pressure gradient (Falkner-Skan)
- Lecture 15 - Falkner skan solutions for heat transfer
- Lecture 16 - Similarity solution for flow and heat transfer with transpiration at walls
- Lecture 17 - Thermal boundary layer in high speed flows
- Lecture 18 - Approximate(Integral) methods for laminar external flow and heat transfer
- Lecture 19 - Integral method for laminar external thermal boundary layer over isothermal surface
- Lecture 20 - Integral method for flows with pressure gradient (von Karman-Pohlhausen method)
- Lecture 21 - Integral method with pressure gradient: heat transfer
- Lecture 22 - Heat transfer across a circular cylinder: Walz approximation
- Lecture 23 - Duhamel's method for varying surface temperature
- Lecture 24 - Laminar External heat transfer with non uniform surface temperature
- Lecture 25 - Laminar internal forced convection - fundamentals
- Lecture 26 - Hydrodynamically and thermally fully developed internal laminar flows
- Lecture 27 - Fully developed laminar internal flow and heat transfer
- Lecture 28 - Shooting method for fully developed heat transfer and thermal entry length problem
- Lecture 29 - Thermal entry length problem with plug velocity profile: Graetz problem
- Lecture 30 - Extended Graetz problem for parabolic velocity profile
- Lecture 31 - Extended Graetz problem

[Lecture 32 - Extended Graetz problem with wall flux boundary condition](#)

[Lecture 33 - Approximate method for laminar internal flows](#)

[Lecture 34 - Integral method for thermal entry length problem](#)

[Lecture 35 - Introduction to Natural Convection Heat Transfer](#)

[Lecture 36 - Similarity Solution in Natural Convection for Vertical isothermal Plate - Part 1](#)

[Lecture 37 - Similarity Solution in Natural Convection for Vertical isothermal Plate - Part 2](#)

[Lecture 38 - Similarity Solution in Natural Convection for Vertical isoflux Plate](#)

[Lecture 39 - Approximate Method in Natural Convection Heat Transfer](#)

[Lecture 40 - Natural Convection in Other Configurations](#)

[Lecture 41 - Turbulent Convective Heat Transfer : RANS Equations - Part 1](#)

[Lecture 42 - Turbulent Convective Heat Transfer : RANS Equations - Part 2](#)

[Lecture 43 - Analogies in Turbulent Convective Heat Transfer - Part 1](#)

[Lecture 44 - Analogies in Turbulent Convective Heat Transfer - Part 2](#)

Lecture 1 - Loud Bang and Disruption

Lecture 2 - Blast Wave in an Explosion: Predictions from Dimensional Considerations

Lecture 3 - Typical Examples of Explosions and Classification

Lecture 4 - Shock Hugoniot and Rayleigh Line

Lecture 5 - Properties behind a Constant Velocity Shock

Lecture 6 - Blast waves: Concentration of Mass at the Front, Snow Plow Approximation, Energy conservation in a Blast wave

Lecture 7 - Blast waves: Decay of a strong Blast wave, Explosion Length, Sach's Scaling, Over pressure, Cranz Hopkinson Scaling law of Overpressure

Lecture 8 - Blast Waves: Overpressure and Impulse in the Near and Far Field, Examples, Introduction to Impulse

Lecture 9 - Blast Waves: Non-dimensional Impulse, Cranz -Hopkinson Scaling, Missiles, Fragments and Shrapnel, Craters, Examples

Lecture 10 - Blast Waves: Interaction with Objects, Reflection and Transmission of Blast Waves, Impedance

Lecture 11 - Blast Waves: Amplification of Reflected Blast Waves; Role of Impedance, Spalling, Damage to Organs containing Air, Mushroom Cloud in an Explosion, Examples

Lecture 12 - Blast Waves: Damage from Blast Waves, Examples, Multiple Spikes in an Impulse, Iso-damage Curve on an Overpressure-Impulse Diagram, Complex Structures

Lecture 13 - Energy Release in a Chemical Reaction: Moles, Internal Chemical Energy, Standard Heats of Formation

Lecture 14 - Energy Release: Stoichiometry, Equivalence Ratio and Heat Release in Fuel Rich and Oxidizer Rich Compounds

Lecture 15 - Energy Release: Examples of Energy Release Calculations, Higher and Lower Calorific Values, Internal Energy of Formation

Lecture 16 - Rate of Energy Release: Concentration, Activation Energy, Energy Release Profile

Lecture 17 - Thermal Theory of Explosion

Lecture 18 - Thermal Theory

Lecture 19 - Role of Chain Carriers in an Explosion

Lecture 20 - Combustion - I

Lecture 21 - Combustion - II

Lecture 22 - Case Histories of Explosions involving Volatile Liquids

Lecture 23 - Detonation

Lecture 24 - Structure of Detonations

Lecture 25 - Realizable States in a Detonation

Lecture 26 - One Dimensional Model of Detonation

Lecture 27 - Case Histories of Explosions involving Detonation or Quasi-Detonation

Lecture 28 - Explosions in Confined and Unconfined Geometries

Lecture 29 - Dust Explosions - I

[Lecture 30 - Dust Explosions - II](#)

[Lecture 31 - Physical Explosions](#)

[Lecture 32 - Rupture of Cryogenic Storage Vessels and Pressure Vessels](#)

[Lecture 33 - Condensed Phased Explosives Based on Hydrocarbons](#)

[Lecture 34 - Condensed Phase Explosives and their Properties](#)

[Lecture 35 - TNT Equivalence and Yield of an Explosion](#)

[Lecture 36 - Atmospheric Dispersion](#)

[Lecture 37 - Modeling Atmospheric Dispersion](#)

[Lecture 38 - Explosions Involving Atmospheric Dispersion](#)

[Lecture 39 - Quantification of Damages in an Explosion](#)

[Lecture 40 - Risk Analysis for an Explosion](#)

Lecture 1 - Introduction to Metrology

Lecture 2 - Metrology terminologies

Lecture 3 - Measurement errors

Lecture 4 - Linear measuring instruments  $\hat{A}$ - 1 (Angle plate, steel rule, spring calipers)

Lecture 5 - Linear measuring instruments  $\hat{A}$ - 2 (Combination set, Vernier calipers)

Lecture 6 - Linear measuring instruments  $\hat{A}$ - 3 (Height gauge, Micrometers  $\hat{A}$ - 1)

Lecture 7 - Linear measuring instruments  $\hat{A}$ - 4 (Micrometers  $\hat{A}$ - 2, Bore gauge)

Lecture 8 - Linear measuring instruments  $\hat{A}$ - 5 (Dial indicators, thickness gauges, depth gauges)

Lecture 9 - Manufacturing tolerances and fits

Lecture 10 - Terminologies of limits fits and tolerances

Lecture 11 - Numerical problems on fit and tolerances

Lecture 12 - Selection of fits, Geometrical tolerances

Lecture 13 - Positional tolerances

Lecture 14 - Limit gauging - 1

Lecture 15 - Limit gauging - 2

Lecture 16 - Design of limit gauges

Lecture 17 - Measurement of straightness, flatness and squareness

Lecture 18 - Perpendicularity measurement

Lecture 19 - Basics of surface roughness

Lecture 20 - Surface finish parameters

Lecture 21 - Stylus type surface finish measuring instruments

Lecture 22 - Non-contact type surface finish measuring instruments

Lecture 23 - Screw thread production and terminology

Lecture 24 - Measurement of screw thread elements

Lecture 25 - Introduction to gears

Lecture 26 - Measurement of gear elements

Lecture 27 - Angle measurement - 1

Lecture 28 - Angle measurement - 2

Lecture 29 - Radius measurement, Contact angle measurement

Lecture 30 - Basics of interferometry

Lecture 31 - Interferometers

[Lecture 32 - Introduction to comparators, Mechanical comparators](#)

[Lecture 33 - Electrical and electronic comparators, Optical comparators](#)

[Lecture 34 - Pneumatic comparators](#)

[Lecture 35 - Geometrical tests on lathe](#)

[Lecture 36 - Geometrical tests on pillar type drilling machine](#)

[Lecture 37 - Universal measuring machine \(UMM\) and Coordinate measuring machine \(CMM\)](#)

[Lecture 38 - CMM probes and CMM software](#)

[Lecture 39 - Feature measurement using CMM, Laser vision](#)

[Lecture 40 - In-process gauging and control](#)

[Lecture 41 - Stage position metrology](#)

[Lecture 42 - Micro and Nano stages, Nano technology instrumentation](#)

[Lecture 43 - Optical system design](#)

[Lecture 44 - Complex opto- mechanical assemblies, Metrology testing and certification services](#)



- Lecture 1 - Introduction to the course
- Lecture 2 - Newton's laws
- Lecture 3 - Equilibrium
- Lecture 4 - Example 1 - Statics
- Lecture 5 - Example 2 - Rigid Body Systems
- Lecture 6 - Example 3 - Rigid Body Systems
- Lecture 7 - Structural Systems with rigid bodies
- Lecture 8 - Types of 1-D Structural Elements
- Lecture 9 - Axial members
- Lecture 10 - Analysis of the truss system
- Lecture 11 - Stability of Structural systems
- Lecture 12 - Beams - Example 1
- Lecture 13 - Beams - BMD and SFD
- Lecture 14 - Beams - Loading, Shear and Bending Moment Relations
- Lecture 15 - Static Friction
- Lecture 16 - Friction - Solving Problems
- Lecture 17 - Particle Kinematics - 1
- Lecture 18 - Particle Kinematics - 2 (Example)
- Lecture 19 - Particle Kinematics - Curvilinear Coordinates
- Lecture 20 - Rigid Body Kinematics
- Lecture 21 - Rotational Motion (Example 1)
- Lecture 22 - Rotational Motion (Example 2)
- Lecture 23 - Dynamics (Introduction)
- Lecture 24 - Dynamics - Example 1
- Lecture 25 - Dynamics - Example 2
- Lecture 26 - Dynamics - Example 3
- Lecture 27 - Dynamics - Example 4
- Lecture 28 - Center of Percussion - Example
- Lecture 29 - Impulse / Momentum - Example 1
- Lecture 30 - Impulse / Momentum - Example 2
- Lecture 31 - Impulse / Momentum - Example 3

[Lecture 32 - Impulse / Momentum - Example 4](#)

[Lecture 33 - Work Energy Methods - Example 1](#)

[Lecture 34 - Work Energy Methods - Example 2](#)

[Lecture 35 - Work Energy Methods - Example 3](#)

[Week 1 - Module-1](#)

[Week 1 - Module-2](#)

[Week 1 - Module-3](#)

[Week 1 - Module-4](#)

[Week 1 - Module-5](#)

[Week 2 - Module-1](#)

[Week 2 - Module-2](#)

[Week 2 - Module-3](#)

[Week 2 - Module-4](#)

[Week 2 - Module-5](#)

[Week 3 - Module-1](#)

[Week 3 - Module-2](#)

[Week 3 - Module-3](#)

[Week 3 - Module-4](#)

[Week 3 - Module-5](#)

[Week 4 - Module-1](#)

[Week 4 - Module-2](#)

[Week 4 - Module-3](#)

[Week 4 - Module-4](#)

[Week 4 - Module-5](#)

[Week 5 - Module-1](#)

[Week 5 - Module-2](#)

[Week 5 - Module-3](#)

[Week 5 - Module-4](#)

[Week 5 - Module-5](#)

[Week 5 - Module-6](#)

[Week 6 - Module-1](#)

[Week 6 - Module-2 - Part 1](#)

[Week 6 - Module-2 - Part 2](#)

[Week 6 - Module-3](#)

[Week 6 - Module-4](#)

[Week 6 - Module-5](#)

[Week 7 - Module-1](#)

[Week 7 - Module-2](#)

[Week 7 - Module-3](#)

[Week 7 - Module-4](#)

[Week 7 - Module-5](#)

[Week 8 - Module-1](#)

[Week 8 - Module-2](#)

[Week 8 - Module-3](#)

[Week 8 - Module-4](#)

[Week 8 - Module-5](#)

[Week 8 - Module-6](#)

[Conclusion](#)

- Lecture 1 - Review of fundamentals of fluid mechanics - I
- Lecture 2 - Review of fundamentals of fluid mechanics - II
- Lecture 3 - Concept of a Boundary Layer (BL) - I
- Lecture 4 - Concept of a Boundary Layer (BL) - II
- Lecture 5 - Concepts of BL thickness (?)
- Lecture 6 - Concepts of BL displacement thickness ( $\delta^*$ ) and BL momentum thickness ( $\theta$ )
- Lecture 7 - Control Volume approach to derive expressions for  $\delta^*$  over a flat plate
- Lecture 8 - Control Volume approach to derive expressions for  $\theta$  over a flat plate
- Lecture 9 - Concept of wall friction
- Lecture 10 - Concept of friction drag
- Lecture 11 - Skin Friction Coefficient - I
- Lecture 12 - Skin Friction Coefficient - II
- Lecture 13 - Derivation of Prandtl's Laminar BL Equations - I
- Lecture 14 - Derivation of Prandtl's Laminar BL Equations - II
- Lecture 15 - Derivation of Prandtl's Laminar BL Equations - III
- Lecture 16 - Derivation of Prandtl's Laminar BL Equations - IV
- Lecture 17 - Similarity Solutions to the BL Equations Applied to a Flat Plate - I
- Lecture 18 - Similarity Solutions to the BL Equations Applied to a Flat Plate - II
- Lecture 19 - Similarity Solutions to the BL Equations Applied to a Flat Plate - III
- Lecture 20 - Runge-Kutta Method to Numerically Solve the BL Equations Applied to a Flat Plate
- Lecture 21 - Description of the Numerical Code to Solve the BL Equations Applied to a Flat Plate
- Lecture 22 - Similarity Solutions to the BL Equations (other than flat plate) - I
- Lecture 23 - Similarity Solutions to the BL Equations (other than flat plate) - II
- Lecture 24 - Similarity Solutions to the BL Equations (other than flat plate) - III
- Lecture 25 - Similarity Solutions to the BL Equations (other than flat plate) - IV
- Lecture 26 - Description of the Numerical Code to Solve the BL Equations (other than flat plate)
- Lecture 27 - The Energy Equation - I
- Lecture 28 - The Energy Equation - II
- Lecture 29 - Similarity Solutions to Thermal BL - I
- Lecture 30 - Similarity Solutions to Thermal BL - II
- Lecture 31 - Similarity Solutions to Thermal BL - III

[Lecture 32 - BL Separation with Pressure-Gradient - I](#)

[Lecture 33 - BL Separation with Pressure Gradient - II](#)

[Lecture 34 - Effect of Prandtl Number in Thermal BL - I](#)

[Lecture 35 - Effect of Prandtl Number in Thermal BL - II](#)

[Lecture 36 - Effect of Prandtl Number in Thermal BL - III](#)

[Lecture 37 - Effect of Dissipation in Thermal BL - I](#)

[Lecture 38 - Effect of Dissipation in Thermal BL - II](#)

[Lecture 39 - Effect of Dissipation in Thermal BL - III](#)

[Lecture 40 - Similarity Solutions to Thermal BL - An Overview](#)

Lecture 1 - Introduction

Lecture 2 - Basics of Thermodynamics

Lecture 3 - Tutorial 1

Lecture 4 - Control Volume Approach

Lecture 5 - Conservation Equations

Lecture 6 - Tutorial 2

Lecture 7 - Energy Equation

Lecture 8 - Concept of stagnation

Lecture 9 - Discussion on stagnation

Lecture 10 - Velocity of sound

Lecture 11 - Discussion on velocity of sound and mach number

Lecture 12 - Wave propagation

Lecture 13 - Mach wave

Lecture 14 - Mach number relations

Lecture 15 - Variable Area Adiabatic flow

Lecture 16 - Variable Area Adiabatic flow (Continued...)

Lecture 17 - \* reference quantities and their relations

Lecture 18 - Importance of stagnation temperature in relation to v

Lecture 19 - Discussion on variable area adiabatic flow and \* reference quantities

Lecture 20 - Gas tables

Lecture 21 - Converging nozzle

Lecture 22 - Condition of choked flow and associated properties

Lecture 23 - Area ratio and pressure ratio in converging nozzles

Lecture 24 - Discussion on converging nozzles

Lecture 25 - Converging - Diverging (C-D) nozzles

Lecture 26 - More on C-D nozzles

Lecture 27 - Discussion on C-D nozzles - 1

Lecture 28 - Discussion on C-D nozzles - 2

Lecture 29 - Examples and applications of flow through C-D nozzles

Lecture 30 - Introduction to normal shocks

Lecture 31 - Normal shock relations - 1

[Lecture 32 - Normal shock relations - 2](#)

[Lecture 33 - Rankine-Hugoniot equation](#)

[Lecture 34 - Discussion on Normal Shocks - 1](#)

[Lecture 35 - Discussion on Normal Shocks - 2](#)

[Lecture 36 - Normal shocks in C-D nozzles](#)

[Lecture 37 - Normal shocks in C-D nozzles \(Continued...\)](#)

[Lecture 38 - Moving Normal Shocks](#)

[Lecture 39 - Discussion on moving normal shocks](#)

[Lecture 40 - Oblique shocks](#)

[Lecture 41 - Oblique shock relations](#)

[Lecture 42 - Discussion on oblique shocks](#)

[Lecture 43 - Reflection of oblique shocks](#)

[Lecture 44 - Discussion on reflection of oblique shocks](#)

[Lecture 45 - Prandtl-Meyer flow](#)

[Lecture 46 - Prandtl-Meyer flow \(Continued...\)](#)

[Lecture 47 - Discussion on Prandtl-Meyer expansion](#)

[Lecture 48 - Shock Polar diagram and Prandtl-Meyer relation for Oblique shocks](#)



Lecture 1 - Introduction to Stress Analysis – Analytical and Numerical Approaches

Lecture 2 - Introduction to Stress Analysis - Experimental Approaches

Lecture 3 - Optical Methods Work as Optical Computers

Lecture 4 - Basic information provided by various experimental methods

Lecture 5 - Visual Appreciation of Field Information - Part 1

Lecture 6 - Visual Appreciation of Field Information - Part 2

Lecture 7 - Visual Appreciation of Field Information - Part 3

Lecture 8 - Visual Appreciation of Field Information - Part 4

Lecture 9 - Visual Appreciation of Field Information - Part 5

Lecture 10 - Completeness of a Numerical Solution

Lecture 11 - Principle of Strain Gauges

Lecture 12 - Overview of Strain Gauge Measurements

Lecture 13 - Elegance of Photoelasticity

Lecture 14 - Introduction to Photoelasticity

Lecture 15 - Different Polariscope

Lecture 16 - Principles of Moiré

Lecture 17 - Introduction to Moiré

Lecture 18 - Introduction to Brittle Coatings

Lecture 19 - Introduction to Holography

Lecture 20 - Introduction to Hologram Interferometry

Lecture 21 - Introduction to Double exposure hologram interferometry

Lecture 22 - Introduction to Speckle Methods

Lecture 23 - Introduction to Speckle Interferometry Techniques

Lecture 24 - Introduction to TSA and DIC

Lecture 25 - Introduction to Caustics

Lecture 26 - Introduction to Coherent Gradient Sensor

Lecture 27 - Naming of Experimental Methods

Lecture 28 - Fringe Patterns - Richness of Qualitative Information

Lecture 29 - Key technologies that have influenced Experimental Mechanics

Lecture 30 - Multiscale analysis and trends in experimental mechanics

Lecture 31 - Selection of an experimental technique - Part 1



Lecture 1 - Introduction to Fluid Flow

Lecture 2 - Flow field, Stresses on fluid element, Newtonian fluid

Lecture 3 - Non Newtonian fluid, Classification of flow, Analysis of flow

Lecture 4 - Tutorial

Lecture 5 - Lecture 1 - Integral analysis, Control volume, Generalised conservation equation

Lecture 6 - Lecture 2 - Mass and linear momentum conservation in CV

Lecture 7 - Lecture 3 - Angular momentum conservation, Non-inertial frame of reference

Lecture 8 - Lecture 4 - Tutorial

Lecture 9 - Lecture 1 - Differential Analysis

Lecture 10 - Lecture 2 - Navier-Stokes equation for 2D incompressible flow

Lecture 11 - Lecture 3 - Vorticity, Stream function, Bernoulli's equation

Lecture 12 - Lecture 4 - Tutorial

Lecture 13 - Lecture 1 - External flows, Laminar and Turbulent Boundary Layer

Lecture 14 - Lecture 2 - Differential analysis of boundary layer, Blassius equation

Lecture 15 - Lecture 3 - Boundary Layer flow with pressure gradient, Flow separation

Lecture 16 - Lecture 4 - Internal flow, Pipe friction

Lecture 17 - Lecture 1 - Basic Thermodynamics

Lecture 18 - Lecture 2 - Turbomachines: Definition and classification

Lecture 19 - Lecture 3 - Dimensional Analysis

Lecture 20 - Lecture 4 - Tutorial

Lecture 21 - Lecture 1 - Representation of Turbomachines and Definition of velocity

Lecture 22 - Lecture 2 - Euler's energy equation

Lecture 23 - Lecture 3 - Real fluid flow and efficiency of turbomachine

Lecture 24 - Lecture 4 - Tutorial

Lecture 25 - Lecture 1 - Pumps

Lecture 26 - Lecture 2 - Pumping Systems

Lecture 27 - Lecture 3 - Hydraulic Turbines : Pelton Turbine

Lecture 28 - Lecture 4 - Hydraulic Turbines : Reaction Turbines

Lecture 29 - Lecture 5 - Cavitation in Hydroturbomachines

Lecture 30 - Lecture 6 - Tutorial

Lecture 31 - Lecture 1 - Introduction to compressible flow

[Lecture 32 - Lecture 2 - Steam and Gas Turbine : Introduction and classification](#)

[Lecture 33 - Lecture 3 - Steam and Gas Turbine : h-s Plots and velocity triangle](#)

[Lecture 34 - Lecture 4 - Tutorial](#)

Lecture 1 - Overview to Micro/Nanoscale energy transport - Part 1

Lecture 2 - Overview to Micro/Nanoscale energy transport - Part 2

Lecture 3 - Some applications of Micro/Nanoscale energy transport

Lecture 4 - Continuum heat transfer and its limitation

Lecture 5 - Energy carriers at Micro/Nanoscale and their attributes

Lecture 6 - Microscopic contributes to Internal energy of a systems

Lecture 7 - Fundamentals of Quantum mechanics - Part 1

Lecture 8 - Fundamentals of Quantum mechanics - Part 2

Lecture 9 - Fundamentals of Quantum mechanics - Part 3

Lecture 10 - Fundamentals of Quantum mechanics - Part 4

Lecture 11 - Fundamentals of Quantum mechanics - Part 5

Lecture 12 - Fundamentals of solid state physics - Part 1

Lecture 13 - Fundamentals of solid state physics - Part 2

Lecture 14 - Fundamentals of solid state physics - Part 3

Lecture 15 - Fundamentals of solid state physics - Part 4

Lecture 16 - Fundamentals of statistical thermodynamics - Part 1

Lecture 17 - Fundamentals of statistical thermodynamics - Part 2

Lecture 18 - Fundamentals of statistical thermodynamics - Part 3

Lecture 19 - Fundamentals of statistical thermodynamics - Part 4

Lecture 20 - Kinetic theory of energy carriers - Part 1

Lecture 21 - Kinetic theory of energy carriers - Part 2

Lecture 22 - Non-equilibrium energy transport at Nanoscales: Boltzmann Transport Equation (BTE)

Lecture 23 - Boltzmann Transport Equation under the relaxation time approximation

Lecture 24 - Derivation of Continuum laws from Boltzmann Transport Equation - Part 1

Lecture 25 - Derivation of Continuum laws from Boltzmann Transport Equation - Part 2

Lecture 26 - Derivation of Continuum laws from Boltzmann Transport Equation - Part 3

Lecture 27 - Nanoscale Energy transport in a Thin Film - Part 1

Lecture 28 - Nanoscale Energy transport in a Thin Film - Part 2

Lecture 29 - Nanoscale Energy transport in a Thin Film - Part 3

Lecture 30 - Gas flow and Heat transport in Microchannels - Part 1

Lecture 31 - Gas flow and Heat transport in Microchannels - Part 2

[Lecture 32 - Single phase liquid flow and Heat transport in Microchannels - Part 1](#)

[Lecture 33 - Single phase liquid flow and Heat transport in Microchannels - Part 2](#)

[Lecture 34 - Fundamentals of Electro kinetics in Microchannels Part1](#)

[Lecture 35 - Fundamentals of Electro kinetics in Microchannels Part2](#)

[Lecture 36 - Fundamentals of Electro kinetics in Microchannels Part3](#)

[Lecture 37 - Two phase Heat transfer in Microchannels - Part 1](#)

[Lecture 38 - Two phase Heat transfer in Microchannels - Part 2](#)

[Lecture 39 - Nano fluid Heat transfer - Part 1](#)

[Lecture 40 - Nano fluid Heat transfer - Part 2](#)

[Lecture 41 - Measurement techniques in Micro and Nanoscale Heat transfer - Part 1](#)

[Lecture 42 - Measurement techniques in Micro and Nanoscale Heat transfer - Part 2](#)

- Lecture 1 - 1D-2D-3D lattice
- Lecture 2 - Stereographic projection - 1
- Lecture 3 - Stereographic Projection - 2
- Lecture 4 - Symmetry in 1-D crystals
- Lecture 5 - Symmetry in 2-D crystals
- Lecture 6 - Symmetry in 3-D crystals
- Lecture 7 - Understanding IUCr tables
- Lecture 8 - Symmetry in 3-D Crystals
- Lecture 9 - Reciprocal lattice
- Lecture 10 - Directions Planes and zone axes
- Lecture 11 - Interplanar distances and angles
- Lecture 12 - Diffraction - 1
- Lecture 13 - Diffraction - 2
- Lecture 14 - Diffraction - Structure and Shape Factor
- Lecture 15 - Transformation of Indices
- Lecture 16 - Microscope - 1
- Lecture 17 - Microscope - 2
- Lecture 18 - Kikuchi Diffraction
- Lecture 19 - Double Diffraction and CBED
- Lecture 20 - CBED and Precession Electron Diffraction
- Lecture 21 - Indexing Diffraction Pattern
- Lecture 22 - Correlation of Diffraction Spots to Microstructure
- Lecture 23 - 3-Index to 4-Index System
- Lecture 24 - Kinematical and Dynamical Theory of Diffraction and Imaging
- Lecture 25 - Contrast from Planar Defects
- Lecture 26 - Contrast from Strain Fields
- Lecture 27 - Atomic Scattering Factor
- Lecture 28 - Coherence
- Lecture 29 - Lens Aberrations
- Lecture 30 - Phase Contrast Microscopy - 1
- Lecture 31 - Phase Contrast Microscopy - 2

[Lecture 32 - Phase Contrast Microscopy - 3](#)

[Lecture 33 - STEM](#)

[Lecture 34 - ELES and EDS](#)

[Lecture 35 - Recent trends](#)

[Lecture 36 - Energy dispersive Spectroscopy](#)

[Lecture 37 - Revision - 1](#)

[Lecture 38 - Revision - 2](#)

[Lecture 39 - Revision of Recent trends in Microscopy](#)

[Lecture 40 - Crystallography Revision](#)



- Lecture 1 - Module 1 - Introduction - 1
- Lecture 2 - Module 1 - Introduction - 2
- Lecture 3 - Module 2 - Governing Equation - 1
- Lecture 4 - Module 2 - Governing Equation - 2
- Lecture 5 - Module 3 - Plane Wave - 1
- Lecture 6 - Module 3 - Plane Wave - 2
- Lecture 7 - Module 4 - Reflection Of Plane Waves - 1
- Lecture 8 - Module 4 - Reflection Of Plane Waves - 2
- Lecture 9 - Module 5 - Frequency Analysis - 1
- Lecture 10 - Module 5 - Frequency Analysis - 2
- Lecture 11 - Module 6 - Harmonic Plane Waves
- Lecture 12 - Module 7 - Travelling And Standing Waves
- Lecture 13 - Module 8 - Acoustic Mode Shapes, Reflection
- Lecture 14 - Module 9 - Plane Waves : Reflection and Intermission
- Lecture 15 - Module 10 - Flexural Waves, evanescent Waves
- Lecture 16 - Module 11 - Near Field Acoustic Waves
- Lecture 17 - Module 12 - cuton Waves in duct
- Lecture 18 - Module 13 - Power Calculation
- Lecture 19 - Module 14 - Decibel Scale
- Lecture 20 - Module 15 - Db Arithmetic
- Lecture 21 - Module 16 - Sound Power Level
- Lecture 22 - Module 17 - Human factors in Acoustic Engineering
- Lecture 23 - Module 18 - Microphone
- Lecture 24 - Module 19 - Acoustic Measurements
- Lecture 25 - Module 20 - Muffler Analysis
- Lecture 26 - Module 21 - Transfer Matrix Method
- Lecture 27 - Module 22 - Electro Mechanical Analogies - Part 1
- Lecture 28 - Module 23 - Electro Mechanical Analogies Simple Example
- Lecture 29 - Module 24 - Electro Mechanical Analogies Example
- Lecture 30 - Module 25 - Helmholtz Resonator
- Lecture 31 - Module 26 - Source Impedance

[Lecture 32 - Module 27 - Insertion Loss](#)

[Lecture 33 - Module 28 - Analysis Of Industrial Mufflers](#)

[Lecture 34 - Module 29 - Spherical Waves](#)

[Lecture 35 - Module 30 - Monopole and Dipole](#)

[Lecture 36 - Module 31 - Inhomogeneous Wave Equation](#)

[Lecture 37 - Module 32 - Green's Function](#)

[Lecture 38 - Module 33 - Kirchoff Helmholtz Integral Equation](#)

[Lecture 39 - Tutorial 1](#)

[Lecture 40 - Tutorial 2](#)

[Lecture 41 - Tutorial 3](#)

[Lecture 42 - Tutorial 4](#)

Lecture 1 - Concept of Steel Quality

Lecture 2 - Control of Residuals and Impact on Quality

Lecture 3 - Non-Metallic Inclusions

Lecture 4 - Evaluation of Residuals and Inclusions

Lecture 5 - Cleanliness Requirements for Different applications

Lecture 6 - Limitation of Primary Steelmaking and Importance of secondary Refining

Lecture 7 - Deoxidation

Lecture 8 - Prevention of Slag carryover

Lecture 9 - Desulphurisation

Lecture 10 - Degassing

Lecture 11 - Secondary Refining Processes

Lecture 12 - Injection of Calcium

Lecture 13 - Different Routes and Temperature Control

Lecture 14 - Decarburisation

Lecture 15 - Cleanliness Measures in Ladle and Tundish

Lecture 16 - Cleanliness Measures in Mould

Lecture 17 - Nature and Distribution of Entrapments in Casting

Lecture 18 - Genesis of Entrapment

Lecture 19 - Effect of Vertical vis-a-vis Curved Mould

Lecture 20 - Quality of Cast Product

Lecture 21 - Role of Concast Process, Caster Design and Steel Grade

Lecture 22 - Primary Cooling in Caster Mould

Lecture 23 - Heat Transfer in Mould

Lecture 24 - Role of Mould Oscillation

Lecture 25 - Cast Structure and Dendrite Size

Lecture 26 - Role of Chemistry - Part I

Lecture 27 - Role of Chemistry - Part II

Lecture 28 - Role of Segregation - Part I

Lecture 29 - Role of Segregation - Part II

Lecture 30 - Deleterious Effect of Phosphorus

Lecture 31 - Strength of Solidifying Strand

[Lecture 32 - Brittle Zone Near Solidus](#)

[Lecture 33 - Strength and Toughness of Solid Shell](#)

[Lecture 34 - Role of Chemistry on Solidification Behaviour](#)

[Lecture 35 - Sticking vis-a-vis Depression Behaviour](#)

[Lecture 36 - Role of Chemistry on Bulging or Depression Tendency - Part I](#)

[Lecture 37 - Role of Chemistry on Bulging or Depression Tendency - Part II](#)

[Lecture 38 - Effect of Cast Grain Size](#)

[Lecture 39 - Brittle Temperature Regions](#)

[Lecture 40 - Typical Cracks and Defects - Part I](#)

[Lecture 41 - Typical Cracks and Defects - Part II](#)

[Lecture 42 - Remedial Measures to Control Defects - Part I](#)

[Lecture 43 - Remedial Measures to Control Defects - Part II](#)

[Lecture 44 - Remedial Measures to Control Defects - Part III](#)

[Lecture 45 - Grade - Specific Casting Parameters - Part I](#)

[Lecture 46 - Grade - Specific Casting Parameters - Part II](#)

[Lecture 47 - Identification of Genesis of Quality Problems Through Metallographic Investigation - Part I](#)

[Lecture 48 - Identification of Genesis of Quality Problems Through Metallographic Investigation - Part II](#)

[Lecture 49 - Identification of Genesis of Quality Problems Through Metallographic Investigation - Part III](#)

Lecture 1 - Geometry of Crystals

Lecture 2 - Geometry of Crystals (Continued...)

Lecture 3 - Tutorial-1

Lecture 4 - Reciprocal Lattice

Lecture 5 - Stereographic Projection

Lecture 6 - Tutorial-2

Lecture 7 - Point Groups and Space Groups

Lecture 8 - Point Groups and Space Groups (Continued...)

Lecture 9 - Tutorial-3

Lecture 10 - Point Groups and Space Groups (Continued...)

Lecture 11 - Basics of X-Rays

Lecture 12 - Production and Detection of X-Rays

Lecture 13 - Production and Detection of X-Rays (Continued...)

Lecture 14 - Principles of X-Ray Diffraction

Lecture 15 - X-Ray Diffraction Methods

Lecture 16 - Debye Sherrer Camera

Lecture 17 - Diffractometer Measurements

Lecture 18 - Tutorial-4

Lecture 19 - Intensity of Diffracted Beams

Lecture 20 - Intensity of Diffracted Beams (Continued...)

Lecture 21 - Determination of Crystal Structures

Lecture 22 - Precise Lattice Parameter Determination

Lecture 23 - XRD - Lab Demonstration

Lecture 24 - Discussion - Based on Forum Queries - 1

Lecture 25 - Phase Diagram Determination

Lecture 26 - Ordered Disordered Transformation

Lecture 27 - Ordered Disordered Transformation (Continued...)

Lecture 28 - Qualitative Phase Analysis

Lecture 29 - Quantitative Phase Analysis - 1

Lecture 30 - Precise Lattice Parameter Determination - 1

Lecture 31 - Chemical Analysis by X-Ray Fluorescence

[Lecture 32 - Chemical Analysis by X-Ray Absorption](#)

[Lecture 33 - Effect of Crystallite Size on Diffracted X-Ray Intensity](#)

[Lecture 34 - Texture Determination by XRD](#)

[Lecture 35 - Particle Size Determination by XRD](#)

[Lecture 36 - Effect of Crystallite Size on Diffracted X-Ray Intensity](#)

[Lecture 37 - Determination of Single Crystal Orientation by X-Rays](#)

[Lecture 38 - Stress Analysis by X-Rays](#)

[Lecture 39 - Factors Contributing to Peak Broadening](#)

[Lecture 40 - Residual Stress Measurement by X-Rays](#)

Lecture 1 - Subscript Notation - Part 1

Lecture 2 - Subscript Notation - Part 2

Lecture 3 - Coordinate Rotation

Lecture 4 - Introduction to Tensors

Lecture 5 - Symmetry of Properties

Lecture 6 - Material Derivative

Lecture 7 - Planar Flows

Lecture 8 - Reynolds Transport Theorem

Lecture 9 - Derivation of Navier-Stokes equation

Lecture 10 - Navier Stokes equations - Part 2

Lecture 11 - Flow problem statements

Lecture 12 - Simple cases in fluid flow : rectangular coordinate system

Lecture 13 - Simple cases in fluid flow : cylindrical coordinate system

Lecture 14 - Pipe flow and porous medium

Lecture 15 - Simple cases in fluid flow : spherical coordinate system

Lecture 16 - Friction factors and correlations

Lecture 17 - Energy Transport

Lecture 18 - Conduction cases - Steady state

Lecture 19 - Conduction cases - Transient state

Lecture 20 - Convective heat transfer

Lecture 21 - Mass Transfer Overview

Lecture 22 - Chemical Equilibrium

Lecture 23 - Reaction Equilibrium

Lecture 24 - Species Balance Equation

Lecture 25 - Solute Transfer Modelling - Part 1

Lecture 26 - Solute Transfer Modelling - Part 2

Lecture 27 - Solute Segregation Profile - Part 1

Lecture 28 - Solute Segregation Profile - Part 2

Lecture 29 - Problem Statements

Lecture 30 - Diffusion in Solid State

Lecture 31 - Transient Solute Diffusion in Solid State

[Lecture 32 - Mass Transfer in Fluids](#)

[Lecture 33 - Similarity Across Transport Phenomena](#)



Lecture 1 - Overview of Experimental Stress Analysis

Lecture 2 - Optical Methods Work as Optical Computers

Lecture 3 - Stress, Strain and Displacement Fields

Lecture 4 - Completeness of a numerical solution

Lecture 5 - Fringe Patterns - Richness of Qualitative Information

Lecture 6 - Multi-Scale Analysis in Experimental Mechanics

Lecture 7 - Selection of an Experimental Technique

Lecture 8 - Introduction to Transmission Photoelasticity

Lecture 9 - Ordinary and Extraordinary Rays

Lecture 10 - Light Ellipse, Passage of Light Through a Crystal Plate

Lecture 11 - Retardation Plates, Stress-optic Law

Lecture 12 - Plane Polariscopes

Lecture 13 - Jones Calculus

Lecture 14 - Circular Polariscopes

Lecture 15 - Determination of Photoelastic Parameters at an Arbitrary Point

Lecture 16 - Tardy's Method of Compensation

Lecture 17 - Calibration of Photoelastic Materials

Lecture 18 - Fringe Thinning Methodologies

Lecture 19 - Fringe Ordering in Photoelasticity

Lecture 20 - Miscellaneous Topics in Transmission Photoelasticity

Lecture 21 - Three Dimensional Photoelasticity

Lecture 22 - Overview of Digital Photoelasticity

Lecture 23 - Introduction to Photoelastic Coatings

Lecture 24 - Correction Factors for Photoelastic Coatings

Lecture 25 - Coating Materials, Selection of Coating Thickness, Industrial Application of Photoelastic Coatings

Lecture 26 - Calibration of Photoelastic Coatings, Introduction to Brittle Coatings

Lecture 27 - Analysis of Brittle Coatings

Lecture 28 - Introduction to Strain Gauges

Lecture 29 - Strain Sensitivity of a Strain Gauge, Bridge Sensitivity, Rosettes

Lecture 30 - Strain Gauge Alloys, Carriers and Adhesives

Lecture 31 - Performance of Strain Gauge System

[Lecture 32 - Temperature Compensation, Two-wire and Three-wire Circuits](#)

[Lecture 33 - Strain Gauge Selection](#)

[Lecture 34 - Bonding of a Strain Gauge](#)

[Lecture 35 - Soldering, Accounting for Transverse Sensitivity Effects](#)

[Lecture 36 - Correction Factors for Special Applications](#)

[Lecture 37 - Special Gauges](#)

Lecture 1 - Basic Terminologies

Lecture 2 - Skeletal System

Lecture 3 - Axial and Appendicular Skeleton

Lecture 4 - Bones in the Human Body

Lecture 5 - Types of Joints

Lecture 6 - Movements about Joints

Lecture 7 - Levers in the Human Body

Lecture 8 - Skeletal Muscles: Functions

Lecture 9 - Skeletal Muscles: Structure - Part I

Lecture 10 - Skeletal Muscles: Structure - Part II

Lecture 11 - Mechanics and Modeling of Muscles

Lecture 12 - Muscle Action - Part I

Lecture 13 - Muscle Action - Part II

Lecture 14 - Principles of Statics

Lecture 15 - Static Analysis of Elbow - Part I

Lecture 16 - Static Analysis of Elbow - Part II

Lecture 17 - Static Analysis of Shoulder - Part I

Lecture 18 - Static Analysis of Shoulder - Part II

Lecture 19 - Static Analysis of Spine - Part I

Lecture 20 - Static Analysis of Spine - Part II

Lecture 21 - Static Analysis of Spine - Part III

Lecture 22 - Static Analysis of Hip - Part I

Lecture 23 - Static Analysis of Hip - Part II

Lecture 24 - Static Analysis of the Knee

Lecture 25 - Static Analysis of the Knee and Ankle

Lecture 26 - Kinetics: Linear Motion - Part I

Lecture 27 - Kinetics: Linear Motion - Part II

Lecture 28 - Kinetics: Linear Motion - Part III

Lecture 29 - Kinetics: Angular Motion - Part I

Lecture 30 - Kinetics: Angular Motion - Part II

Lecture 31 - Kinetics: Angular Motion - Part III

- [Lecture 32 - Kinetics: Angular Motion - Part IV](#)
- [Lecture 33 - Kinetics of Arm Swinging during Walking](#)
- [Lecture 34 - Inverse Dynamics Analysis](#)
- [Lecture 35 - Biomechanics of Balance - Part I](#)
- [Lecture 36 - Biomechanics of Balance - Part II](#)
- [Lecture 37 - Biomechanics of Balance - Part III](#)
- [Lecture 38 - Human Gait](#)
- [Lecture 39 - Human Gait Terminologies](#)
- [Lecture 40 - Characteristics of Normal Gait - Part I](#)
- [Lecture 41 - Characteristics of Normal Gait - Part II](#)
- [Lecture 42 - Characteristics of Normal Gait - Part III](#)
- [Lecture 43 - Pathological Gait - Part I](#)
- [Lecture 44 - Pathological Gait - Part II](#)
- [Lecture 45 - Pathological Gait - Part III](#)
- [Lecture 46 - Introduction to Assistive Devices for Mobility](#)
- [Lecture 47 - Design Considerations: Prosthetic Foot](#)
- [Lecture 48 - Design Considerations: Prosthesis and Orthosis](#)
- [Lecture 49 - Design Considerations: Prosthetic Knee](#)
- [Lecture 50 - Journey of Standing Wheelchair Development](#)

# DIGIMAT - The No.1 Autonomous Learning Platform for Creative Learning

**NPTEL : NOC:Design for Quality, Manufacturing and Assembly (Mechanical Engineering)**

**Co-ordinators : Prof. Palaniappaan Ramu**

Lecture 1 - Introduction to DfX

Lecture 2 - Introduction to Quality

Lecture 3 - Introduction to Robustness

Lecture 4 - Introduction to Six Sigma Concept

Lecture 5 - Recap and clarifications of basic concepts

Lecture 6 - Review of Six Sigma and Quality Loss Function (QLF)

Lecture 7 - Types of QLF and SN Ratio

Lecture 8 - Linking Quality and Robustness

Lecture 9 - Design for Six Sigma - Stages, Design of Experiments

Lecture 10 - Introduction To Design Of Experiments

Lecture 11 - Need for DoE and basic DoE methods

Lecture 12 - Factorial Design

Lecture 13 - Orthogonal Array- L4 and L8 example

Lecture 14 - Setting up an Orthogonal Array

Lecture 15 - Confounding OA and Resolution Table

Lecture 16 - Confounding Logic and Randomization of Experiments

Lecture 17 - Paper Helicopter Case Study - Part I

Lecture 18 - Paper Helicopter Case Study - Part II

Lecture 19 - Introduction To Injection Molding Process, Materials, Terminologies Related To Plastic Parts and Design Guidelines

Lecture 20 - Estimation of Mold Cost for Injection Molding (Dixon and Poli's Method)

Lecture 21 - Estimation of Mold Cost for Injection Molding (Dixon and Poli's Method) (Continued...)

Lecture 22 - Mold Cost Estimation - Tutorial

Lecture 23 - Design for Additive Manufacturing

Lecture 24 - Demo

Lecture 25 - Introduction to Sustainable Development and Sustainability Indicators - Part 1

Lecture 26 - Introduction to Sustainable Development and Sustainability Indicators - Part 2

Lecture 27 - Introduction to design process

Lecture 28 - Accounting for manufacturability and assembly in design - An overview

Lecture 29 - DfMA in product design

Lecture 30 - General design guidelines for manual assembly

Lecture 31 - Systematic DFA methodology

[Lecture 32 - Alpha symmetry, Beta symmetry](#)

[Lecture 33 - Quantification of part size and thickness](#)

[Lecture 34 - Systematic DFA Case study - controller assembly](#)

[Lecture 35 - DFA examples and discussion](#)

[Lecture 36 - Xerox Producibility Index \(XPI\)](#)

[Lecture 37 - High Speed and Robotic Assembly](#)

[Lecture 38 - Sheet Metal Working](#)

[Lecture 39 - Overview of DoE Workflow](#)

[Lecture 40 - DFA Software](#)

[Lecture 41 - DFM Software and Case Studies](#)

Lecture 1 - Overview and Motivation of Course

Lecture 2 - Basic Optimization Problem Formulation

Lecture 3 - Problem Formulation Example

Lecture 4 - Calculus related to Optimization

Lecture 5 - The big picture - Overview

Lecture 6 - Introduction to DOE - 1

Lecture 7 - Introduction to DOE - 2

Lecture 8 - Types of DOE - 1

Lecture 9 - Types of DOE - 2 and some examples

Lecture 10 - Introduction to surrogate modeling

Lecture 11 - Types of surrogate - Polynomial models

Lecture 12 - Radial basis function - 1

Lecture 13 - Radial basis function - 2

Lecture 14 - Kriging - 1

Lecture 15 - Kriging - 2

Lecture 16 - Metamodels for Safe and Efficient Automotive Structures

Lecture 17 - Exploration and Exploitation in Surrogates

Lecture 18 - Errors Based Exploration

Lecture 19 - Ensemble of Surrogates

Lecture 1 - Concept of Steel Quality

Lecture 2 - Typical Examples of Surface Defects

Lecture 3 - Origin of Common Quality Problems

Lecture 4 - Present Scenario on Quality Demands

Lecture 5 - Control of Residuals and Impact on Quality

Lecture 6 - Non-Metallic Inclusions

Lecture 7 - Evaluation of Residuals and Inclusions

Lecture 8 - Cleanliness Requirements for Different applications

Lecture 9 - Limitation of Primary Steelmaking and Importance of secondary Refining

Lecture 10 - Deoxidation

Lecture 11 - Prevention of Slag carryover

Lecture 12 - Desulphurisation

Lecture 13 - Degassing

Lecture 14 - Secondary Refining Processes

Lecture 15 - Injection of Calcium

Lecture 16 - Decarburisation

Lecture 17 - Cleanliness Measures in Ladle and Tundish

Lecture 18 - Cleanliness Measures in Mould

Lecture 19 - Different Routes and Temperature Control

Lecture 20 - Nature and Distribution of Entrapments in Casting

Lecture 21 - Sources of Exogenous Entrapments

Lecture 22 - Effect of Vertical vis-a-vis Curved Mould

Lecture 23 - Quality of Cast Product

Lecture 24 - Role of Concast Process, Caster Design and Steel Grade

Lecture 25 - Primary Cooling in Caster Mould

Lecture 26 - Heat Transfer in Mould

Lecture 27 - Cast Structure and Dendrite Size

Lecture 28 - Role of Mould Oscillation

Lecture 29 - Role of Chemistry - Part I

Lecture 30 - Role of Chemistry - Part II

Lecture 31 - Role of Segregation - Part I



[Lecture 32 - Role of Segregation - Part II](#)

[Lecture 33 - Deleterious Effect of Phosphorus](#)

[Lecture 34 - Strength of Solidifying Strand](#)

[Lecture 35 - Brittle Zone Near Solidus](#)

[Lecture 36 - Strength and Toughness of Solid Shell](#)

[Lecture 37 - Role of Chemistry on Solidification Behaviour](#)

[Lecture 38 - Sticking vis-a-vis Depression Behaviour](#)

[Lecture 39 - Role of Chemistry on Bulging or Depression Tendency - Part I](#)

[Lecture 40 - Role of Chemistry on Bulging or Depression Tendency - Part II](#)

[Lecture 41 - Effect of Cast Grain Size](#)

[Lecture 42 - Brittle Temperature Regions](#)

[Lecture 43 - Role of Secondary Cooling - Part 1](#)

[Lecture 44 - Role of Secondary Cooling - Part 2](#)

[Lecture 45 - Typical Cracks and Defects - Part I](#)

[Lecture 46 - Typical Cracks and Defects - Part II](#)

[Lecture 47 - Remedial Measures to Control Defects - Part I](#)

[Lecture 48 - Remedial Measures to Control Defects - Part II](#)

[Lecture 49 - Remedial Measures to Control Defects - Part III](#)

[Lecture 50 - Grade - Specific Casting Parameters - Part I](#)

[Lecture 51 - Grade - Specific Casting Parameters - Part II](#)

[Lecture 52 - Identification of Genesis of Quality Problems Through Metallographic Investigation - Part I](#)

[Lecture 53 - Identification of Genesis of Quality Problems Through Metallographic Investigation - Part II](#)

[Lecture 54 - Identification of Genesis of Quality Problems Through Metallographic Investigation - Part III](#)

[Lecture 55 - Some Examples of Quality Problems](#)

- Lecture 1 - Review of Kinematics Fundamentals-I
- Lecture 2 - Links, Pairs, Kinematic Chains; Planar Mobility Criterion
- Lecture 3 - Mobility of Mechanisms, Grubler's Criterion and Applications
- Lecture 4 - Inversions, Grashof Criterion, Kinematic equivalence
- Lecture 5 - Linkage Synthesis Classification, 2-position Motion Generation
- Lecture 6 - Driver dyad, Quick-return synthesis - I
- Lecture 7 - Quick-return synthesis - II, 3-position Motion Generation
- Lecture 8 - Specified fixed pivots, Path generation
- Lecture 9 - Function generation
- Lecture 10 - Function generation using relative poles
- Lecture 11 - Structural Error, and Chebyshev Spacing
- Lecture 12 - Chebyshev Spacing
- Lecture 13 - Analytical Linkage Synthesis-I: Vector Loop Closure, Freudenstein's method
- Lecture 14 - Analytical Linkage Synthesis-II: Bloch's method, Driver Dyad
- Lecture 15 - Four-bar Position Analysis, Dyad or Standard Form Synthesis
- Lecture 16 - Dyad Form Synthesis: Motion Generation
- Lecture 17 - Dyad Form Synthesis: Path and Function Generation
- Lecture 18 - Dyad Form Synthesis: Multi loop linkages
- Lecture 19 - Dyad Form Synthesis: Four Position Motion Generation
- Lecture 20 - Coupler Curves - I
- Lecture 21 - Coupler Curves - II, Fixed and Moving Centroids
- Lecture 22 - Coupler Curves - III, Symmetrical Coupler Curves
- Lecture 23 - Roberts-Chebyshev Theorem
- Lecture 24 - Cognates
- Lecture 25 - Velocity Analysis: Review of Velocity Polygons
- Lecture 26 - Velocity Analysis: Velocity Polygons (Continued...) and Instant Centres
- Lecture 27 - Velocity Analysis: Auxiliary Point Method
- Lecture 28 - Auxiliary Point Method: (Continued...)
- Lecture 29 - Velocity and Acceleration Analysis: Analytical Method
- Lecture 30 - Acceleration Analysis: Analytical Method (Continued...)
- Lecture 31 - Acceleration Analysis: Auxiliary Point Method

[Lecture 32 - Force Analysis of Mechanisms, Mechanical Advantage](#)

[Lecture 33 - Force Analysis of Mechanisms - II](#)

[Lecture 34 - Balancing of Mechanisms using Counterweights](#)

[Lecture 35 - Balancing of Mechanisms using Springs](#)

[Lecture 36 - Spatial Mechanisms](#)

[Lecture 37 - Introduction to the Kinematics of Spatial Mechanisms](#)

Lecture 1 - Introduction to Engineering Mechanics - I

Lecture 2 - Introduction to Engineering Mechanics - II

Lecture 3 - Force Systems - I

Lecture 4 - Force Systems - II

Lecture 5 - Equilibrium of Rigid bodies - I

Lecture 6 - Equilibrium of Rigid bodies - II

Lecture 7 - Trusses - I

Lecture 8 - Trusses - II

Lecture 9 - Trusses - III

Lecture 10 - Beams - I

Lecture 11 - Beams - II

Lecture 12 - Beams - III

Lecture 13 - Beams - IV

Lecture 14 - Virtual Work - I

Lecture 15 - Virtual Work - II

Lecture 16 - Energy Relations

Lecture 17 - Review Before Quiz - I

Lecture 18 - Friction - I

Lecture 19 - Friction - II

Lecture 20 - Friction - III

Lecture 21 - Particle Dynamics

Lecture 22 - Circular Motion

Lecture 23 - Absolute Motion

Lecture 24 - Relative Motion - I

Lecture 25 - Relative Motion - II

Lecture 26 - Relative Motion - III and Instantaneous Center

Lecture 27 - Rotating frame of reference I - Velocity

Lecture 28 - Rotating frame of reference II - Acceleration

Lecture 29 - Rotating frame of reference III - Choice of rotating frame of reference

Lecture 30 - RFR- IV Crank and slotted bar

Lecture 31 - RFR-V Understanding Coriolis Acceleration

[Lecture 32 - Kinetics - I](#)

[Lecture 33 - Kinetics - II](#)

[Lecture 34 - Kinetics - III](#)

[Lecture 35 - 3D Kinematics - I](#)

[Lecture 36 - 3D Kinematics - II](#)

[Lecture 37 - 3D Kinematics - III](#)

- Lecture 1 - Introduction to the course
- Lecture 2 - Some applications of MD simulations
- Lecture 3 - Introduction to Bravais lattices and constructing simple crystals with MATLAB
- Lecture 4 - Introduction to symmetry - 1
- Lecture 5 - Symmetry Elements - 1
- Lecture 6 - Symmetry elements - 2
- Lecture 7 - Plane groups and their Hermann-Mauguin (HM) symbols
- Lecture 8 - Glide reflection; Examples of writing point group symbols; Wyckoff positions
- Lecture 9 - Generating 2D crystal with MATLAB using Bilbao crystallography website
- Lecture 10 - Symmetry of space groups
- Lecture 11 - Hermann mauguin symbols of space groups
- Lecture 12 - Translational symmetry operators
- Lecture 13 - The Space groups
- Lecture 14 - Generation of crystals
- Lecture 15 - Generation of monoclinic lattice
- Lecture 16 - Introduction to Statistical Mechanics - 1
- Lecture 17 - Introduction to Statistical Mechanics - 2
- Lecture 18 - Introduction to Statistical Mechanics - 3
- Lecture 19 - Statistical mechanics - 1
- Lecture 20 - Statistical mechanics - 2
- Lecture 21 - Basic introduction to mechanics
- Lecture 22 - Introduction to phase space
- Lecture 23 - Introduction to phase average and time average
- Lecture 24 - Canonical ensemble; Partition function
- Lecture 25 - Basic introduction to MD
- Lecture 26 - Input script for LAMMPS - 1
- Lecture 27 - Input script for LAMMPS - 2
- Lecture 28 - Input script for LAMMPS - 3
- Lecture 29 - Input script for LAMMPS - 4
- Lecture 30 - LAMMPS exercises - 1
- Lecture 31 - LAMMPS exercises - 2

[Lecture 32 - LAMMPS exercises - 3](#)

[Lecture 33 - LAMMPS exercises - 4](#)

[Lecture 34 - LAMMPS exercises - 5](#)

Lecture 1 - Introduction

Lecture 2 - Combustion processes in ICE and Gas turbine engines

Lecture 3 - Combustion in solid and liquid rocket motors

Lecture 4 - Equilibrium

Lecture 5 - Chemical kinetics, Equilibrium vs rate controlled

Lecture 6 - Demonstration of NASA-CEA

Lecture 7 - Premixed and diffusion flames: principal features and differences - Part I

Lecture 8 - Premixed and diffusion flames: principal features and differences - Part II

Lecture 9 - Quenching, flammability and other limit phenomena

Lecture 10 - Conservation equations

Lecture 11 - Integral Analysis of flame

Lecture 12 - Solid propellant combustion

Lecture 13 - Erosive burning

Lecture 14 - Instability in solid rockets

Lecture 15 - Analysis of p-t traces - Part II

Lecture 16 - Statistical representation of composite propellants in HeQu1D - geometry and thermochemistry

Lecture 17 - HeQu1D model - Parameter estimation

Lecture 18 - Effects of Al - extended HeQu1D model

Lecture 19 - Instability in solid rockets - II

Lecture 20 - Tutorial

Lecture 21 - Liquid propellant rockets - Part I

Lecture 22 - Liquid propellant rockets - Part II

Lecture 23 - Combustion in liquid rockets

Lecture 24 - Instabilities in liquid rockets and gas turbine after burners

Lecture 25 - CFD modeling aspects - Fundamentals

Lecture 26 - CFD modeling aspects - Modeling approaches

Lecture 27 - Effect of turbulence on flames

Lecture 28 - Scramjets - Part I

Lecture 29 - Scramjets - Part II

Lecture 30 - Summary - Premixed flames

Lecture 31 - Summary - Non-premixed flames



[Lecture 32 - Summary - Solid rocket propulsion](#)

[Lecture 33 - Additional Insights](#)

Lecture 1 - Introduction

Lecture 2 - Material Property Landscape

Lecture 3 - Crystal Structure-1 (Platonic Solids)

Lecture 4 - Crystal Structure-2 (Unit Cell, Lattice, Crystal)

Lecture 5 - Crystal Structure-3 (Bravais lattice, Symmetry in Crystals)

Lecture 6 - Crystal Structure-4 (Miller Indices for Crystallographic Points and Directions)

Lecture 7 - Crystal Structure-5 (Miller-Bravais Indices, Linear and Planar Density)

Lecture 8 - Crystal Structure-6 (Planar density, Close-Packed Structures, Stacking Faults)

Lecture 9 - Crystal Structure-7 (Single Crystal and Polycrystalline Materials)

Lecture 10 - Crystal Structure-8 (X-Ray Diffraction and Determination of Structure)

Lecture 11 - Defects in Crystalline Materials-1 (Types of Crystalline Defects)

Lecture 12 - Defects in Crystalline Materials-1 (Point Defects)

Lecture 13 - Defects in Crystalline Materials-1 (Equilibrium Concentration of Vacancies)

Lecture 14 - Defects in Crystalline Materials-1 (Theoretical Shear Strength)

Lecture 15 - Defects in Crystalline Materials-2 (Effect of Point Defects)

Lecture 16 - Defects in Crystalline Materials-2 (Point Defects and Solid Solutions)

Lecture 17 - Defects in Crystalline Materials-3 (Line Defects, Types of Dislocations and their Characteristics)

Lecture 18 - Defects in Crystalline Materials-4 (Slip Systems, Burger's Vector and Dislocation Motion)

Lecture 19 - Defects in Crystalline Materials-4 (Slip in Single Crystals and Resolved Shear Stress)

Lecture 20 - Defects in Crystalline Materials-5 (Different Stages of Slip in Single Crystalline Materials)

Lecture 21 - Defects in Crystalline Materials-5 (Geometry and Slip, Stress Field Around a Dislocation and Deformation Twinning)

Lecture 22 - Defects in Crystalline Materials-6 (Twinning, Interfacial Defects and Volume Defects)

Lecture 23 - Defects in Crystalline Materials-6 (Strengthening Mechanisms)

Lecture 24 - Defects in Crystalline Materials-7 (Plastic deformation in polycrystalline materials, Softening Mechanisms)

Lecture 25 - Mechanical Properties of Materials (Concept of Stress Tensor)

Lecture 26 - Mechanical Properties (Tension Test-Elastic Deformation)

Lecture 27 - Mechanical Properties (Tension Test - Plastic Deformation)

Lecture 28 - Mechanical Properties (Tension Test - Plastic Deformation)

Lecture 29 - Mechanical Properties (Hardness Test)

Lecture 30 - Static Failure Theories (Introduction, Definition of Failure)

Lecture 31 - Static Failure Theories (General form of failure theory, Stress tensor, Principal stress)

[Lecture 32 - Static Failure Theories \(Distortion Energy Theory\)](#)

[Lecture 33 - Static Failure Theories \(Maximum Shear Stress Theory\)](#)

[Lecture 34 - Static Failure Theories \(Design Problems\)](#)

[Lecture 35 - Static Failure Theories \(Failure of Brittle Materials\)](#)

[Lecture 36 - Static Failure Theories \(Coulomb-Mohr and Modified Coulomb-Mohr\)](#)

[Lecture 37 - Static Failure Theories \(Notches and Stress Concentration\)](#)

[Lecture 38 - Introduction to Fracture Mechanics, Griffith's Analysis of a Cracked Body](#)

[Lecture 39 - Fracture Mechanics \(Energy Release Rate\)](#)

[Lecture 40 - Fracture Mechanics \(Crack Resistance, Stress Intensity Factor, Fracture Toughness\)](#)

[Lecture 41 - Fatigue Failure of Materials \(Introduction, Historical Events, S-N Diagram\)](#)

[Lecture 42 - Fatigue Failure of Materials \(S-N Diagram, Types of Time Varying Loads\)](#)

[Lecture 43 - Fatigue Failure of Materials \(High Cycle Fatigue, Low Cycle Fatigue, Stress Ratio, Amplitude Ratio\)](#)

[Lecture 44 - Fatigue Failure of Materials \(Rotating Beam Bending Test, Estimated S-N diagram\)](#)

[Lecture 45 - Fatigue Failure Theories \(Fatigue strength correction factors\)](#)

[Lecture 46 - Problems on Fatigue Failure-1 \(S-N diagram and Corrected endurance strength\)](#)

[Lecture 47 - Fatigue Failure of Materials \(Features of Fatigue Failure; Factor of Safety in Life and Stress\)](#)

[Lecture 48 - Fatigue Failure of Materials \(Effect of Mean Stress\)](#)

[Lecture 49 - Fatigue Failure of Materials \(Multiaxial Fatigue and Variable Amplitude Loading\)](#)

[Lecture 50 - Fatigue Failure of Materials \(Fatigue Stress Concentration Factor\)](#)

[Lecture 51 - Fatigue Failure of Materials \(Fatigue Crack Growth, Paris' law\)](#)

[Lecture 52 - Problems on Fatigue Failure-2 \(Effect of mean stress, Fatigue crack growth\)](#)

[Lecture 53 - Problems on Fatigue Failure-3 \(Effect of Notch, Multiaxial Loading\)](#)

[Lecture 54 - Phase Diagrams \(Introduction\)](#)

[Lecture 55 - Phase Diagrams \(Language of Phase Diagrams, Types of Binary Phase Alloys\)](#)

[Lecture 56 - Phase Diagrams \(Tie line, Lever Rule, Identification of compositions and weight fractions in two-phase regions\)](#)

[Lecture 57 - Phase Diagrams \(Type I: Isomorphous Alloys, Microstructure evolution in Equilibrium and Non equilibrium cooling\)](#)

[Lecture 58 - Phase Diagrams \(Congruent Melting Alloys, Type II Alloys, Eutectic Reaction\)](#)

[Lecture 59 - Phase Diagrams \(Type III Alloys with Partial Solubility in Solid State\)](#)

[Lecture 60 - Phase Diagrams \(Congruent melting alloys, Peritectic Reaction, Monotectic Reaction\)](#)

[Lecture 61 - Phase Diagrams \(Allotropy, Eutectoid and Peritectoid Reactions\)](#)

[Lecture 62 - Phase Diagrams \(Iron-Iron Carbide Phase Diagram\)](#)

[Lecture 63 - Kinetics of Phase Transformations \(Homogeneous Nucleation\)](#)

[Lecture 64 - Kinetics of Phase Transformations \(Heterogeneous Nucleation\)](#)

[Lecture 65 - Isothermal Transformation Diagram](#)

[Lecture 66 - Martensite Transformation, C-C-T Diagram](#)

[Lecture 67 - Heat Treatment of Steels \(Annealing and Normalizing\)](#)

Lecture 1 - Review of governing equations: Conservation of mass

Lecture 2 - Review of governing equations: Conservation of momentum

Lecture 3 - Review of governing equations: Conservation of energy

Lecture 4 - Review of governing equations: Navier-Stokes equations and energy equation

Lecture 5 - Review of governing equations: General scalar transport equation

Lecture 6 - Review of governing equations: classification of PDEs

Lecture 7 - Overview of Numerical Methods: Finite Difference Method

Lecture 8 - Overview of Numerical Methods: Finite Volume Method

Lecture 9 - Overview of Numerical Methods: Solution of linear algebraic equations

Lecture 10 - Finite Volume Method for Diffusion Equation: Discretization of 1D diffusion equation

Lecture 11 - Finite Volume Method for Diffusion Equation: Discretization of 2D diffusion equation

Lecture 12 - Finite Volume Method for Diffusion Equation: Boundary conditions for 2D diffusion equation

Lecture 13 - Finite Volume Method for Diffusion Equation: Discretization of 3D diffusion equation, mixed boundary conditions

Lecture 14 - Finite Volume Method for Diffusion Equation: Tri-Diagonal Matrix Algorithm

Lecture 15 - Finite Volume Method for Diffusion Equation: Linearization of source term, line-by-line TDMA

Lecture 16 - Finite Volume Method for Diffusion Equation: Problem solving using TDMA

Lecture 17 - Finite Volume Method for Diffusion Equation: Problem solving using line-by-line TDMA

Lecture 18 - Finite Volume Method for Diffusion Equation: Steady diffusion in polar and axisymmetric coordinates

Lecture 19 - Finite Volume Method for Diffusion Equation: Discretization of unsteady diffusion equation

Lecture 20 - Finite Volume Method for Diffusion Equation: Unsteady diffusion time-stepping schemes

Lecture 21 - Finite Volume Method for Diffusion Equation: Unsteady diffusion time-stepping schemes and Truncation errors of the FV schemes

Lecture 22 - Finite Volume Method for Diffusion Equation: Truncation errors and stability analysis

Lecture 23 - Finite Volume Method for Diffusion Equation: Stability analysis and steady diffusion in unstructured meshes.

Lecture 24 - Finite Volume Method for Diffusion Equation: Steady diffusion in unstructured meshes - Part 1

Lecture 25 - Finite Volume Method for Diffusion Equation: Steady diffusion in unstructured meshes - Part 2

Lecture 26 - Finite Volume Method for Diffusion Equation: Steady diffusion in unstructured meshes - Part 3

Lecture 27 - Finite Volume Method for Diffusion Equation: Steady diffusion in unstructured meshes - Part 4

Lecture 28 - Finite Volume Method for Diffusion Equation: Steady diffusion in unstructured meshes - Part 5

Lecture 29 - Finite Volume Method for Convection and Diffusion: Discretization of steady convection equation

Lecture 30 - Finite Volume Method for Convection and Diffusion: Discretization of steady convection equation

## DIGIMAT - The No.1 Autonomous Learning Platform for Creative Learning

[Lecture 31 - Finite Volume Method for Convection and Diffusion: Discretization of steady and unsteady convection equation](#)

[Lecture 32 - Finite Volume Method for Convection and Diffusion: Discretization of unsteady convection equation](#)

[Lecture 33 - Finite Volume Method for Convection and Diffusion: Discretization of convection-diffusion equation on unstructured mesh](#)

[Lecture 34 - Finite Volume Method for Convection-diffusion and fluid flow calculations](#)

[Lecture 35 - Finite Volume Method for Fluid Flow Calculations: The staggered grid approach](#)

[Lecture 36 - Finite Volume Method for Fluid Flow Calculations: SIMPLE algorithm - Part 1](#)

[Lecture 37 - Finite Volume Method for Fluid Flow Calculations: SIMPLE algorithm - Part 2](#)

[Lecture 38 - Finite Volume Method for Fluid Flow Calculations: SIMPLE algorithm - Part 3](#)

[Lecture 39 - Finite Volume Method for Fluid Flow Calculations: SIMPLE-Revised and SIMPLE-Corrected algorithm](#)

[Lecture 40 - Finite Volume Method for Fluid Flow Calculations: SIMPLE algorithm for Colocated mesh - Part 1](#)

[Lecture 41 - Finite Volume Method for Fluid Flow Calculations: SIMPLE algorithm for Colocated mesh - Part 2](#)

[Lecture 42 - Finite Volume Method for Fluid Flow Calculations: SIMPLE-Colocated algorithm for Unstructured mesh](#)

Lecture 1 - Introduction to Mobile Robots and Manipulators

Lecture 2 - Introduction to Locomotion and Types of Locomotion

Lecture 3 - Introduction to Mobile Robot Kinematics

Lecture 4 - Degree of Maneuverability and Types of Wheels

Lecture 5 - Kinematic Simulation of a Mobile Robot (Land-based)

Lecture 6 - Kinematic Simulation and Motion Animation of a Mobile Robot (Land-based)

Lecture 7 - A Generalized Wheel (Kinematic) Model

Lecture 8 - Examples related to the Generalized Wheel (Kinematic) Model

Lecture 9 - Holonomic and Non-holonomic Mobile Robots

Lecture 10 - Kinematic Simulation of Wheeled Mobile Robots - Part 1

Lecture 11 - Kinematic Simulation of Wheeled Mobile Robots - Part 2

Lecture 12 - Kinematic Simulation of Wheeled Mobile Robots - Part 3

Lecture 13 - Mobile Robot Dynamics - Part 1

Lecture 14 - Mobile Robot Dynamics - Part 2

Lecture 15 - Equation of Motion and Dynamic Simulation of a Mobile Robot

Lecture 16 - Dynamic Models of Wheeled Mobile Robots with Wheel Configurations

Lecture 17 - Kinematic and Dynamic Models of a Mobile base with Four-Independent Steerable Power Wheels

Lecture 18 - Sensing and Perception

Lecture 19 - Sensors and Sensing

Lecture 20 - Commonly used sensors - 1

Lecture 21 - Commonly used sensors - 2

Lecture 22 - Commonly used sensors - 3

Lecture 23 - Sensor Errors and Error modelling

Lecture 24 - Mobile Robot Localisation

Lecture 25 - Map based Localisation

Lecture 26 - Markov Localisation

Lecture 27 - Kalman Filter Localisation

Lecture 28 - SLAM

Lecture 29 - Mobile Robot Navigation

Lecture 30 - Path Planning: Graph Construction

Lecture 31 - Graph Search Methods

[Lecture 32 - Path Planning and Obstacle avoidance](#)

[Lecture 33 - Introduction to Motion Control of Mobile Robots - Part 1](#)

[Lecture 34 - Introduction to Motion Control of Mobile Robots - Part 2](#)

[Lecture 35 - Kinematic control of Land-based Mobile Robots](#)

[Lecture 36 - Simulation of Land-based Mobile Robots along with Kinematic Control - Part 1](#)

[Lecture 37 - Simulation of Land-based Mobile Robots along with Kinematic Control - Part 2](#)

[Lecture 38 - Simulation of Land-based Mobile Robots along with Kinematic Control - Part 3](#)

[Lecture 39 - Dynamic Control of Mobile Robots](#)

[Lecture 40 - Cascaded or Back-stepping Control of Mobile Robots](#)

[Lecture 41 - Modern Robotics and Challenges](#)

[Lecture 42 - Multiple Mobile Robotic Systems](#)

[Lecture 43 - Autonomous Mobile Robots and Mobile Manipulators](#)

[Lecture 44 - Legged and Hybrid Robots](#)

[Lecture 45 - Underwater and Aerial Robots](#)

[Lecture 46 - Healthcare Robots](#)



Lecture 1 - Fuel and their properties - Part 1

Lecture 2 - Fuel and their properties - Part 2 - Gaseous and Liquid fuels

Lecture 3 - Fuel and their properties - Part 3 - Liquid and Solid fuels

Lecture 4 - Review of basic thermodynamics of ideal gas mixtures - Part 1

Lecture 5 - Review of basic thermodynamics of ideal gas mixtures - Part 2

Lecture 6 - Stoichiometry - Part 1

Lecture 7 - Stoichiometry - Part 2 - Worked Examples

Lecture 8 - Stoichiometry - Part 3 - Worked Examples (Continued...)

Lecture 9 - First law and Second law of thermodynamics applied to combustion - Part 1 - Heat Calculation

Lecture 10 - First law and Second law of thermodynamics applied to combustion - Part 2 - Enthalpy Calculation

Lecture 11 - First law and Second law of thermodynamics applied to combustion - Part 3 - Calculation of flame temperature

Lecture 12 - First law and Second law of thermodynamics applied to combustion - Part 4 - Chemical equilibrium

Lecture 13 - First law and Second law of thermodynamics applied to combustion - Part 5 - Chemical equilibrium (Continued...)

Lecture 14 - First law and Second law of thermodynamics applied to combustion - Part 6 - Worked examples

Lecture 15 - First law and Second law of thermodynamics applied to combustion - Part 7 - Worked examples (Continued...)

Lecture 16 - Mass transfer basics - Part 1 - Fundamentals

Lecture 17 - Mass transfer basics - Part 2 - Calculation of diffusion velocity

Lecture 18 - Mass transfer basics - Part 3 - Steady evaporation (The Stefan Problem)

Lecture 19 - Mass transfer basics - Part 4 - Steady evaporation of liquid droplet and Worked examples

Lecture 20 - Fundamentals of combustion kinetics - Part 1 - Global and elementary reactions

Lecture 21 - Fundamentals of combustion kinetics - Part 2 - Reaction rates and equilibrium constant

Lecture 22 - Fundamentals of combustion kinetics - Part 3 - Steady state and partial equilibrium approximation

Lecture 23 - Fundamentals of combustion kinetics - Part 4 - Worked examples

Lecture 24 - Governing equations for reacting flow - Part 1 - Continuity, momentum and species conservation equations

Lecture 25 - Governing equations for reacting flow - Part 2 - The energy equation

Lecture 26 - Governing equations for reacting flow - Part 3 - Estimation of thermo-physical properties and control of combustion phenomena

Lecture 27 - Governing equations for reacting flow - Part 4 - Control of combustion phenomena and simplified chemically reacting system

Lecture 28 - Governing equations for reacting flow - Part 5 - Conserved scalars and mixture fraction approach

Lecture 29 - Characteristics of combustion flame and detonation - Part 1

Lecture 30 - Characteristics of combustion flame and detonation - Part 2

- [Lecture 31 - Characteristics of combustion flame and detonation - Part 3 - Rankine-Hugoniot relation](#)
- [Lecture 32 - Characteristics of combustion flame and detonation - Part 4 - Estimation of detonation velocity and Worked examples](#)
- [Lecture 33 - Laminar Premixed Flames - Part 1 - Laminar flame propagation](#)
- [Lecture 34 - Laminar Premixed Flames - Part 2 - Laminar flame speed variation and Structure of premixed flames](#)
- [Lecture 35 - Laminar Premixed Flames - Part 3 - Flammability limits and Premixed flame theory](#)
- [Lecture 36 - Laminar Premixed Flames - Part 4 - Estimation of laminar flame speed](#)
- [Lecture 37 - Laminar Premixed Flames - Part 5 - Ignition of premixed mixture \(Semenov's Analysis\)](#)
- [Lecture 38 - Laminar Premixed Flames - Part 6 - Piloted ignition and Flame quenching](#)
- [Lecture 39 - Laminar Premixed Flames - Part 7 - Premixed flame stability](#)
- [Lecture 40 - Laminar Premixed Flames - Part 8 - Stability Maps and Worked examples](#)
- [Lecture 41 - Laminar Diffusion Flames - Part 1 - Theory of gas jets](#)
- [Lecture 42 - Laminar Diffusion Flames - Part 2 - Analysis of gas jets and jet diffusion flames](#)
- [Lecture 43 - Laminar Diffusion Flames - Part 3 - Diffusion flame characteristics and flame structure](#)
- [Lecture 44 - Laminar Diffusion Flames - Part 4 - Diffusion flame structure and Flame regimes](#)
- [Lecture 45 - Laminar Diffusion Flames - Part 5 - Diffusion flame regimes and Flame height correlations](#)
- [Lecture 46 - Laminar Diffusion Flames - Part 6 - Diffusion flame control](#)
- [Lecture 47 - Laminar Diffusion Flames - Part 7 - Diffusion flame configurations \(coflow, crossflow and opposed flow flames\)](#)
- [Lecture 48 - Laminar Diffusion Flames - Part 8 - Diffusion flame stability and Worked examples](#)
- [Lecture 49 - Turbulent Flames - Part 1 - Characteristics of turbulence](#)
- [Lecture 50 - Turbulent Flames - Part 2 - Turbulent length scales and turbulent stresses](#)
- [Lecture 51 - Turbulent Flames - Part 3 - Axisymmetric turbulent jet](#)
- [Lecture 52 - Turbulent Flames - Part 4 - Turbulent premixed flames and flame regimes](#)
- [Lecture 53 - Turbulent Flames - Part 5 - Turbulent diffusion flames](#)
- [Lecture 54 - Droplet evaporation and combustion - Part 1 - Steady evaporation of liquid droplet](#)
- [Lecture 55 - Droplet evaporation and combustion - Part 2 - Equilibrium under steady evaporation of liquid droplet and droplet combustion](#)
- [Lecture 56 - Droplet evaporation and combustion - Part 3 - Droplet combustion \(simplified analysis\)](#)
- [Lecture 57 - Droplet evaporation and combustion - Part 4 - Species and temperature profiles](#)
- [Lecture 58 - Droplet evaporation and combustion - Part 5 - Evaluation of mass burning rate and worked examples](#)
- [Lecture 59 - Combustion of carbon particle - Part 1 - Coal combustion](#)
- [Lecture 60 - Combustion of carbon particle - Part 2 - One film model](#)
- [Lecture 61 - Combustion of carbon particle - Part 3 - Two film model and worked examples](#)

Lecture 1 - Introduction, Learning Objectives, Course Content and References

Lecture 2 - Merits and Demerits of Fluid Power, Power Transmission Method

Lecture 3 - Brief History, Application Areas, Major Divisions of Fluid Power System

Lecture 4 - Introduction to Oil Hydraulics and its Basic Components

Lecture 5 - Introduction to Pneumatic and its Basic Components, Applications-Stationary and Mobile

Lecture 6 - Typical Application of Fluid Power System, Status and Development

Lecture 7 - Pascal's law and its application-Hydraulic jack, Hydraulic brake and Numerical

Lecture 8 - Pressure Intensifier, Numericals, Air-to-Hydraulic Booster and Bernoulli equation

Lecture 9 - Applications of Bernoulli equation-Venturi, Torricelli's theorem, Siphon, Continuity equation and flow configuration, Concept of pressures and Gas laws

Lecture 10 - Introduction to Fluid Power Symbols, Hydraulic lines and Color Coding

Lecture 11 - Symbols for Functional Units, Hydraulic Pumps, Hydraulic Motors, Cylinders, Air Compressors, Pneumatic Motors and Orifices

Lecture 12 - Symbols for Filters, Check Valves, DCVs, Spool Actuation methods, PCV, Miscellaneous, Port Configurations

Lecture 13 - Introduction to Hydraulic Pumps, Facts and Figures, Classifications

Lecture 14 - Positive Displacement pump and pumping theory

Lecture 15 - Ideal pump, pump losses, efficiency curve, Constructional features and Operations of External Gear pump

Lecture 16 - Construction features and operations of Internal Gear Pump, Gerotor Pump and Screw Pump

Lecture 17 - Numericals on Gear Pump, Tree Structure of Vane Pump

Lecture 18 - Vane Pump, Pumping theory, Construction and Operation of Unbalanced Vane Pump, Vane loading and solutions, Different Vanes

Lecture 19 - Variable Displacement Pressure Compensated Vane Pump, Balance Vane Pump, Kinematic Inversion of Vane pump and Numerical

Lecture 20 - Piston pump, Pumping theory, Constructional features and Operations of Hand Pump-Single acting, Twin single acting, Double acting, Two-stage

Lecture 21 - Axial Piston Pump- Construction and Operating principles of Bent axis and Swash plate type pump

Lecture 22 - Radial Piston Pumps- Construction and Operation, Pump failure and Cavitations, Important parameters while selecting Pump, Numerical

Lecture 23 - Pneumatic Control System-Introduction, Air preparation-Primary and Secondary Air Treatment

Lecture 24 - Pneumatic Power Source- Compressor, Classification, Air Receiver and Control Methods

Lecture 25 - Reciprocating Type Air Compressor-Single and Multi-stage Piston Pump, PV Diagram and Work Done

Lecture 26 - Construction and Operation of Two-stage Reciprocating type Air Compressor, Diaphragm Type Air Compressor, Rotary Vane Compressor, Twin Lobe Air compressor, Screw Compressor, Liquid Ring Compressor and Selection Criteria

Lecture 27 - Energy Loss and Cost Break Down in Air Preparation Process, Pressure Drop and its Effect

# DIGIMAT - The No.1 Autonomous Learning Platform for Creative Learning

Lecture 28 - What causes Pressure Drop ?, Minimising Pressure Drop, Air Distribution System- Sizing of Pipes, Tubes, Materials and Fittings, Important Air Flow Parameters

Lecture 29 - Pressure drop Predictions using Various Empirical Formulae and Nomogram, Best Practices for Compressed Air Piping System and Installation Tips

Lecture 30 - Need for Air Dryer, Analysis of Moisture Removal from Air, Typical Air Drying Methods, Basic Types of Air Dryers

Lecture 31 - Construction and Operation of Refrigerated Air dryers, Absorption Dryer, Adsorption Dryer, Membrane Dryer, How to Choose the Right Air Dryer?

Lecture 32 - Directional Control Valves

Lecture 33 - Directional Control Valves

Lecture 34 - Directional Control Valves

Lecture 35 - Directional Control Valves

Lecture 36 - Directional Control Valves

Lecture 37 - Pressure Control Valves

Lecture 38 - Pressure Control Valves

Lecture 39 - Pressure Control Valves

Lecture 40 - Flow Control Valves

Lecture 41 - Flow Control Valves

Lecture 42 - Flow Control Valves

Lecture 43 - Estimation of leakage through spool and housing bore and Numericals on DCV, PCV and FCV

Lecture 44 - Estimation of leakage through spool and housing bore and Numericals on DCV, PCV and FCV

Lecture 45 - Hydraulic Motors

Lecture 46 - Hydraulic Motors

Lecture 47 - Hydraulic Motors

Lecture 48 - Hydraulic Motors

Lecture 49 - Hydraulic Motors

Lecture 50 - Hydraulic Motors

Lecture 51 - Hydraulic Cylinders

Lecture 52 - Hydraulic Cylinders

Lecture 53 - Hydraulic Cylinders

Lecture 54 - Hydraulic Cylinders

Lecture 55 - Hydraulic Cylinders

Lecture 56 - Numericals on Fluid Power Actuators

Lecture 57 - Numericals on Fluid Power Actuators

Lecture 58 - Subsystems: Hydraulic Reservoir, Coolers and Filters

Lecture 59 - Subsystems: Hydraulic Reservoir, Coolers and Filters

[Lecture 60 - Subsystems: Hydraulic Reservoir, Coolers and Filters](#)

[Lecture 61 - Subsystems: Hydraulic Fluids, Conduits and Simple Numericals](#)

[Lecture 62 - Subsystems: Hydraulic Fluids, Conduits and Simple Numericals](#)

[Lecture 63 - Subsystems: Hydraulic Fluids, Conduits and Simple Numericals](#)

[Lecture 64 - Subsystems: Hydraulic accumulators, Classifications, Applications, Accumulator physics, Maintenance, Numericals](#)

[Lecture 65 - Subsystems: Hydraulic accumulators, Classifications, Applications, Accumulator physics, Maintenance, Numericals](#)

[Lecture 66 - Subsystems: Hydraulic accumulators, Classifications, Applications, Accumulator physics, Maintenance, Numericals](#)

[Lecture 67 - Oil Hydraulic Circuits: Design and Analysis](#)

[Lecture 68 - Oil Hydraulic Circuits: Design and Analysis](#)

[Lecture 69 - Oil Hydraulic Circuits: Design and Analysis](#)

[Lecture 70 - Task Based Selection and Analysis of Oil Hydraulic Circuits](#)

[Lecture 71 - Task Based Selection and Analysis of Oil Hydraulic Circuits](#)

[Lecture 72 - Task Based Selection and Analysis of Oil Hydraulic Circuits](#)

[Lecture 73 - Task Based Selection and Analysis of Oil Hydraulic Circuits](#)

[Lecture 74 - Pneumatic Circuits: Design and Analysis](#)

[Lecture 75 - Pneumatic Circuits: Design and Analysis](#)

[Lecture 76 - Pneumatic Circuits: Design and Analysis](#)

[Lecture 77 - Pneumatic Circuits: Design and Analysis of Multiple Actuators](#)

[Lecture 78 - Pneumatic Circuits: Design and Analysis of Multiple Actuators](#)

[Lecture 79 - Pneumatic Circuits: Design and Analysis of Multiple Actuators](#)

[Lecture 80 - Pump-controlled Hydraulic Systems](#)

[Lecture 81 - Pump-controlled Hydraulic Systems](#)

[Lecture 82 - Pump-controlled Hydraulic Systems](#)

[Lecture 83 - Hydrostatic Transmissions](#)

[Lecture 84 - Hydrostatic Transmissions](#)

[Lecture 85 - Hydrostatic Transmissions](#)

[Lecture 86 - Proportional Valve Technology](#)

[Lecture 87 - Proportional Valve Technology](#)

[Lecture 88 - Proportional Valve Technology](#)

[Lecture 89 - Electro Hydraulic Servo Valve \(EHSV\)](#)

[Lecture 90 - Electro Hydraulic Servo Valve \(EHSV\)](#)

[Lecture 91 - Electro Hydraulic Servo Valve \(EHSV\)](#)

[Lecture 92 - Electro-Hydraulic Actuator \(EHA\)](#)

[Lecture 93 - Electro-Hydraulic Actuator \(EHA\)](#)

[Lecture 94 - Modeling and Simulation in Hydraulic Components](#)

[Lecture 95 - Modeling and Simulation in Hydraulic Components](#)

[Lecture 96 - Modeling and Simulation in Hydraulic Components](#)

**NPTEL : Introduction to Turbomachines (Mechanical Engineering)**

**Co-ordinators : Prof. Babu Viswanathan**

Lecture 1 - Introduction

Lecture 2 - Basic Theory of Turbomachines - Part 1

Lecture 3 - Basic Theory of Turbomachines - Part 2

Lecture 4 - Basic Theory of Turbomachines - Part 3

Lecture 5 - Basic Theory of Turbomachines - Part 4

Lecture 6 - Basic Theory of Turbomachines - Part 5

Lecture 7 - Basic Theory of Turbomachines - Part 6

Lecture 8 - Hydro Turbomachines - Centrifugal pumps - Part 1

Lecture 9 - Hydro Turbomachines - Centrifugal pumps - Part 2

Lecture 10 - Hydro Turbomachines - Centrifugal pumps - Part 3

Lecture 11 - Hydro Turbomachines - Centrifugal pumps - Part 4

Lecture 12 - Hydro Turbomachines - Francis turbine - Part 1

Lecture 13 - Hydro Turbomachines - Francis turbine - Part 2

Lecture 14 - Hydro Turbomachines - Kaplan turbine

Lecture 15 - Hydro Turbomachines - Pelton turbine

Lecture 16 - Positive Displacement Pumps - Gear pump

Lecture 17 - Thermal Turbomachines - Introduction

Lecture 18 - Thermal Turbomachines - Gas turbines

Lecture 19 - Thermal Turbomachines - Steam Turbines

Lecture 20 - Thermal Turbomachines - Part 1

Lecture 21 - Thermal Turbomachines - Part 2

Lecture 1 - Introduction

Lecture 2 - Introduction to robot mechanics

Lecture 3 - Introduction to forward and inverse kinematics

Lecture 4 - Description of position and orientation

Lecture 5 - Transformation matrix

Lecture 6 - Compound rotations - Part 1

Lecture 7 - Compound rotations - Part 2

Lecture 8 - Kinematic parameters

Lecture 9 - DH parameters

Lecture 10 - DH representation

Lecture 11 - Frame arrangement and examples - Part 1

Lecture 12 - Examples related to frame arrangement

Lecture 13 - Frame arrangement and examples - Part 2

Lecture 14 - Forward and inverse kinematics of robotic manipulators

Lecture 15 - Examples related to inverse kinematics

Lecture 16 - Inverse kinematic solution based on numerical methods

Lecture 17 - Forward kinematic solution using Matlab

Lecture 18 - Inverse kinematic solution based on numerical methods using Matlab

Lecture 19 - Introduction to differential kinematics

Lecture 20 - Velocity propagation model for serial manipulators and Jacobian matrix

Lecture 21 - Velocity propagation model using Matlab

Lecture 22 - Manipulator Statics and Workspace singularities

Lecture 23 - Introduction to robot dynamics and Lagrange-Euler method

Lecture 24 - Newton-Euler method

Lecture 25 - Equation of motion in state-space form

Lecture 26 - Dynamic model derivation using Newton-Euler method in Matlab

Lecture 27 - Dynamic model derivation using Lagrange-Euler method in Matlab

Lecture 28 - Dynamic simulation of serial manipulators using Matlab

Lecture 29 - Introduction to trajectory generation

Lecture 30 - Trajectory generation using smooth functions

Lecture 31 - Trajectory generation schemes for serial manipulators



[Lecture 32 - Trajectory generation using Matlab - Part 1](#)

[Lecture 33 - Trajectory generation using Matlab - Part 2](#)

[Lecture 34 - Trajectory generation for serial manipulators using matlab](#)

[Lecture 35 - Trajectory generation for serial manipulators with workspace using matlab](#)

[Lecture 36 - Introduction to robot motion control](#)

[Lecture 37 - Types of robot manipulator control and concerns](#)

[Lecture 38 - Kinematic control](#)

[Lecture 39 - Matlab simulation on kinematic control](#)

[Lecture 40 - Dynamic control](#)

[Lecture 41 - Simulations related to dynamic control schemes using Matlab - Part 1](#)

[Lecture 42 - Cascaded control design](#)

[Lecture 43 - Simulations related to dynamic control schemes using Matlab - Part 2](#)

[Lecture 44 - Simulations related to dynamic control schemes using Matlab - Part 3](#)

[Lecture 45 - Kinematic and dynamic models of a mobile robot using DH approach](#)

Lecture 1 - Introduction to inverse problems

Lecture 2 - Fermi estimation

Lecture 3 - Forward/Direct and Inverse problems

Lecture 4 - Key drivers for studying inverse methods in engineering

Lecture 5 - Formulation for inverse problems

Lecture 6 - Statistical tools for estimation

Lecture 7 - Statistical description of errors

Lecture 8 - Well-posed and ill-posed problems

Lecture 9 - Probability and Statistics Brief overview - I

Lecture 10 - Probability and Statistics Brief overview - II

Lecture 11 - Gaussian distribution

Lecture 12 - Gaussian distribution (Continued...), and Maximum Likelihood Estimation (MLE)

Lecture 13 - Linear least square regression

Lecture 14 - Linear least square regression (Continued...)

Lecture 15 - Alternatives to Linear least square

Lecture 16 - Polynomial regression

Lecture 17 - Inverse problems in transient conduction - I

Lecture 18 - Inverse problems in transient conduction - II

Lecture 19 - Non-linear regression

Lecture 20 - Gauss-Newton algorithm (GNA)

Lecture 21 - Gauss-Newton algorithm (GNA) Example

Lecture 22 - Levenberg-Marquardt algorithm (LMA)

Lecture 23 - Tikhonov regularization

Lecture 24 - Jacobian and its calculation

Lecture 25 - Bayesian methods

Lecture 26 - Bayesian methods (Continued...)

Lecture 27 - Metropolis-Hastings algorithm (MH) and Markov Chain Monte Carlo Methods (MCMC)

Lecture 28 - Introduction to machine learning in heat transfer

Lecture 29 - Overview of machine learning

Lecture 30 - Calculation in a neural network model

Lecture 31 - Gradient Descent method

[Lecture 32 - Gradient Descent method \(Continued...\)](#)

[Lecture 33 - Back propagation](#)

[Lecture 34 - Neural network as a surrogate forward model](#)

[Lecture 35 - PINN for an inverse problem](#)

[Lecture 36 - PINN for an inverse problem \(Continued...\)](#)

[Lecture 37 - Inverse methods in heat transfer - Summary](#)

[Lecture 1 - Course outline](#)

[Lecture 2 - Introduction - Part 1](#)

[Lecture 3 - Introduction - Part 2](#)

[Lecture 4 - Basic concepts - Part 1](#)

[Lecture 5 - Basic concepts - Part 2](#)

[Lecture 6 - Basic concepts - Part 3](#)

[Lecture 7 - Basic concepts - Part 4](#)

[Lecture 8 - Basic concepts - Part 5](#)

[Lecture 9 - Work and Heat - Part 1](#)

[Lecture 10 - Work and Heat - Part 2](#)

[Lecture 11 - Work and Heat - Part 3](#)

[Lecture 12 - First law of thermodynamics](#)

[Lecture 13 - Pure substances](#)

[Lecture 14 - Ideal gases and ideal gas mixtures](#)

[Lecture 15 - Two-phase mixtures - Part 1](#)

[Lecture 16 - Two-phase mixtures - Part 2](#)

[Lecture 17 - First law analysis of systems - Part 1](#)

[Lecture 18 - First law analysis of systems - Part 2](#)

[Lecture 19 - First law analysis of systems - Part 3](#)

[Lecture 20 - First law analysis of systems - Part 4](#)

[Lecture 21 - First law of thermodynamics for a control volume](#)

[Lecture 22 - Control volume analysis of steady flow devices - Part 1](#)

[Lecture 23 - Control volume analysis of steady flow devices - Part 2](#)

[Lecture 24 - Control volume analysis of steady flow devices - Part 3](#)

[Lecture 25 - Unsteady analysis](#)

[Lecture 26 - Second law of Thermodynamics - Part 1](#)

[Lecture 27 - Second law of Thermodynamics - Part 2](#)

[Lecture 28 - Second law of Thermodynamics - Part 3](#)

[Lecture 29 - Second law of Thermodynamics - Part 4](#)

[Lecture 30 - Second law of Thermodynamics - Part 5](#)

[Lecture 31 - Entropy - Part 1](#)

[Lecture 32 - Entropy - Part 2](#)

[Lecture 33 - Entropy - Part 3](#)

[Lecture 34 - Entropy - Part 4](#)

[Lecture 35 - Entropy - Part 5](#)

[Lecture 36 - Entropy - Part 6](#)

[Lecture 37 - Thermodynamic cycles - Part 1](#)

[Lecture 38 - Thermodynamic cycles - Part 2](#)

[Lecture 1 - Free and Forced Vortices - I](#)

[Lecture 2 - Free and Forced Vortices - II](#)

[Lecture 3 - Impact of Jet on hemispherical shell](#)

[Lecture 4 - Impact of Jet on horizontal flat plate](#)

[Lecture 5 - Pressure Distribution on a Circular Cylinder](#)

[Lecture 6 - Verification of Bernoulli's Theorem](#)

[Lecture 7 - Visualization of potential flows](#)

[Lecture 8 - Visualization of vortex shedding](#)

[Lecture 9 - Wake Velocity Measurement for flow over a Circular Cylinder](#)

- Lecture 1 - Non-dimensional numbers in interfacial flows
- Lecture 2 - Integral form of governing equations
- Lecture 3 - Boundary (Jump) conditions at a fluid-fluid interface (no surface tension)
- Lecture 4 - On surface tension and interfacial energy
- Lecture 5 - Introduction to surface tension effects
- Lecture 6 - Boundary (Jump) conditions at a fluid-fluid interface (with surface tension) - Part 1
- Lecture 7 - Boundary (Jump) conditions at a fluid-fluid interface (with surface tension) - Part 2
- Lecture 8 - Summary of equations
- Lecture 9 - Capillary statics shape of meniscus - Part 1
- Lecture 10 - Capillary statics shape of meniscus - Part 2
- Lecture 11 - Shape of static meniscus-Energy minimisation - Part 1
- Lecture 12 - Calculus of variations (a primer): Euler-Lagrange equations
- Lecture 13 - Shape of static meniscus-Energy minimisation - Part 2
- Lecture 14 - Method of Lagrange multipliers
- Lecture 15 - On wetting and shape of a drop
- Lecture 16 - The Young's Equation: Partial wetting
- Lecture 17 - Variational approach to the Young-Laplace equation - Part 1
- Lecture 18 - Variational approach to the Young-Laplace equation - Part 2
- Lecture 19 - Shape of a puddle - large/heavy drops
- Lecture 20 - Wetting on rough and textured surface - Part 1
- Lecture 21 - Wetting on rough and textured surface - Part 2
- Lecture 22 - Wetting on rough and textured surface - Part 3
- Lecture 23 - Law of capillary rise
- Lecture 24 - Dynamics of capillary rise
- Lecture 25 - Dynamics of capillary rise: Analysis of regimes
- Lecture 26 - Forced wetting and coating flows
- Lecture 27 - More on coating and Landau-Levich equation
- Lecture 28 - Lubrication approximation and thin films
- Lecture 29 - Free surface flows and interface conditions
- Lecture 30 - Uniform flow down an incline
- Lecture 31 - Shape of a falling jet

- [Lecture 32 - A quick tour of stability analysis](#)
- [Lecture 33 - Rayleigh-Plateau instability - Part 1](#)
- [Lecture 34 - Rayleigh-Plateau instability - Part 2](#)
- [Lecture 35 - Rayleigh-Plateau instability - Part 3](#)
- [Lecture 36 - Rupture of thin films - Part 1](#)
- [Lecture 37 - Rupture of thin films - Part 2](#)
- [Lecture 38 - Rupture of thin films - Effect of van der Waals force](#)
- [Lecture 39 - Rupture of thin films - Part 3](#)
- [Lecture 40 - Rupture of thin films - Part 4](#)
- [Lecture 41 - Benard-Marangoni Instability - Part 1](#)
- [Lecture 42 - Benard-Marangoni Instability - Part 2](#)
- [Lecture 43 - Benard-Marangoni Instability - Part 3](#)
- [Lecture 44 - Benard-Marangoni Instability - Part 4](#)
- [Lecture 45 - Kelvin helmholtz instability - Part 1](#)
- [Lecture 46 - Kelvin helmholtz instability - Part 2](#)
- [Lecture 47 - Kelvin helmholtz instability - Part 3](#)
- [Lecture 48 - Kelvin helmholtz instability - Part 4](#)
- [Lecture 49 - Contact angle hysteresis](#)
- [Lecture 50 - Thin film down an incline-a contact line problem - Part 1](#)
- [Lecture 51 - Thin film down an incline-a contact line problem - Part 2](#)
- [Lecture 52 - Local flow near a moving contact line](#)
- [Lecture 53 - Modelling of moving contact line](#)



- Lecture 1 - Introduction
- Lecture 2 - Entropy change of a control volume - Part 1
- Lecture 3 - Entropy change of a control volume - Part 2
- Lecture 4 - Entropy change of a control volume - Part 3
- Lecture 5 - Work interaction of internally reversible steady flow processes
- Lecture 6 - Exergy - Part 1
- Lecture 7 - Exergy - Part 2
- Lecture 8 - Exergy - Part 3
- Lecture 9 - Exergy - Part 4
- Lecture 10 - Exergy - Part 5
- Lecture 11 - Thermodynamic cycles - Rankine cycle - Part 1
- Lecture 12 - Thermodynamic cycles - Rankine cycle - Part 2
- Lecture 13 - Thermodynamic cycles - Rankine cycle - Part 3
- Lecture 14 - Thermodynamic cycles - Air standard Brayton cycle - Part 1
- Lecture 15 - Thermodynamic cycles - Air standard Brayton cycle - Part 2
- Lecture 16 - Thermodynamic cycles - Air standard Brayton cycle - Part 3
- Lecture 17 - Thermodynamic cycles - Air standard Brayton cycle - Part 4
- Lecture 18 - Thermodynamic cycles - Air standard Brayton cycle - Part 5
- Lecture 19 - Thermodynamic cycles - Air standard Otto cycle
- Lecture 20 - Thermodynamic cycles - Air standard Diesel cycle - Part 1
- Lecture 21 - Thermodynamic cycles - Air standard Diesel cycle - Part 2
- Lecture 22 - Thermodynamic cycles - Vapor compression refrigeration cycle
- Lecture 23 - Psychrometry - Part 1
- Lecture 24 - Psychrometry - Part 2
- Lecture 25 - Psychrometry - Part 3
- Lecture 26 - Psychrometry - Part 4
- Lecture 27 - Psychrometry - Part 5
- Lecture 28 - Psychrometry - Part 6
- Lecture 29 - Psychrometry - Part 7
- Lecture 30 - Combustion thermodynamics - Part 1
- Lecture 31 - Combustion thermodynamics - Part 2

[Lecture 32 - Combustion Thermodynamics - Part 3](#)

[Lecture 33 - Combustion thermodynamics - Part 4](#)

[Lecture 34 - Compressible flow through nozzles - Part 1](#)

[Lecture 35 - Compressible flow through nozzles - Part 2](#)

[Lecture 36 - Compressible flow through nozzles - Part 3](#)

[Lecture 37 - Compressible flow through nozzles - Part 4](#)

[Lecture 38 - Compressible flow through nozzles - Part 5](#)

[Lecture 39 - Compressible flow through nozzles - Part 6](#)

[Lecture 40 - Compressible flow through nozzles - Part 7](#)

[Lecture 41 - Compressible flow through nozzles - Part 8](#)

[Lecture 42 - Compressible flow through nozzles - Part 9](#)

[Lecture 43 - Compressible flow through nozzles - Part 10](#)

[Lecture 44 - Compressible flow through nozzles - Part 11](#)

[Lecture 45 - Compressible flow through nozzles - Part 12](#)

Lecture 1 - Introduction to the Inverse Methods in Heat Transfer Course

Lecture 2 - Inverse Problems - Definition, History and Applications

Lecture 3 - The inverse problem solving process

Lecture 4 - Review of Basic Heat Transfer for this course

Lecture 5 - Introduction to Week - 2

Lecture 6 - Introduction to Linear Regression for Inverse Problems

Lecture 7 - Example Application of Linear regression for an inverse conduction problem

Lecture 8 - Goodness of Fit and Coefficient of Determination

Lecture 9 - Linear Regression with Quadratic Model

Lecture 10 - Summary of Week - 2

Lecture 11 - Introduction to Week - 3

Lecture 12 - Introduction to Normal Equations for linear models

Lecture 13 - Normal Equations for linear models (Continued...)

Lecture 14 - Parity Plots

Lecture 15 - Programming Inverse Methods using Normal Equations

Lecture 16 - Variants on the Linear Model for inverse problems

Lecture 17 - Summary of Week - 3

Lecture 18 - The General Inverse Methods Process

Lecture 19 - Simple nonlinear inverse problem - Transient Heat transfer

Lecture 20 - Review of required calculus results

Lecture 21 - Gradient Descent Algorithm

Lecture 22 - Gradient Descent - Simple Example

Lecture 23 - Gradient Descent for Nonlinear Inverse Problem - Theory

Lecture 24 - Gradient Descent for Nonlinear Inverse Problem - Coding Example

Lecture 25 - Newton Algorithm for a System of Equations

Lecture 26 - Gauss Newton Algorithm - Derivation and Code

Lecture 27 - Overfitting and Regularization for Linear Models

Lecture 28 - Tikhonov Regularization and Levenberg-Marquardt - Theory

Lecture 29 - Tikhonov and Levenberg-Marquardt - Example Code

Lecture 30 - Introduction to Probability for Inverse Methods

Lecture 31 - Sum and Product Rules of Probability

- Lecture 32 - Bayes Theorem - Simple Examples
- Lecture 33 - Independence and Expectation
- Lecture 34 - Variance and Covariance
- Lecture 35 - Gaussian distribution and the standard normal table
- Lecture 36 - Maximum Likelihood Estimate
- Lecture 37 - MLE, MAP estimates
- Lecture 38 - Introduction to Bayesian Methods for Inverse Problems
- Lecture 39 - Offline Bayesian Estimation
- Lecture 40 - Offline Bayesian Estimation - MATLAB Demo
- Lecture 41 - MHMCMC for Inverse Problems
- Lecture 42 - MHMCMC for Inverse Problems - MATLAB Demo
- Lecture 43 - Why Machine Learning in Inverse Heat Transfer ?
- Lecture 44 - Overview of AI and ML
- Lecture 45 - Supervised Machine Learning as an Inverse Problem
- Lecture 46 - Introduction to Week 9 - From Linear Models to Neural Networks
- Lecture 47 - Gradient Descent - Batch, Stochastic and Mini Batch
- Lecture 48 - Logistic Regression - The Forward Model
- Lecture 49 - Logistic Regression - Binary Entropy Cost Function and Gradient
- Lecture 50 - Multiclass Classification
- Lecture 51 - Linear Separability and Neural Networks
- Lecture 52 - Introduction to Week 10 - XOR and Deeper networks
- Lecture 53 - Forward pass through a simple neural network
- Lecture 54 - Backprop in a scalar chain
- Lecture 55 - Backprop in a MLP
- Lecture 56 - Introduction to Week 11 - ANNs as Surrogate models
- Lecture 57 - Physics Informed Neural Networks - Introduction
- Lecture 58 - Physics Informed Neural Networks - an intuitive explanation
- Lecture 59 - Physics Informed Neural Networks - BC incorporation
- Lecture 60 - PINNs for inverse problems
- Lecture 61 - Introduction to Week 12 - Sensitivity Analysis
- Lecture 62 - Code Examples of Logistic Regression - OR and AND gates
- Lecture 63 - Code Example of shallow neural network - XOR gate
- Lecture 64 - Code walkthrough for PINNs in Burgers equation

[Lecture 65 - Formulation of a PINN based inverse problem in unsteady conduction](#)

[Lecture 66 - Formulation of a surrogate model based inverse solution in unsteady conduction](#)

[Lecture 67 - Summary of course](#)

Lecture 1 - Introduction and Fundamental Concepts - Part 1

Lecture 2 - Introduction and Fundamental Concepts - Part 2

Lecture 3 - Energy Scenario in Modern World - Part 1

Lecture 4 - Energy Scenario in Modern World - Part 2

Lecture 5 - Macro Trends in Energy Use - World and India - Part 1

Lecture 6 - Macro Trends in Energy Use - World and India - Part 2

Lecture 7 - Impact of Fossil fuels - Part 1

Lecture 8 - Impact of Fossil fuels - Part 2

Lecture 9 - Fossil Fuels and Climate Change - Part 1

Lecture 10 - Fossil Fuels and Climate Change - Part 2

Lecture 11 - Continual of previous lecture and Overview of Renewable energy Technology - Part 1

Lecture 12 - Continual of previous lecture and Overview of Renewable energy Technology - Part 2

Lecture 13 - Numerical examples - Part 1

Lecture 14 - Numerical examples - Part 2

Lecture 15 - Renewable Energy Contributions - Part 1

Lecture 16 - Renewable Energy Contributions - Part 2

Lecture 17 - Hydro Power - Part 1

Lecture 18 - Hydro Power - Part 2

Lecture 19 - The Fundamentals of various Turbine working principle - Part 1

Lecture 20 - The Fundamentals of various Turbine working principle - Part 2

Lecture 21 - Hydroturbine Selection Principle

Lecture 22 - Pumped Hydro Storage

Lecture 23 - Worked Out Examples of HydroPower

Lecture 24 - Introduction to Wind Energy - Part 1

Lecture 25 - Introduction to Wind Energy - Part 2

Lecture 26 - Wind Speed and Power Analysis - Part 1

Lecture 27 - Wind Speed and Power Analysis - Part 2

Lecture 28 - Design of Wind Turbine - Part 1

Lecture 29 - Design of Wind Turbine - Part 2

Lecture 30 - Wind Turbine Parts and Performance - Part 1

Lecture 31 - Wind Turbine Parts and Performance - Part 2

[Lecture 32 - Wind farms, Offshore Wind Turbines and Numerical Examples in Wind Energy - Part 1](#)

[Lecture 33 - Wind farms, Offshore Wind Turbines and Numerical Examples in Wind Energy - Part 2](#)

[Lecture 34 - Introduction to Solar Energy - Part 1](#)

[Lecture 35 - Introduction to Solar Energy - Part 2](#)

[Lecture 36 - Solar Thermal Energy Systems - Part 1](#)

[Lecture 37 - Solar Thermal Energy Systems - Part 2](#)

[Lecture 38 - Solar Water Heaters - Part 1](#)

[Lecture 39 - Solar Water Heaters - Part 2](#)

[Lecture 40 - Concentrated Solar Thermal Power \(CSP\)](#)

[Lecture 41 - Introduction to Solar Photovoltaic Systems - Part 1](#)

[Lecture 42 - Introduction to Solar Photovoltaic Systems - Part 2](#)

[Lecture 43 - Solar Photovoltaic Technology - Part 1](#)

[Lecture 44 - Solar Photovoltaic Technology - Part 2](#)

[Lecture 45 - Doping of a Semiconductor - Part 1](#)

[Lecture 46 - Doping of a Semiconductor - Part 2](#)

[Lecture 47 - Structure of a Solar Cell and its Electrical Properties - Part 1](#)

[Lecture 48 - Structure of a Solar Cell and its Electrical Properties - Part 2](#)

[Lecture 49 - Solar Cell Efficiency - Part 1](#)

[Lecture 50 - Solar Cell Efficiency - Part 2](#)

[Lecture 51 - Types of solar cells - Part 1](#)

[Lecture 52 - Types of solar cells - Part 2](#)

[Lecture 53 - Bioenergy and Biofuels - Part 1](#)

[Lecture 54 - Bioenergy and Biofuels - Part 2](#)

[Lecture 55 - Biofuel Feedstocks](#)

[Lecture 56 - Bioenergy Technology and Sustainability - Part 1](#)

[Lecture 57 - Bioenergy Technology and Sustainability - Part 2](#)

[Lecture 58 - Production Technologies for Bioethanol, Biodiesel and Biogas](#)

[Lecture 59 - Introduction of Geothermal Energy](#)

[Lecture 60 - Different types of Geothermal power systems](#)

[Lecture 61 - Characteristics of electricity demand and the technology is developed to respond the energy demand](#)

[Lecture 62 - Continuation of Energy demand and adaptation of renewable energies](#)

[Lecture 63 - Introduction of Energy storage system](#)

[Lecture 64 - Major parameters of energy storage technology](#)

[Lecture 65 - Mechanical Energy Storage Technologies](#)

[Lecture 66 - Compressed Air Energy Storage System](#)

[Lecture 67 - Flywheel Based Energy Storage System - Part 1](#)

[Lecture 68 - Flywheel Based Energy Storage System - Part 2](#)

[Lecture 69 - Energy Storage System Through Capacitor](#)

[Lecture 70 - Electrolytic Capacitor](#)

[Lecture 71 - Super Capacitor](#)

[Lecture 72 - Electrochemical Energy Storage Systems](#)

[Lecture 73 - Performance Characteristics of Battery](#)

[Lecture 74 - Types of Rechargeable Batteries - Part 1](#)

[Lecture 75 - Types of Rechargeable Batteries - Part 2](#)

[Lecture 76 - Thermal Energy Storage Systems - Part 1](#)

[Lecture 77 - Thermal Energy Storage Systems - Part 2](#)

[Lecture 78 - Storage of Coolness and Synoptic View of Energy Storage Technology](#)

[Lecture 79 - Storage Needs for the Grid](#)

[Lecture 80 - Energy Storage Types](#)

[Lecture 81 - Trends in Energy Storage Types and their Characteristics](#)

[Lecture 82 - Analysis of Growth in Energy Storage-focussed on Pumped Hydro Storage, Flywheels and Li-ion batteries](#)

[Lecture 83 - Fuel Cells and Hydrogen Energy Economy](#)

[Lecture 84 - Hydrogen production and storage technologies](#)

[Lecture 85 - Hydrogen storage technologies](#)

[Lecture 86 - Fuel cell technology](#)

[Lecture 87 - Fuel cell types](#)

[Lecture 88 - Carbon Capture and Storage \(CCS\) technologies - Part 1](#)

[Lecture 89 - Carbon Capture and Storage \(CCS\) technologies - Part 2](#)



- Lecture 1 - Introduction to Strength of Materials - 1
- Lecture 2 - Introduction to Strength of Materials - 2
- Lecture 3 - Stress Component is Scalar
- Lecture 4 - Stress Vector
- Lecture 5 - Stress Tensor
- Lecture 6 - Equilibrium Conditions
- Lecture 7 - Mohr's Circle
- Lecture 8 - Proof of Mohr's Circle
- Lecture 9 - Principal Stresses
- Lecture 10 - Octahedral and Deviatoric Stresses and Principal Directions
- Lecture 11 - Free Surfaces
- Lecture 12 - Photoelasticity
- Lecture 13 - Strain
- Lecture 14 - State of Strain
- Lecture 15 - Strain Measurement
- Lecture 16 - Tension Test
- Lecture 17 - Stress Strain Relations
- Lecture 18 - Interrelations between Elastic Constants
- Lecture 19 - Thermal Strain
- Lecture 20 - Torsion 1 - Thought and Physical Experiments
- Lecture 21 - Torsion 2 - Mathematical Development
- Lecture 22 - Torsion 3 - Problem solving, Hollow shaft
- Lecture 23 - Bending 1 - Euler-Bernoulli Hypothesis
- Lecture 24 - Bending 2 - Flexure Formula
- Lecture 25 - Bending 3 - Engineering Analysis of Beams
- Lecture 26 - Bending 4 - Shear Stress in Beams
- Lecture 27 - Bending 5 - Composite Beams
- Lecture 28 - Bending 6 - Shear in I Beams and Shear Centre
- Lecture 29 - Bending 7 - Unsymmetrical Bending and Combined Loading
- Lecture 30 - Review 1
- Lecture 31 - Deflection 1 - Moment-Curvature and Load Deflection

[Lecture 32 - Deflection 2 - Moment-Area Method](#)

[Lecture 33 - Deflection 3 - Method of Superposition and Energy Method](#)

[Lecture 34 - Deflection 4 - Fictitious Load Method](#)

[Lecture 35 - Theories of Failure 1 - Overview](#)

[Lecture 36 - Theories of Failure 2 - Yield surfaces, Mohr's Theory and Failure in Combined Loading](#)

[Lecture 37 - Stability 1 - Governing Equations, Fixed-free and Pinned-pinned](#)

[Lecture 38 - Stability 2 - Fixed-pinned, Fixed-fixed](#)

[Lecture 39 - Review 2](#)

Lecture 1 - Course outline

Lecture 2 - Introduction - Part 1

Lecture 3 - Introduction - Part 2

Lecture 4 - Basic concepts - Part 1

Lecture 5 - Basic concepts - Part 2

Lecture 6 - Basic concepts - Part 3

Lecture 7 - Basic concepts - Part 4

Lecture 8 - Basic concepts - Part 5

Lecture 9 - Tutorial 1 - Basic concepts, pressure and temperature measurements - Part 1

Lecture 10 - Tutorial 1 - Basic concepts, pressure and temperature measurements - Part 2

Lecture 11 - Tutorial 1 - Basic concepts, pressure and temperature measurements - Part 3

Lecture 12 - Work and Heat - Part 1

Lecture 13 - Work and Heat - Part 2

Lecture 14 - Work and Heat - Part 3

Lecture 15 - Tutorial 2 - Work and heat transfer examples - Part 1

Lecture 16 - Tutorial 2 - Work and heat transfer examples - Part 2

Lecture 17 - Tutorial 2 - Work and heat transfer examples - Part 3

Lecture 18 - First law of thermodynamics

Lecture 19 - Pure substances

Lecture 20 - Ideal gases and ideal gas mixtures

Lecture 21 - Two-phase mixtures - Part 1

Lecture 22 - Two-phase mixtures - Part 2

Lecture 23 - First law analysis of systems - Part 1

Lecture 24 - First law analysis of systems - Part 2

Lecture 25 - First law analysis of systems - Part 3

Lecture 26 - First law analysis of systems - Part 4

Lecture 27 - Tutorial 3 - First law analysis of system - Part 1

Lecture 28 - Tutorial 3 - First law analysis of system - Part 2

Lecture 29 - Tutorial 3 - First law analysis of system - Part 3

Lecture 30 - Tutorial 4 - Systems involving ideal gas mixtures - Part 1

Lecture 31 - Tutorial 4 - Systems involving ideal gas mixtures - Part 2

[Lecture 32 - Tutorial 4 - Systems involving ideal gas mixtures - Part 3](#)

[Lecture 33 - Tutorial 5 - Systems involving Steam and R134a using table - Part 1](#)

[Lecture 34 - Tutorial 5 - Systems involving Steam and R134a using table - Part 2](#)

[Lecture 35 - Tutorial 5 - Systems involving Steam and R134a using table - Part 3](#)

[Lecture 36 - Tutorial 5 - Systems involving Steam and R134a using table - Part 4](#)

[Lecture 37 - Tutorial 5 - Systems involving Steam and R134a using table - Part 5](#)

[Lecture 38 - Tutorial 5 - Systems involving Steam and R134a using table - Part 6](#)

[Lecture 39 - First law of thermodynamics for a control volume](#)

[Lecture 40 - Control volume analysis of steady flow devices - Part 1](#)

[Lecture 41 - Control volume analysis of steady flow devices - Part 2](#)

[Lecture 42 - Control volume analysis of steady flow devices - Part 3](#)

[Lecture 43 - Unsteady analysis](#)

[Lecture 44 - Tutorial 6 - First law for control volumes](#)

[Lecture 45 - Second law of Thermodynamics - Part 1](#)

[Lecture 46 - Second law of Thermodynamics - Part 2](#)

[Lecture 47 - Second law of Thermodynamics - Part 3](#)

[Lecture 48 - Second law of Thermodynamics - Part 4](#)

[Lecture 49 - Second law of Thermodynamics - Part 5](#)

[Lecture 50 - Tutorial 7 - Second law of thermodynamics - Part 1](#)

[Lecture 51 - Tutorial 7 - Second law of thermodynamics - Part 2](#)

[Lecture 52 - Tutorial 7 - Second law of thermodynamics - Part 3](#)

[Lecture 53 - Tutorial 7 - Second law of thermodynamics - Part 4](#)

[Lecture 54 - Tutorial 7 - Second law of thermodynamics - Part 5](#)

[Lecture 55 - Entropy - Part 1](#)

[Lecture 56 - Entropy - Part 2](#)

[Lecture 57 - Entropy - Part 3](#)

[Lecture 58 - Entropy - Part 4](#)

[Lecture 59 - Entropy - Part 5](#)

[Lecture 60 - Entropy - Part 6](#)

[Lecture 61 - Tutorial 8 - Entropy - Part 1](#)

[Lecture 62 - Tutorial 8 - Entropy - Part 2](#)

[Lecture 63 - Tutorial 8 - Entropy - Part 3](#)

[Lecture 64 - Tutorial 8 - Entropy - Part 4](#)

[Lecture 65 - Tutorial 8 - Entropy - Part 5](#)

[Lecture 66 - Thermodynamic cycles - Part 1](#)

[Lecture 67 - Thermodynamic cycles - Part 2](#)

[Lecture 68 - Tutorial 9 - Thermodynamic cycles - Part 1](#)

[Lecture 69 - Tutorial 9 - Thermodynamic cycles - Part 2](#)

[Lecture 70 - Tutorial 9 - Thermodynamic cycles - Part 3](#)

[Lecture 1 - Basics of Fire - Part 1](#)

[Lecture 2 - Basics of Fire - Part 2](#)

[Lecture 3 - Basics of Fire - Part 3](#)

[Lecture 4 - Basics of Fire - Part 4](#)

[Lecture 5 - Basics of Fire - Part 5](#)

[Lecture 6 - Basics of Fire - Part 6](#)

[Lecture 7 - Basics of Fire - Part 7](#)

[Lecture 8 - Basics of Fire - Part 8](#)

[Lecture 9 - Basics of Fire - Part 9](#)

[Lecture 10 - Review of thermo-chemistry, chemical equilibrium and kinetics - Part 1](#)

[Lecture 11 - Review of thermo-chemistry, chemical equilibrium and kinetics - Part 2](#)

[Lecture 12 - Review of thermo-chemistry, chemical equilibrium and kinetics - Part 3](#)

[Lecture 13 - Review of thermo-chemistry, chemical equilibrium and kinetics - Part 4](#)

[Lecture 14 - Review of thermo-chemistry, chemical equilibrium and kinetics - Part 5](#)

[Lecture 15 - Review of thermo-chemistry, chemical equilibrium and kinetics - Part 6](#)

[Lecture 16 - Review of thermo-chemistry, chemical equilibrium and kinetics - Part 7](#)

[Lecture 17 - Review of thermo-chemistry, chemical equilibrium and kinetics - Part 8](#)

[Lecture 18 - Review of Premixed and Diffusion Flames - Part 1](#)

[Lecture 19 - Review of Premixed and Diffusion Flames - Part 2](#)

[Lecture 20 - Review of Premixed and Diffusion Flames - Part 3](#)

[Lecture 21 - Review of Premixed and Diffusion Flames - Part 4](#)

[Lecture 22 - Review of Premixed and Diffusion Flames - Part 5](#)

[Lecture 23 - Review of Premixed and Diffusion Flames - Part 6](#)

[Lecture 24 - Review of Premixed and Diffusion Flames - Part 7](#)

[Lecture 25 - Review of Premixed and Diffusion Flames - Part 8](#)

[Lecture 26 - Burning of Liquid Fuels- Part 1](#)

[Lecture 27 - Burning of Liquid Fuels- Part 2](#)

[Lecture 28 - Burning of Liquid Fuels- Part 3](#)

[Lecture 29 - Burning of Liquid Fuels- Part 4](#)

[Lecture 30 - Burning of Liquid Fuels- Part 5](#)

[Lecture 31 - Burning of Liquid Fuels- Part 6](#)

[Lecture 32 - Burning of Liquid Fuels- Part 7](#)

[Lecture 33 - Burning of Liquid Fuels- Part 8](#)

[Lecture 34 - Burning of Solid Fuels - Part 1](#)

[Lecture 35 - Burning of Solid Fuels - Part 2](#)

[Lecture 36 - Burning of Solid Fuels - Part 3](#)

[Lecture 37 - Burning of Solid Fuels - Part 4](#)

[Lecture 38 - Burning of Solid Fuels - Part 5](#)

[Lecture 39 - Burning of Solid Fuels - Part 6](#)

[Lecture 40 - Burning of Solid Fuels - Part 7](#)

[Lecture 41 - Analysis of Fire Plumes - Part 1](#)

[Lecture 42 - Analysis of Fire Plumes - Part 2](#)

[Lecture 43 - Analysis of Fire Plumes - Part 3](#)

[Lecture 44 - Analysis of Fire Plumes - Part 4](#)

[Lecture 45 - Analysis of Fire Plumes - Part 5](#)

[Lecture 46 - Analysis of Fire Plumes - Part 6](#)

[Lecture 47 - Enclosure Fires - Part 1](#)

[Lecture 48 - Enclosure Fires - Part 2](#)

[Lecture 49 - Enclosure Fires - Part 3](#)

[Lecture 50 - Enclosure Fires - Part 4](#)

[Lecture 51 - Enclosure Fires - Part 5](#)

[Lecture 52 - Enclosure Fires - Part 6](#)

[Lecture 53 - Enclosure Fires - Part 7](#)

[Lecture 54 - Introduction to dust ignition, dust explosion and forest fires - Part 1](#)

[Lecture 55 - Introduction to dust ignition, dust explosion and forest fires - Part 2](#)

[Lecture 56 - Introduction to dust ignition, dust explosion and forest fires - Part 3](#)

[Lecture 57 - Introduction to dust ignition, dust explosion and forest fires - Part 4](#)

[Lecture 58 - Introduction to dust ignition, dust explosion and forest fires - Part 5](#)

[Lecture 59 - Fire safety aspects - Part 1](#)

[Lecture 60 - Fire safety aspects - Part 2](#)

[Lecture 61 - Fire safety aspects - Part 3](#)

- Lecture 1 - Manufacturing and Manufacturing Systems
- Lecture 2 - Manufacturing Trends and Challenges
- Lecture 3 - Manufacturing Aspects, Selection and Classification
- Lecture 4 - Description and Taxonomy of the Mfg. Processes
- Lecture 5 - Metal Casting basics, Gating and Riser design
- Lecture 6 - Evaporative Pattern Casting Process (EPC)
- Lecture 7 - Continuous, Permanent mold, Centrifugal and Pressure Die Casting
- Lecture 8 - Hybrid EPC Processes and Vacuum EPC Process
- Lecture 9 - Set-up of VEPC and Investment Casting Processes
- Lecture 10 - Ceramic Shell Investment Casting Process
- Lecture 11 - Shell Molding Process
- Lecture 12 - Abrasive Flow Machining
- Lecture 13 - Mechanism of Material Removal in AFM and Variant processes in AFM
- Lecture 14 - Abrasive Jet Machining (AJM)
- Lecture 15 - Water Jet and Abrasive Water Jet Machining
- Lecture 16 - Ultrasonic Machining Process (USM)
- Lecture 17 - Mechanism, Processes Variants and applications of USM
- Lecture 18 - Micro USM and advances in USM
- Lecture 19 - Electric Discharge Machining (EDM) Process
- Lecture 20 - Die-Sinker EDM and Wire Cut Electric Discharge Machining (WEDM)
- Lecture 21 - Variant Processes in EDM
- Lecture 22 - Electro Chemical Discharge Machining (ECDM)
- Lecture 23 - Laser Beam Machining (LBM)
- Lecture 24 - Equipment and Process Parameters in LBM
- Lecture 25 - Electrochemical Machining (ECM)
- Lecture 26 - ECM Kinematics and Tool Design
- Lecture 27 - The Subsystems in ECM, advantages and applications
- Lecture 28 - Variant Processes in ECM: ECG, ECH, ECDe and STEM
- Lecture 29 - Electron Beam, Plasma Beam and Ion Beam Machining
- Lecture 30 - Submerged Arc Welding (SAW)
- Lecture 31 - Resistance Welding Process



[Lecture 32 - Solid State Welding processes](#)

[Lecture 33 - Friction Welding process](#)

[Lecture 34 - Electron Beam and Plasma Welding Processes](#)

[Lecture 35 - Laser Beam welding and Diffusion welding processes](#)

[Lecture 36 - High Energy Rate Forming Processes](#)

[Lecture 37 - Rapid Prototyping Technology \(RPT\)](#)

[Lecture 38 - Rapid Manufacturing, applications and advancements](#)

[Lecture 39 - Microwave Processing of Materials](#)

[Lecture 40 - Applications and new trends in Microwave Material Processing](#)

- Lecture 1 - General Introduction: Historical Background and Spectrum of Applications
- Lecture 2 - CFD: Simulation Process and Course Outline
- Lecture 3 - Conservation Laws and Mathematical Preliminaries
- Lecture 4 - Mass Conservation: Continuity Equation
- Lecture 5 - Momentum Equation: Newton's 2nd Law
- Lecture 6 - Momentum Equation: Navier-Stokes Equations
- Lecture 7 - Navier-Stokes Equation and its Simplified Forms
- Lecture 8 - Energy and Scalar Transport Equations
- Lecture 9 - Scalar Transport, Mathematical Classification and Boundary Conditions
- Lecture 10 - Finite Difference Method: Methodology and Grid Notation
- Lecture 11 - Finite Difference Approximation of First Order Derivatives
- Lecture 12 - Finite Difference Approximation of Second Order Derivatives - 1
- Lecture 13 - Finite Difference Approximation of Second Order Derivatives - 2
- Lecture 14 - Approximation of Mixed Derivatives and Multi-Dimensional F.D. Formulae
- Lecture 15 - Implementation of Boundary Conditions and Finite Difference Algebraic System
- Lecture 16 - Applications of FDM to Scalar Transport Problems - 1
- Lecture 17 - Applications of FDM to Scalar Transport Problems - 2
- Lecture 18 - Application of FDM to Advection-Diffusion and Computer Implementation Aspects
- Lecture 19 - Computer Implementation of FDM for Steady State Heat Diffusion Problems - 1
- Lecture 20 - Computer Implementation of FDM for Steady State Heat Diffusion Problems - 2
- Lecture 21 - Computer Implementation of FDM for Steady State Heat Diffusion Problems - 3
- Lecture 22 - Solution of Discrete Algebraic Systems
- Lecture 23 - Direct and Basic Iterative Methods for Linear Systems
- Lecture 24 - Accelerated Iterative Methods for Linear Systems
- Lecture 25 - Two Level and Multi-Level Methods for First Order IVPs - 1
- Lecture 26 - Two Level and Multi-Level Methods for First Order IVPs - 2
- Lecture 27 - Application to Unsteady Transport Problems
- Lecture 28 - Introduction to Finite Volume Method
- Lecture 29 - Finite Volume Interpolation Schemes
- Lecture 30 - Application of FVM to Scalar Transport
- Lecture 31 - Introduction to Finite Element Method

[Lecture 32 - Finite Element Shape Functions and Numerical Integration - 1](#)

[Lecture 33 - Finite Element Shape Functions and Numerical Integration - 2](#)

[Lecture 34 - Application of FEM to Scalar Transport](#)

[Lecture 35 - Special Features of Navier-Stokes Equations](#)

[Lecture 36 - Time Integration Techniques for Navier-Stokes Equations](#)

[Lecture 37 - Implicit Pressure Correction Methods](#)

[Lecture 38 - SIMPLEC, SIMPLER and Fractional Step Methods](#)

[Lecture 39 - Turbulent Flows: Features and Simulation Strategies](#)

[Lecture 40 - Reynolds Averaging and RANS Simulation Models](#)

[Lecture 41 - RANS Turbulence Models and Large Eddy Simulation](#)

[Lecture 42 - Introduction to Grid Generation](#)

[Lecture 43 - Aspects of Practical CFD Analysis](#)

**NPTEL : Metal Casting (Mechanical Engineering)**

**Co-ordinators : Dr. D. B. Karunakar**

Lecture 1 - Introduction

Lecture 2 - Overview of different casting processes - 1

Lecture 3 - Overview of different casting processes - 2

Lecture 4 - Overview of different casting processes - 3

Lecture 5 - Terminology and Tools of Sand Moulding

Lecture 6 - Moulding Sands and Design - 1

Lecture 7 - Moulding Sands and Design - 2

Lecture 8 - Moulding Sands Properties

Lecture 9 - Moulding Sand Properties Testing

Lecture 10 - Cores and Core Sands

Lecture 11 - Patterns and Allowances

Lecture 12 - Steps Involved in Making a Sand Casting

Lecture 13 - Design of Riser System - 1

Lecture 14 - Design of Riser System - 2

Lecture 15 - Design of Riser System - 3

Lecture 16 - Design of Riser System - 4

Lecture 17 - Design of Riser System - 5

Lecture 18 - Design of Gating System - 1

Lecture 19 - Design of Gating System - 2

Lecture 20 - Sand Casting Defects - 1

Lecture 21 - Sand Casting Defects - 2

Lecture 22 - Melting Furnaces and Practice

Lecture 23 - Treatment of Molten Metal

Lecture 24 - Fluidity of Molten Metal

Lecture 25 - Solidification

Lecture 26 - Cast Irons and Steels

Lecture 27 - Aluminum and Magnesium Cast Alloys

Lecture 28 - Copper, Zinc and Titanium Cast Alloys

Lecture 29 - Die Casting Process - I

Lecture 30 - Die Casting Process - II

Lecture 31 - Investment Casting Process - I

[Lecture 32 - Investment Casting Process - II](#)

[Lecture 33 - Continuous Casting Process](#)

[Lecture 34 - Centrifugal Casting Process](#)

[Lecture 35 - Evaporative Pattern Casting and Plaster Moulding](#)

[Lecture 36 - Vacuum Sealed Moulding and Squeeze Casting](#)

[Lecture 37 - Shakeout, Fettling and Finishing](#)

[Lecture 38 - Inspection, Testing and Quality Control](#)

[Lecture 39 - Design Consideration and Economics](#)

[Lecture 40 - Environment, Health and Safety Aspects](#)

Lecture 1 - Engineering Materials and Processing Techniques: Introduction

Lecture 2 - Properties of Non-Metals

Lecture 3 - Glass Structure and Properties

Lecture 4 - Glass Processing - I

Lecture 5 - Glass Processing - II

Lecture 6 - Ceramics - I

Lecture 7 - Ceramics - II

Lecture 8 - Ceramic Powder Preparation

Lecture 9 - Ceramic Powder Preparation - I

Lecture 10 - Processing of Ceramic Parts - Pressing

Lecture 11 - Processing of Ceramic Parts - II

Lecture 12 - Ceramics: Secondary Processing

Lecture 13 - Thermoplastics and Thermosets

Lecture 14 - Processing of Plastics

Lecture 15 - Extrusion of Plastics

Lecture 16 - Transfer Molding and Compression Molding

Lecture 17 - Injection Molding

Lecture 18 - Thermoforming

Lecture 19 - Rotational Molding and Blow Molding

Lecture 20 - Composite Materials

Lecture 21 - Composite Materials: Classification and Applications

Lecture 22 - Processing of Polymer Matrix Composites

Lecture 23 - Hand Lay-up and Spray Lay-up

Lecture 24 - Pultrusion

Lecture 25 - Compression Molding

Lecture 26 - Filament Winding

Lecture 27 - Injection Molding-1

Lecture 28 - Pre-pregging and Sheet Molding Compounds

Lecture 29 - Resin Transfer Molding and Autoclave Molding

Lecture 30 - Ceramic Matrix Composites

Lecture 31 - Ceramic Matrix Composites: Fundamentals and Properties

[Lecture 32 - Powder Processing: Ceramic Matrix Composites](#)

[Lecture 33 - Chemical Vapour Infiltration](#)

[Lecture 34 - Ceramic Matrix Composites: Processing-1](#)

[Lecture 35 - Ceramic Matrix Composites: Post Processing](#)

[Lecture 36 - Drilling of Polymer Matrix Composites](#)

[Lecture 37 - Hole Making Techniques for Polymer Matrix Composites](#)

[Lecture 38 - Joining of Polymer Matrix Composites](#)

[Lecture 39 - Microwave Joining of Polymer Matrix Composites](#)

[Lecture 40 - Research Tools for Secondary Processing](#)

Lecture 1 - Basics of Vibrations for Simple Mechanical Systems

Lecture 2 - Introduction to Damping in Free and Force Vibrations

Lecture 3 - Free and Forced Vibrations of Two Degree of Systems

Lecture 4 - Multi Degree of Freedom Systems

Lecture 5 - Reduction at source - 1

Lecture 6 - Reduction at source - 2

Lecture 7 - Reduction at source - 3

Lecture 8 - Feedback Control System - 1

Lecture 9 - Shunt Damping

Lecture 10 - Vibration Isolation - 1

Lecture 11 - Vibration Isolation - 2

Lecture 12 - Vibration Isolation - 3

Lecture 13 - Source Classification

Lecture 14 - Self Excitation Vibration

Lecture 15 - Flow Induction Vibration

Lecture 16 - Field Balancing of Rigid / Flexible Rotors

Lecture 17 - Damping: Models and Measures - I

Lecture 18 - Damping: Models and Measures - II

Lecture 19 - Numerical Problems

Lecture 20 - Design Sensitivity - I

Lecture 21 - Design Specification

Lecture 22 - Design for Enhanced Material Damping

Lecture 23 - Basics of Passive Vibration Control

Lecture 24 - Design of Absorber

Lecture 25 - Shock Absorber

Lecture 26 - Isolators with Stiffness and Damping

Lecture 27 - Basics of Active Vibration Control

Lecture 28 - Piezoelectric Material - I

Lecture 29 - Piezoelectric Material - II: Applications

Lecture 30 - Piezoelectric Accelerometers

Lecture 31 - Electro-rheological (ER) Fluids



[Lecture 32 - Magneto-rheological \(MR\) Fluids](#)

[Lecture 33 - Magneto and Electrostrictive Materials](#)

[Lecture 34 - Shape Memory Alloy](#)

[Lecture 35 - Electro-Magnetics](#)

[Lecture 36 - Numerical Problems](#)

[Lecture 37 - Basics of Vibration Measurement System](#)

[Lecture 38 - Data Acquisition](#)

[Lecture 39 - Fourier Transformation](#)

[Lecture 40 - Filters](#)

- Lecture 1 - Introduction to Welding Engineering
- Lecture 2 - Classification of Welding Processes - I
- Lecture 3 - Classification of Welding Processes - II
- Lecture 4 - Sources of Heat and Protection of Weld pool
- Lecture 5 - Protection of Weld Pool
- Lecture 6 - Introduction
- Lecture 7 - Fundamentals of Arc Initiation
- Lecture 8 - Arc Maintenance & Arc Characteristics
- Lecture 9 - Arc Forces
- Lecture 10 - Arc Efficiency
- Lecture 11 - Melting Rate in Different Welding Processes
- Lecture 12 - Types of power sources and their characteristics - I
- Lecture 13 - Types of power sources and their characteristics - II
- Lecture 14 - SMAW - I
- Lecture 15 - SMAW - II
- Lecture 16 - GTAW - I
- Lecture 17 - GTAW - II
- Lecture 18 - PAW & SAW
- Lecture 19 - SAW
- Lecture 20 - GMAW
- Lecture 21 - Brazing, Soldering & Braze Welding
- Lecture 22 - Braze welding and Electroslag welding
- Lecture 23 - Weld Thermal Cycle
- Lecture 24 - Effect of WTC and Cooling rate in welding
- Lecture 25 - Cooling rate
- Lecture 26 - Peak temperature & Solidification rate
- Lecture 27 - Residual stress - I
- Lecture 28 - Residual stress - II
- Lecture 29 - Introduction
- Lecture 30 - Type of joints and welds
- Lecture 31 - Edge preparation

[Lecture 32 - Design for static and fatigue loading](#)

[Lecture 33 - Fatigue fracture of weld joints - I](#)

[Lecture 34 - Fatigue fracture of weld joints - II](#)

[Lecture 35 - Introduction-](#)

[Lecture 36 - DT & NDT](#)

[Lecture 37 - Understanding Weldability](#)

[Lecture 38 - Reactions in weldment](#)

[Lecture 39 - Weldability of Al alloys](#)

[Lecture 40 - Failure analysis and prevention](#)

- Lecture 1 - Production Planning and Control
- Lecture 2 - Product Design and Development
- Lecture 3 - Statistical Process Control - Part I
- Lecture 4 - Statistical Process Control - Part II
- Lecture 5 - Statistical Process Control - Part III
- Lecture 6 - Productivity
- Lecture 7 - Factors Affecting the Productivity
- Lecture 8 - Improving the Productivity Introduction to Work Study
- Lecture 9 - Work Study Human Component and Method Study
- Lecture 10 - Recording Techniques for Method Study - Part I
- Lecture 11 - Recording Techniques for Method Study - Part II
- Lecture 12 - Recording Techniques Critical Examination
- Lecture 13 - Principles of Motion Economy
- Lecture 14 - Work Measurement Time Study - Part I
- Lecture 15 - Work Measurement Time Study - Part II
- Lecture 16 - Performance Rating Allowances
- Lecture 17 - Work Measurement: Work Sampling
- Lecture 18 - PMT System Standard Data Method
- Lecture 19 - Ergonomics
- Lecture 20 - Metabolism and Organization at Work
- Lecture 21 - Working Conditions Lights Vibrations
- Lecture 22 - Materials Management - Part I
- Lecture 23 - Materials Management - Part II
- Lecture 24 - Materials Requirement Planning
- Lecture 25 - Sales Forecasting - Part I
- Lecture 26 - Sales Forecasting - Part II
- Lecture 27 - Capacity Planning - Part I
- Lecture 28 - Capacity Planning - Part II
- Lecture 29 - Network Analysis - Part I
- Lecture 30 - Network Analysis - Part II
- Lecture 31 - Facility Design Part - Part I

[Lecture 32 - Facility Design Part - Part II](#)

[Lecture 33 - Facility Design Part - Part III](#)

[Lecture 34 - Facility Design Part - Part IV](#)

[Lecture 35 - Product Design Development](#)

[Lecture 36 - Materials Handling](#)

[Lecture 37 - Quality Concepts](#)

[Lecture 38 - Value Engineering](#)

[Lecture 39 - Reliability](#)

[Lecture 40 - Industrial Safety](#)

Lecture 1 - Powder Metallurgy - Part I

Lecture 2 - Powder Metallurgy - Part II

Lecture 3 - Powder Metallurgy - Part III

Lecture 4 - Metal Forming - Fundamentals

Lecture 5 - Forging

Lecture 6 - Swaging and Wire Drawing

Lecture 7 - Sheet Metal Operations - Part I

Lecture 8 - Sheet Metal Operations - Part II

Lecture 9 - Sheet Metal Operations - Part III

Lecture 10 - Sheet Metal Working - Presses

Lecture 11 - Sheet Metal Working - Equipment

Lecture 12 - High Energy Rate Forming Processes

Lecture 13 - Machining Fundamentals

Lecture 14 - Machining - Part I

Lecture 15 - Machining - Part II

Lecture 16 - Machining - Part III

Lecture 17 - Metal casting - Part I

Lecture 18 - Metal casting - Part II

Lecture 19 - Metal Casting - Part III

Lecture 20 - Metal Casting - Part IV

Lecture 21 - Metal Casting - Part V

Lecture 22 - Metal Casting - Part VI

Lecture 23 - Metal Casting - Part VII

Lecture 24 - Metal Casting - Part VIII

Lecture 25 - Metal Casting - Part IX

Lecture 26 - Metal Casting - Part X

Lecture 27 - Introduction

Lecture 28 - Welding Process Classification

Lecture 29 - Brazing Soldering Braze Welding

Lecture 30 - Arc Welding Power Source - Part I

Lecture 31 - Arc Welding Power Source - Part II

[Lecture 32 - Shielded Metal Arc Welding - Part I](#)

[Lecture 33 - Shielded Metal Arc Welding - Part II](#)

[Lecture 34 - Submerged Arc Welding](#)

[Lecture 35 - Gas Metal Arc Welding - Part I](#)

[Lecture 36 - Gas Metal Arc Welding - Part II](#)

[Lecture 37 - Tungsten Inert Gas Welding - Part I](#)

[Lecture 38 - Tungsten Inert Gas Welding - Part II](#)

[Lecture 39 - Resistance Welding Process](#)

[Lecture 40 - Reaction in Weld Region Welding Defects](#)

[Lecture 1 - Solid Mechanics](#)

[Lecture 2 - Strength of Materials](#)

[Lecture 3 - Strength of Materials](#)

[Lecture 4 - Solid Mechanics](#)

[Lecture 5 - Strength of Materials](#)

[Lecture 6 - Strength of Materials](#)

[Lecture 7 - Strength of Materials](#)

[Lecture 8 - Strength of Materials](#)

[Lecture 9 - Strength of Materials](#)

[Lecture 10 - Strength of Materials](#)

[Lecture 11 - Strength of Materials](#)

[Lecture 12 - Strength of Materials](#)

[Lecture 13 - Strength of Materials](#)

[Lecture 14 - Strength of Materials](#)

[Lecture 15 - Strength of Materials](#)

[Lecture 16 - Strength of Materials](#)

[Lecture 17 - Strength of Materials](#)

[Lecture 18 - Strength of Materials](#)

[Lecture 19 - Strength of Materials](#)

[Lecture 20 - Strength of Materials](#)

[Lecture 21 - Strength of Materials](#)

[Lecture 22 - Strength of Materials](#)

[Lecture 23 - Strength of Materials](#)

[Lecture 24 - Strength of Materials](#)

[Lecture 25 - Strength of Materials](#)

[Lecture 26 - Strength of Materials](#)

[Lecture 27 - Strength of Materials](#)

[Lecture 28 - Strength of Materials](#)

[Lecture 29 - Strength of Materials](#)

[Lecture 30 - Strength of Materials](#)

[Lecture 31 - Strength of Materials](#)



[Lecture 32 - Strength of Materials](#)

[Lecture 33 - Strength of Materials](#)

[Lecture 34 - Strength of Materials](#)

[Lecture 35 - Strength of Materials](#)

[Lecture 36 - Strength of Materials](#)

[Lecture 37 - Strength of Materials](#)

[Lecture 38 - Strength of Materials](#)

[Lecture 39 - Strength of Materials](#)

[Lecture 40 - Strength of Materials](#)

Lecture 1 - Introduction

Lecture 2 - Flow Regimes

Lecture 3 - Homogeneous Model

Lecture 4 - Drift Flux Model

Lecture 5 - Separated Flow Model

Lecture 6 - Dispersed Flow

Lecture 7 - Slug Flow

Lecture 8 - Annular Flow

Lecture 9 - Droplet Annular and Stratified Flow

Lecture 10 - Measurement of Void Fraction

Lecture 11 - Signal Analysis

Lecture 12 - Two Fluid and Population Balance Model

Lecture 13 - Interface Tracking

Lecture 14 - Lattice Boltzmann Method

Lecture 15 - Smoothed Particle Hydrodynamics

Lecture 16 - Molecular Perspective of Two Phase Flow

Lecture 17 - Boiling Heat Transfer

Lecture 18 - Condensation

Lecture 19 - Solid-Liquid Flow

Lecture 20 - Gas-Solid Flow

Lecture 1 - Recapitulation of Thermodynamics

Lecture 2 - Introduction to Refrigeration

Lecture 3 - Air Refrigeration Cycle

Lecture 4 - Aircraft Refrigeration Cycles - 1

Lecture 5 - Aircraft Refrigeration Cycles - 2

Lecture 6 - Aircraft Refrigeration Cycles - 3

Lecture 7 - Vapour Compression Cycle - 1

Lecture 8 - Vapour Compression Cycle - 2

Lecture 9 - P-h Charts

Lecture 10 - Actual Vapour Compression Cycle - 1

Lecture 11 - Actual Vapour Compression Cycle - 2

Lecture 12 - Compound Compression with Intercooling - 1

Lecture 13 - Compound Compression with Intercooling - 2

Lecture 14 - Multiple Evaporator and Cascade System

Lecture 15 - Problem Solving - 1

Lecture 16 - Refrigerants - 1

Lecture 17 - Refrigerants - 2

Lecture 18 - Vapour Absorption Systems - 1

Lecture 19 - Vapour Absorption Systems - 2

Lecture 20 - Vapour Absorption Systems - 3

Lecture 21 - Introduction to Air-conditioning

Lecture 22 - Properties of Moist Air

Lecture 23 - Psychrometric Chart

Lecture 24 - Psychrometric Processes - 1

Lecture 25 - Psychrometric Processes - 2

Lecture 26 - Psychrometric Processes - 3

Lecture 27 - Infiltration

Lecture 28 - Design Conditions

Lecture 29 - Cooling Load - 1

Lecture 30 - Cooling Load - 2

Lecture 31 - Cooling Load - 3

[Lecture 32 - Air Distribution System - 1](#)

[Lecture 33 - Air Distribution System - 2](#)

[Lecture 34 - Problem Solving - 2](#)

[Lecture 35 - Air-Conditioning Systems](#)

[Lecture 36 - Human Physiology](#)

[Lecture 37 - Thermal Comfort](#)

[Lecture 38 - Indoor Environmental Health - 1](#)

[Lecture 39 - Indoor Environmental Health - 2](#)

[Lecture 40 - Problem Solving - 3](#)

- Lecture 1 - Introduction to Engineering Economy, Physical and Economic Environment, Phases in Engg. process
- Lecture 2 - Some economic concepts, Value and utility, Interest and Interest rate, Time value of money
- Lecture 3 - Interest formulas: Simple and compound interest, Cash flow diagrams
- Lecture 4 - Interest formulas for discrete compounding and discrete payments: Single payment (CAF and PWF)
- Lecture 5 - Interest formulas for discrete compounding and discrete payments: Equal payment series (CAF, CRF and PWF)
- Lecture 6 - Problem solving on discrete compounding, discrete payment
- Lecture 7 - Interest formulas for Uniform gradient series
- Lecture 8 - Interest formulas for geometric gradient series
- Lecture 9 - Compounding frequency of Interest: Nominal and Effective interest rates
- Lecture 10 - Problem solving on frequency compounding of interest and gradient series factors
- Lecture 11 - Economic equivalence: Meaning and principles of equivalence
- Lecture 12 - Equivalence calculations involving cash flows
- Lecture 13 - Methods of comparison of alternatives: Present worth, Annual equivalent, Future worth, Internal rate of return
- Lecture 14 - comparison of alternatives: Capitalized equivalent amount, Capital recovery with return
- Lecture 15 - Problem solving on equivalence and comparison of alternatives
- Lecture 16 - Replacement analysis: Reason, Concept of defender and challenger
- Lecture 17 - Proper treatment of sunk cost in replacement
- Lecture 18 - Replacement because of improved efficiency, inadequacy, demand etc.
- Lecture 19 - Problem solving on replacement analysis
- Lecture 20 - Economic life of the asset
- Lecture 21 - Depreciation: Definition, Reasons, Types of property, Value time function and book value
- Lecture 22 - Basic depreciation methods:S-L method, Declining balance method
- Lecture 23 - Depreciation: Declining balance switching to S-L, SOYD Method
- Lecture 24 - Modified accelerated cost recovery system (MACRS) method of depreciation, Depletion
- Lecture 25 - Depreciation: Units of production method, Depletion
- Lecture 26 - Problem solving based on Depreciation and Depletion
- Lecture 27 - Elements of cost: types of cost
- Lecture 28 - Breakeven analysis, Effect of fixed and variable cost on BEP.
- Lecture 29 - Economic order quantity
- Lecture 30 - Problem solving based on Breakeven analysis and EOQ
- Lecture 31 - Cost estimation: Methods of cost estimation, Adjustment of data, Learning

[Lecture 32 - cost estimating relationships](#)

[Lecture 33 - Introduction to decision under risk Criteria for decision under risk](#)

[Lecture 34 - Expected value decision making under risk](#)

[Lecture 35 - Expected variance decision making under risk](#)

[Lecture 36 - Problem solving based on decision under risk](#)

[Lecture 37 - Income taxes: Principles and calculation of effective income tax rates](#)

[Lecture 38 - Effect of method of depreciation on income taxes](#)

[Lecture 39 - After tax economic analysis](#)

[Lecture 40 - Problem solving based on Income tax analysis](#)

Lecture 1 - Introduction

Lecture 2 - Balance of Total Energy

Lecture 3 - Different Forms of Thermal Energy Equation

Lecture 4 - Thermal Boundary Layer

Lecture 5 - Forced Convection : Low Prandtl Number over a Flat Plate

Lecture 6 - Forced Convection : High Prandtl Number over a Flat Plate

Lecture 7 - Forced Convection over a Flat Plate : Uniform Heat Flux

Lecture 8 - Natural Convection : Uniform Wall Temperature

Lecture 9 - Natural Convection : Uniform Heat Flux

Lecture 10 - Tutorial : Convection over Flat Plate

Lecture 11 - Forced Convection in Ducts

Lecture 12 - Thermally Developed Slug Flow in a Duct

Lecture 13 - Thermally and Hydrodynamically Developed Flow : Uniform Heat Flux

Lecture 14 - Thermally and Hydrodynamically Developed Flow : Uniform Wall Temperature

Lecture 15 - Thermal Entrance Region : Uniform Wall Temperature

Lecture 16 - Thermal Entrance Region : Uniform Heat Flux

Lecture 17 - Rayleigh Benard Convection

Lecture 18 - Heat Transfer with Phase Change

Lecture 19 - Mass Transfer

Lecture 20 - Tutorial : Convection inside Duct and Mass Transfer

Lecture 1 - Lesson 1 - Introduction

Lecture 2 - Lesson 2 - Addition of two harmonic motions and beat phenomenon

Lecture 3 - Lesson 3 - Fourier series and harmonic analysis

Lecture 4 - Lesson 4 - Vibration analysis procedure

Lecture 5 - Lesson 5 - Numerical problems

Lecture 6 - Lesson 1 - Undamped free vibration

Lecture 7 - Lesson 2 - Energy method

Lecture 8 - Lesson 3 - Damped free vibration

Lecture 9 - Lesson 4 - Viscous damped systems and logarithmic decrement

Lecture 10 - Lesson 5 - Coulomb damping

Lecture 11 - Lesson 1 - Harmonic excitations

Lecture 12 - Lesson 2 - Magnification factor and frequency response curve

Lecture 13 - Lesson 3 - Rotating unbalance

Lecture 14 - Lesson 4 - Excitation of the support

Lecture 15 - Lesson 5 - Energy input and dissipation by viscous damping

Lecture 16 - Lesson 1 - Coulomb damping and equivalent viscous damping

Lecture 17 - Lesson 2 - Structural damping and equivalent viscous damping

Lecture 18 - Lesson 3 - Vibration isolation and force transmissibility

Lecture 19 - Lesson 4 - Motion transmissibility

Lecture 20 - Lesson 5 - Numerical problems

Lecture 21 - Lesson 1 - Transducers and vibration pickup

Lecture 22 - Lesson 2 - Vibrometer

Lecture 23 - Lesson 3 - Accelerometer

Lecture 24 - Lesson 4 - Velocity pickup or Velometer

Lecture 25 - Lesson 5 - Phase distortion and frequency measurement

Lecture 26 - Lesson 1 - Undamped free vibration

Lecture 27 - Lesson 2 - Principal modes of vibration

Lecture 28 - Lesson 3 - Combined rectilinear and angular modes

Lecture 29 - Lesson 4 - Damped free vibration

Lecture 30 - Lesson 5 - Undamped forced vibration with harmonic excitation

Lecture 31 - Lesson 1 - Undamped dynamic vibration absorber



[Lecture 32 - Lesson 2 - Tuned absorber](#)

[Lecture 33 - Lesson 3 - Numerical problems](#)

[Lecture 34 - Lesson 4 - Damped dynamic vibration absorber](#)

[Lecture 35 - Lesson 5 - Optimally tuned vibration absorber](#)

[Lecture 36 - Lesson 1 - Undamped free vibration](#)

[Lecture 37 - Lesson 2 - Eigen values and eigen vectors](#)

[Lecture 38 - Lesson 3 - Flexibility influence coefficients](#)

[Lecture 39 - Lesson 4 - Stiffness influence coefficients](#)

[Lecture 40 - Lesson 5 - Static and dynamic coupling](#)

- Lecture 1 - Introduction: Manufacturing and Joining
- Lecture 2 - Fundamental mechanisms of Joining
- Lecture 3 - Classification of Joining Processes
- Lecture 4 - Heat Generation in Welding
- Lecture 5 - Protection of Weld Metal
- Lecture 6 - Principle of Fusion Welding Processes: Gas Welding
- Lecture 7 - Fundamentals of Welding
- Lecture 8 - Physics of Welding Arc
- Lecture 9 - Shielded Metal Arc Welding
- Lecture 10 - Gas Tungsten Arc Welding
- Lecture 11 - Newer variants of Gas tungsten arc welding
- Lecture 12 - Gas metal arc welding
- Lecture 13 - Submerged arc welding
- Lecture 14 - Electro-slag and Electro-gas welding
- Lecture 15 - Laser beam welding
- Lecture 16 - Brazing
- Lecture 17 - Soldering and braze welding
- Lecture 18 - Fundamentals of resistance welding
- Lecture 19 - Resistance welding processes: spot and seam welding
- Lecture 20 - Flash butt welding
- Lecture 21 - Adhesive joining
- Lecture 22 - Weld bonding
- Lecture 23 - Solid state joining technologies: Fundamentals
- Lecture 24 - Ultrasonic welding
- Lecture 25 - Diffusion welding
- Lecture 26 - Explosive welding
- Lecture 27 - Magnetic pulse welding
- Lecture 28 - Weld thermal cycle
- Lecture 29 - Heat affected zone and weld thermal cycle - I
- Lecture 30 - Heat affected zone and weld thermal cycle - II
- Lecture 31 - Solidification of weld metal

- Lecture 32 - Metallurgical transformations in weld and heat affected zone of steels
- Lecture 33 - Residual Stresses in Weld Joints
- Lecture 34 - Solidification cracking and their control
- Lecture 35 - Cracking of Welded Joints II - Cold Cracks
- Lecture 36 - Understanding Weldability Introduction - I
- Lecture 37 - Understanding Weldability Introduction - II
- Lecture 38 - Metal Properties and Weldability - I
- Lecture 39 - Metal Properties and Weldability - II
- Lecture 40 - Weldability of Work Hardenable Metals
- Lecture 41 - Weldability of Work Hardenable and Precipitation Strengthened Metals
- Lecture 42 - Weldability of Precipitation Strengthened Metals
- Lecture 43 - Weldability of Metals Strengthened by Grain Refinement and Transformation Hardening
- Lecture 44 - Weldability of Transformation Hardening Metals
- Lecture 45 - Weldability of Metals - Combination of Strengthening Mechanisms
- Lecture 46 - Weldability Consideration
- Lecture 47 - Weldability of Carbon and Alloy Steel - I
- Lecture 48 - Weldability of Carbon and Alloy Steel - II
- Lecture 49 - Weldability of Carbon and Alloy Steel - III
- Lecture 50 - Weldability of Low Carbon Steel and Mild Steel
- Lecture 51 - Weldability of Medium Carbon Steel and High Carbon Steel
- Lecture 52 - Weldability of High Strength Low Alloy Steels
- Lecture 53 - Weldability of HTLA Steel - I
- Lecture 54 - Weldability of HTLA Steel - II
- Lecture 55 - Weldability of Cr-Mo Steel - I
- Lecture 56 - Weldability of Cr-Mo Steel - II
- Lecture 57 - Weldability of Pre-coated Steel - I
- Lecture 58 - Weldability of Pre-coated Steel - II
- Lecture 59 - Weldability of Stainless Steel - I
- Lecture 60 - Weldability of Stainless Steel - II

- Lecture 1 - Introduction to Modelling
- Lecture 2 - Examples of models
- Lecture 3 - Modeling of Dynamic Systems
- Lecture 4 - Introduction to Simulation
- Lecture 5 - MATLAB as a Simulation tool
- Lecture 6 - Bond graphs modelling
- Lecture 7 - Bond graph model and causality
- Lecture 8 - Generation of System Equations
- Lecture 9 - Methods of Drawing bond graph models - Mechanical Systems
- Lecture 10 - Methods of Drawing bond graph models - Electrical Systems
- Lecture 11 - Basic System Models - Mechanical Systems
- Lecture 12 - Basic System Models - Electrical Systems
- Lecture 13 - Basic System Models - Hydraulic Systems
- Lecture 14 - Basic System Models - Pneumatic Systems
- Lecture 15 - Basic System Models - Thermal Systems
- Lecture 16 - System Models : Linearity and Non Linearity in Systems
- Lecture 17 - System Model of Combined Rotary and Translatory Systems
- Lecture 18 - System Model of Electro Mechanical Systems
- Lecture 19 - System Model of Hydro Mechanical Systems
- Lecture 20 - System Models of Robots
- Lecture 21 - Dynamic response of the 1st order system
- Lecture 22 - Dynamic response of 2nd order system
- Lecture 23 - Performance measures for 2nd order system
- Lecture 24 - System Transfer functions
- Lecture 25 - Transfer Function of 1st and 2nd Order System
- Lecture 26 - Block Diagram Algebra
- Lecture 27 - Signal Flow Graphs
- Lecture 28 - State Variable Formulation
- Lecture 29 - Frequency Response
- Lecture 30 - Bode Plot
- Lecture 31 - Simulation using SIMULINK

[Lecture 32 - Simulation of simple and compound pendulums](#)

[Lecture 33 - Simulation of planar mechanisms](#)

[Lecture 34 - Simulation of wheeled mobile robots](#)

[Lecture 35 - Validation and Verification of Simulation Models](#)

[Lecture 36 - Parameter estimation methods](#)

[Lecture 37 - Parameter estimation examples](#)

[Lecture 38 - System identifications](#)

[Lecture 39 - Introduction to Optimization](#)

[Lecture 40 - Optimization with modeling of engineering problems](#)

Lecture 1 - Introduction to Casting Technology

Lecture 2 - Mechanism of solidification

Lecture 3 - Solidification of Pure Metals and Alloys

Lecture 4 - Freeze Wave Mechanism and Solidification Time

Lecture 5 - Problem Solving on Solidification

Lecture 6 - Technology of pattern making

Lecture 7 - Allowances in pattern making

Lecture 8 - Moulding sands and its ingredients

Lecture 9 - Testing of molding sands

Lecture 10 - Sand preparation for casting

Lecture 11 - Technology of mould making

Lecture 12 - Technology of core making

Lecture 13 - Special sand moulding process

Lecture 14 - Organic binders

Lecture 15 - Special moulding process

Lecture 16 - Introduction of gating design

Lecture 17 - Types of gate

Lecture 18 - Pouring time calculation

Lecture 19 - Aspiration effects in gating system

Lecture 20 - Problem solving on gating design

Lecture 21 - Solidification analysis

Lecture 22 - Riser methods

Lecture 23 - Shape factor

Lecture 24 - Feeding and Chills effect

Lecture 25 - Problem related to riser design

Lecture 26 - Special casting process - 1

Lecture 27 - Special casting process - 2

Lecture 28 - Special casting process - 3

Lecture 29 - Technology of melting

Lecture 30 - Melting practices

Lecture 31 - Melting and Casting of cast metal

[Lecture 32 - Melting practice for gray iron](#)

[Lecture 33 - Melting practice for Malleable iron and S.G iron](#)

[Lecture 34 - Casting of steel and alloy steel](#)

[Lecture 35 - Casting practices for non-ferrous metals and alloys](#)

[Lecture 36 - Fettling of castings](#)

[Lecture 37 - Heat treatment of castings](#)

[Lecture 38 - Heat treatment practices for cast iron and non-ferrous metals and alloys](#)

[Lecture 39 - Casting defects](#)

[Lecture 40 - Diagnostics of casting defects](#)

Lecture 1 - Review of Thermodynamics

Lecture 2 - Rankine Cycle

Lecture 3 - Performance of Rankine Cycle

Lecture 4 - Binary vapour cycle and co-generation

Lecture 5 - Problem Solving (Rankine Cycle)

Lecture 6 - Steam Generators

Lecture 7 - Fire Tube Boilers

Lecture 8 - Water Tube Boilers

Lecture 9 - Boiler Mountings and Accessories

Lecture 10 - High Pressure Boilers (Part-1)

Lecture 11 - High Pressure Boilers (Part-2)

Lecture 12 - Draught

Lecture 13 - Performance of Boiler

Lecture 14 - Combustion of Fuel

Lecture 15 - Combustion of Fuel (Problem Solving)

Lecture 16 - Boiler Trial

Lecture 17 - Nozzles and Diffusers - Momentum and Continuity Equations

Lecture 18 - Nozzles and Diffusers - Efficiency and Critical Pressure

Lecture 19 - Nozzles and Diffusers - General Relationships and Supersaturated Flow

Lecture 20 - Problem Solving (Nozzles and diffusers)

Lecture 21 - Steam Turbine

Lecture 22 - Compounding of Steam Turbine

Lecture 23 - Impulse Steam Turbine

Lecture 24 - Impulse Steam Turbine Performance

Lecture 25 - Problem solving (Impulse Steam Turbine)

Lecture 26 - Impulse Reaction Steam Turbine

Lecture 27 - Impulse Reaction Steam Turbine Performance

Lecture 28 - Energy Losses in Steam Turbine

Lecture 29 - Condensers

Lecture 30 - Problem Solving (Steam Turbine)

Lecture 31 - Gas turbine cycle



[Lecture 32 - Gas Turbine cycle Performance Evaluations](#)

[Lecture 33 - Gas Turbine cycle - Modifications](#)

[Lecture 34 - Problem Solving \(Gas Turbine Cycle\)](#)

[Lecture 35 - Centrifugal Compressors](#)

[Lecture 36 - Centrifugal Compressors Characteristics](#)

[Lecture 37 - Axial Flow Compressor](#)

[Lecture 38 - Axial Flow Compressor Characteristics](#)

[Lecture 39 - Jet Propulsion](#)

[Lecture 40 - Problem Solving](#)

Lecture 1 - Introduction to product design and development

Lecture 2 - Product life-cycle

Lecture 3 - Product policy of an organization and selection of profitable products

Lecture 4 - Product design

Lecture 5 - Product design steps and product analysis

Lecture 6 - Value engineering concepts

Lecture 7 - Problem Identification and VEJP

Lecture 8 - Function analysis

Lecture 9 - Functional analysis system technique

Lecture 10 - Case study on value engineering

Lecture 11 - Quality function deployment

Lecture 12 - Computer aided design

Lecture 13 - Robust design

Lecture 14 - Design for X

Lecture 15 - Ergonomics in product design

Lecture 16 - DFMA guidelines

Lecture 17 - Product design for manual assembly

Lecture 18 - Design guidelines for different processes

Lecture 19 - Rapid prototyping: concept, advantages

Lecture 20 - Rapid prototyping processes

- Lecture 1 - Understanding Manufacturing
- Lecture 2 - Fundamental Approaches of Manufacturing
- Lecture 3 - Manufacturing Process Specific Advantages and Limitations
- Lecture 4 - Material and Manufacturing Processes
- Lecture 5 - Classification of Manufacturing Processes
- Lecture 6 - Selection of Manufacturing Processes
- Lecture 7 - Applications of Manufacturing Processes
- Lecture 8 - Effect of Manufacturing Processes on Mechanical Properties
- Lecture 9 - Break Even Analysis in Manufacturing Processes
- Lecture 10 - Casting: Introduction and Suitability
- Lecture 11 - Steps of Casting Processes
- Lecture 12 - Casting: Terminology
- Lecture 13 - The Pattern Allowances - I
- Lecture 14 - The Pattern Allowances - II
- Lecture 15 - Casting: Sand Moulding - I
- Lecture 16 - Sand Moulding - II
- Lecture 17 - Casting: Core and Core Prints
- Lecture 18 - Casting: Gating System
- Lecture 19 - Casting: Yield and Riser Design
- Lecture 20 - Casting: Riser Design
- Lecture 21 - Casting: Cleaning of Castings
- Lecture 22 - Casting: Casting Defects and their Preventions
- Lecture 23 - Casting: Shell Mould Casting
- Lecture 24 - Casting: Investment and Permanent Mould Casting
- Lecture 25 - Metal Working Processes: Hot and Cold Working
- Lecture 26 - Metal Working Processes: Rolling
- Lecture 27 - Metal Working Processes: Forging
- Lecture 28 - Metal Working Processes: Extrusion
- Lecture 29 - Metal Working Processes: Wire Drawing
- Lecture 30 - Metal Working Processes: Press
- Lecture 31 - Sheet Metal Operations: Shearing

- Lecture 32 - Metal Working Processes: Sheet Metal Operations - II
- Lecture 33 - Metal Working Processes: Sheet Metal Operations - III
- Lecture 34 - Metal Working Processes: Dies and Die sets
- Lecture 35 - Material Removal Processes: Machining
- Lecture 36 - Material Removal Processes: Mechanism of Metal Cutting
- Lecture 37 - Material Removal Processes: Chip Formation
- Lecture 38 - Material Removal Processes: Types of Chips and Power Consumption
- Lecture 39 - Material Removal Processes: Heat Generation
- Lecture 40 - Material Removal Processes: Tool Failure and Tool Life
- Lecture 41 - Material Removal Processes: Tool materials
- Lecture 42 - Material removal processes: Cutting fluids
- Lecture 43 - Material removal processes: Grinding - I
- Lecture 44 - Material removal Processes: Grinding - II
- Lecture 45 - Material removal Processes: Grinding - III
- Lecture 46 - Material removal processes: Grinding operations
- Lecture 47 - Joining of metals: Fundamentals - I
- Lecture 48 - Joining of metals: Fundamentals - II
- Lecture 49 - Joining of metals: Welding processes - I
- Lecture 50 - Brazing, soldering and weldability
- Lecture 51 - Weldability and welding defects
- Lecture 52 - Heat treatment: Fundamentals - I
- Lecture 53 - Heat treatment: Fundamentals - II
- Lecture 54 - Heat treatment: Fundamentals - III
- Lecture 55 - Heat treatment: Normalizing and hardening
- Lecture 56 - Heat treatment: Tempering
- Lecture 57 - Improving surface properties: Introduction
- Lecture 58 - Improving surface properties: Surface modification processes I
- Lecture 59 - Improving surface properties: Changing chemical composition
- Lecture 60 - Improving surface properties: Coating

Lecture 1 - Introduction to Simulation

Lecture 2 - Concept of System, Model and Simulation

Lecture 3 - Time advance mechanism, Components of a simulation model

Lecture 4 - Program organization and logic, Steps in a simulation study

Lecture 5 - Simulation examples

Lecture 6 - Statistical Models in Simulation

Lecture 7 - Input probability distribution functions for discrete systems

Lecture 8 - Continuous distribution functions

Lecture 9 - Continuous distribution functions and empirical distribution functions

Lecture 10 - Problem solving on statistical models in simulation

Lecture 11 - Characteristics of a queueing system

Lecture 12 - Performance measures of queueing system

Lecture 13 - Analysis of a single server queueing system

Lecture 14 - Simulation of a single server queueing system

Lecture 15 - Computer representation of simulation of single server queuing system

Lecture 16 - Generation of Random Numbers

Lecture 17 - Issues and Challenges in Congruential Generators

Lecture 18 - Testing of random numbers

Lecture 19 - Generation of Random Variates

Lecture 20 - Problem Solving on Random Number and Random Variate Generation

Lecture 21 - Input modeling: Identifying distributions with data

Lecture 22 - Input modeling: Estimation of parameters

Lecture 23 - Input modeling: Goodness-of-fit tests and assessing sample dependence

Lecture 24 - Input modeling: Multivariate input models

Lecture 25 - Problem Solving on input modeling

Lecture 26 - Output analysis of a single system: Introduction

Lecture 27 - Obtaining a specified precision

Lecture 28 - Comparison of alternative system configurations

Lecture 29 - Confidence Intervals for comparing more than two systems

Lecture 30 - Problem Solving on output analysis of single and alternative systems

Lecture 31 - Introduction to simulation of manufacturing and material handling system

[Lecture 32 - Issues in material handling system](#)

[Lecture 33 - Modeling of system randomness: Machine downtime](#)

[Lecture 34 - Verification of simulation models](#)

[Lecture 35 - Model validity and credibility](#)

[Lecture 36 - Problem solving and case studies on simulation of manufacturing system](#)

[Lecture 37 - Introduction to Monte Carlo Simulation](#)

[Lecture 38 - Inventory Control Simulation using Monte Carlo Technique](#)

[Lecture 39 - In this lecture, Monte Carlo technique was used to solve inventory system problems](#)

[Lecture 40 - Problem solving on Monte Carlo Simulation](#)

Lecture 1 - Introduction to course

Lecture 2 - Engineering materials and processing techniques

Lecture 3 - Thermoplastics and thermosets

Lecture 4 - Processing of polymers

Lecture 5 - Thermoforming processes

Lecture 6 - Extrusion - I

Lecture 7 - Extrusion - II

Lecture 8 - Compression molding

Lecture 9 - Injection molding - I

Lecture 10 - injection molding - II

Lecture 11 - Transfer molding

Lecture 12 - Rotational molding

Lecture 13 - Blow molding

Lecture 14 - Composite materials: Basic concepts

Lecture 15 - Classification of composite materials

Lecture 16 - Processing of polymer composites

Lecture 17 - Hand lay-up

Lecture 18 - Spray lay-up

Lecture 19 - Compression molding

Lecture 20 - Injection molding

Lecture 21 - Reaction injection molding

Lecture 22 - Autoclave molding

Lecture 23 - Resin transfer molding

Lecture 24 - Filament winding

Lecture 25 - Pultrusion process

Lecture 26 - Sheet molding

Lecture 27 - Pre-pregging and challenges in primary processing of composites

Lecture 28 - Secondary processing of polymer composites

Lecture 29 - Joining of polymer composites

Lecture 30 - Adhesive joining

Lecture 31 - Mechanical joining

[Lecture 32 - Microwave joining](#)

[Lecture 33 - Induction and resistance welding](#)

[Lecture 34 - Drilling of polymer matrix composites - I](#)

[Lecture 35 - Drilling of polymer matrix composites - II](#)

[Lecture 36 - Methods to prevent drilling induced damage](#)

[Lecture 37 - Non-conventional drilling](#)

[Lecture 38 - Process simulation of secondary processing](#)

[Lecture 39 - Intelligent drilling of polymer matrix composites](#)

[Lecture 40 - Web based tools for polymer matrix composites](#)



- Lecture 1 - Operations Management: Basics
- Lecture 2 - Operations Management: Objectives
- Lecture 3 - Operations Management: Functions and Scope
- Lecture 4 - Types of Production Systems
- Lecture 5 - Operations Strategy
- Lecture 6 - Product Life-Cycle
- Lecture 7 - Value Engineering Concepts
- Lecture 8 - Design for X (DFX)
- Lecture 9 - Ergonomics in Product Design
- Lecture 10 - Rapid Prototyping: Concept, Advantages
- Lecture 11 - Sales Forecasting
- Lecture 12 - Forecasting System
- Lecture 13 - Qualitative Methods of Forecasting
- Lecture 14 - Quantitative Methods - I
- Lecture 15 - Quantitative Methods - II
- Lecture 16 - Facility Planning
- Lecture 17 - Factors Affecting Plant Location
- Lecture 18 - Plant Location: Case Study on Uttarakhand
- Lecture 19 - Location Evaluation Methods - I
- Lecture 20 - Location Evaluation Methods - II
- Lecture 21 - Facility Layout and Planning - I
- Lecture 22 - Facility Layout and Planning - II
- Lecture 23 - Factors Influencing Plant Layout
- Lecture 24 - Material Flow Patterns
- Lecture 25 - Tools and Techniques used For Plant Layout Planning
- Lecture 26 - Production Planning and Control
- Lecture 27 - Process Planning
- Lecture 28 - Aggregate Production Planning
- Lecture 29 - Capacity Planning: Introduction
- Lecture 30 - Capacity Planning: Examples
- Lecture 31 - Project Scheduling

- Lecture 32 - Network Diagrams
- Lecture 33 - Critical Path Method
- Lecture 34 - Critical Path Method: Problems - I
- Lecture 35 - Critical Path Method: Problems - II
- Lecture 36 - Program Evaluation and Review Technique (PERT)
- Lecture 37 - PERT Problems - I
- Lecture 38 - PERT Problems - II
- Lecture 39 - Time Cost Trade Off (Crashing)
- Lecture 40 - Project Network: Crashing Problems
- Lecture 41 - Production Control
- Lecture 42 - Sequencing
- Lecture 43 - Sequencing Problems - I
- Lecture 44 - Sequencing Problems - II
- Lecture 45 - Master Production Scheduling (MPS)
- Lecture 46 - Concept of Quality
- Lecture 47 - Total Quality Management (TQM)
- Lecture 48 - Total Productive Maintenance
- Lecture 49 - Statistical Quality Control (SQC)
- Lecture 50 - Six Sigma
- Lecture 51 - Materials Management
- Lecture 52 - Inventory Control
- Lecture 53 - Economic Order Quantity (EOQ) Models
- Lecture 54 - Economic Order Quantity (EOQ): Problems
- Lecture 55 - Production Quantity Model
- Lecture 56 - Just In time (JIT)
- Lecture 57 - Kanban System
- Lecture 58 - Materials Requirement Planning (MRP) - I
- Lecture 59 - Materials Requirement Planning (MRP) - II
- Lecture 60 - Enterprise Resource Planning (ERP)

- Lecture 1 - Introduction to Theory and Practics of Casting
- Lecture 2 - Theory of Solidification: Cooling curves
- Lecture 3 - Solidification of pure metals and alloys
- Lecture 4 - Factors affecting solidification process
- Lecture 5 - Fluidity of liquid metals
- Lecture 6 - Technology of patternmaking: Pattern materials
- Lecture 7 - Patternmaking: Types of pattern and allowances
- Lecture 8 - Molding sand ingredients and sand testing methods
- Lecture 9 - Sand molding methods
- Lecture 10 - Coremaking: Properties and types of cores
- Lecture 11 - Gating system design: Types of gates
- Lecture 12 - Gating system design: Pouring time calculation
- Lecture 13 - Introduction to riser design
- Lecture 14 - Riser design methods
- Lecture 15 - Problem solving on gating design and riser design methods
- Lecture 16 - Theory of melting: Types of furnaces
- Lecture 17 - Melting and production of Iron castings
- Lecture 18 - Production of steel and non-ferrous castings
- Lecture 19 - Casting design considerations
- Lecture 20 - Casting defects: Types, causes and remedies
- Lecture 21 - Concept of stress and strain, Elastic and plastic behavior
- Lecture 22 - State of stress in two and three dimensions, Mohr's circle
- Lecture 23 - Description of strain at a point
- Lecture 24 - Mean and deviator stresses, Elastic stress strain relationships
- Lecture 25 - Theory of plasticity: True stress and true strain, Flow curve
- Lecture 26 - Yield criteria for ductile materials
- Lecture 27 - Flow rules, Plastic stress strain relationships
- Lecture 28 - Classification of metal working processes
- Lecture 29 - Mechanics of metal working
- Lecture 30 - Temperature in metalworking: Hot and cold working
- Lecture 31 - Rolling process: Classification, Hot and cold rolling

[Lecture 32 - Analysis of rolling operation: Forces and geometrical relationships](#)

[Lecture 33 - Introduction to forging Process: Classification and equipments](#)

[Lecture 34 - Analysis of forging process](#)

[Lecture 35 - Problem solving on rolling and forging processes](#)

[Lecture 36 - Extrusion process: Classification and analysis](#)

[Lecture 37 - Drawing of rods, tubes and wires](#)

[Lecture 38 - Analysis of drawing operation](#)

[Lecture 39 - Sheet metal operations](#)

[Lecture 40 - Metal Forming Defects](#)

[Lecture 41 - Classification of joining processes](#)

[Lecture 42 - Heat flow in welding](#)

[Lecture 43 - Metallurgy of fusion welds](#)

[Lecture 44 - Heat affected zone in welding](#)

[Lecture 45 - Heat treatment processes in welding](#)

[Lecture 46 - Principle of shield arc welding processes](#)

[Lecture 47 - Principle of gas shield arc welding processes](#)

[Lecture 48 - Principle of Resistance welding](#)

[Lecture 49 - Principle of Solid State Welding Processes](#)

[Lecture 50 - Brazing, soldering and adhesive bonding](#)

[Lecture 51 - Residual stresses in welding](#)

[Lecture 52 - Methods of controlling residual stresses in welding](#)

[Lecture 53 - Welding Distortion](#)

[Lecture 54 - Control of welding distortion](#)

[Lecture 55 - Preheat and postweld heat treatment of weldments](#)

[Lecture 56 - Weldability of metals](#)

[Lecture 57 - Weldability of steels](#)

[Lecture 58 - Weldability of cast iron](#)

[Lecture 59 - Weldability of non-ferrous materials](#)

[Lecture 60 - Welding defects](#)

Lecture 1 - Definition and Types

Lecture 2 - Performance Specifications

Lecture 3 - Design Process

Lecture 4 - Block Diagrams

Lecture 5 - Laplace Transform and Transfer Function

Lecture 6 - Translational Mechanical System

Lecture 7 - Rotational Mechanical System

Lecture 8 - Electrical System

Lecture 9 - Linearization of Nonlinear Systems

Lecture 10 - Numerical Problems

Lecture 11 - Poles and Zeros

Lecture 12 - First Order System

Lecture 13 - Second Order System

Lecture 14 - Underdamped Second Order System - I

Lecture 15 - Underdamped Second Order System - II

Lecture 16 - Definition of Stability

Lecture 17 - Routh-Hurwitz Criterion

Lecture 18 - Routh-Hurwitz Criterion- Special Cases

Lecture 19 - Steady State Errors

Lecture 20 - Static Error Constants

Lecture 21 - Define Root Locus

Lecture 22 - Sketching of Root Locus - I

Lecture 23 - Sketching of Root Locus - II

Lecture 24 - Sketching of Root Locus - III

Lecture 25 - Numerical Examples and Second Order Approximation

Lecture 26 - PI Controller Design

Lecture 27 - PD Controller Design

Lecture 28 - PID Controller Design

Lecture 29 - Lag Compensation

Lecture 30 - Lead and Lag-Lead Compensation

Lecture 31 - State Space Representation

[Lecture 32 - Converting a Transfer Function to State Space](#)

[Lecture 33 - Converting From State Space to Transfer Function](#)

[Lecture 34 - Controller Design](#)

[Lecture 35 - Controller Design and Controllability](#)

[Lecture 36 - Transfer Function, Poles, Zeros, Response](#)

[Lecture 37 - Steady State Error, Root Locus](#)

[Lecture 38 - Design Via Root Locus, Compensation - I](#)

[Lecture 39 - Design Via Root Locus, Compensation - II](#)

[Lecture 40 - State Space Method](#)

- Lecture 1 - Introduction - Need and scope of failure analysis and prevention
- Lecture 2 - Introduction - Engineering disasters and understanding failures
- Lecture 3 - Fundamental sources of failures - Deficient design - I
- Lecture 4 - Fundamental sources of failures - Deficient design - II
- Lecture 5 - Fundamental sources of failures - Deficient design - III and upgrading of a part
- Lecture 6 - Fundamental sources of failures - Imperfections in base metals
- Lecture 7 - Fundamental sources of failures - Improper Manufacturing - I
- Lecture 8 - Fundamental sources of failures - Improper Manufacturing - II
- Lecture 9 - Fundamental sources of failures - Improper Manufacturing - III
- Lecture 10 - Fundamental sources of failures - Improper Manufacturing - IV and improper service conditions
- Lecture 11 - Fundamental sources of failures - Poor assembly, service and maintenance
- Lecture 12 - Industrial engineering tool for failure analysis - Pareto diagram
- Lecture 13 - Industrial engineering tool for failure analysis - Fishbone diagram and FMEA
- Lecture 14 - Industrial engineering tool for failure analysis - FMEA
- Lecture 15 - Industrial engineering tool for failure analysis - Fault tree analysis
- Lecture 16 - Industrial engineering tool for failure analysis - Reliability - I
- Lecture 17 - Industrial engineering tool for failure analysis - Reliability - II
- Lecture 18 - General procedure of failure analysis - Steps
- Lecture 19 - General procedure of failure analysis - Background information collection
- Lecture 20 - General procedure of failure analysis - Preliminary examination
- Lecture 21 - General procedure of failure analysis - NDT for failure analysis
- Lecture 22 - General procedure of failure analysis - Destructive testing
- Lecture 23 - General procedure of failure analysis - DT, selection, preservation, cleaning and sectioning of samples
- Lecture 24 - General procedure of failure analysis - Macroscopy of fracture surfaces - I
- Lecture 25 - General procedure of failure analysis - Macroscopy of fracture surfaces - II
- Lecture 26 - General procedure of failure analysis - Macroscopy of fracture surfaces - III
- Lecture 27 - General procedure of failure analysis - Macroscopy of fracture surfaces - IV
- Lecture 28 - General procedure of failure analysis - Microscopy of fracture surfaces
- Lecture 29 - General procedure of failure analysis - Metallography of failed components
- Lecture 30 - General procedure of failure analysis - Determination of type of fracture - I
- Lecture 31 - General procedure of failure analysis - Determination of type of fracture - II

[Lecture 32 - General procedure of failure analysis - Determination of type of fracture - III and chemical analysis](#)

[Lecture 33 - General procedure of failure analysis - Application of fracture mechanics - I](#)

[Lecture 34 - General procedure of failure analysis - Application of fracture mechanics - II](#)

[Lecture 35 - General procedure of failure analysis - Simulated test service conditions and analysis of evidences](#)

[Lecture 36 - General procedure of failure analysis - Question for analysis](#)

[Lecture 37 - General procedure of failure analysis - Reporting failure analysis and failure analysis of welded joint](#)

[Lecture 38 - General procedure of failure analysis - Failure analysis of weld joint](#)

[Lecture 39 - General procedure of failure analysis - Examples of failure analysis](#)

[Lecture 40 - General procedure of failure analysis - Embrittlement of steels](#)



Lecture 1 - Basic concepts of measurement

Lecture 2 - Functional elements of instruments

Lecture 3 - Classification of measuring instruments

Lecture 4 - Methods of correction for interfering and modifying inputs

Lecture 5 - Static characteristics of measuring instruments - 1

Lecture 6 - Static characteristics of measuring instruments - 2

Lecture 7 - Loading effect and Impedance matching

Lecture 8 - Statistical analysis

Lecture 9 - Chi-square test

Lecture 10 - Least square method

Lecture 11 - Uncertainty analysis

Lecture 12 - Problem solving - 1

Lecture 13 - Generalized model of a measuring system

Lecture 14 - Zero and first order system

Lecture 15 - First order system - step response

Lecture 16 - First order system - ramp response

Lecture 17 - First order system - impulse response

Lecture 18 - First order system - frequency response

Lecture 19 - Second order system - step response - 1

Lecture 20 - Second order system - step response - 2

Lecture 21 - Second order system - ramp response

Lecture 22 - Second order system - impulse and frequency response

Lecture 23 - Higher order systems

Lecture 24 - Compensation

Lecture 25 - Transducers - 1

Lecture 26 - Transducers - 2

Lecture 27 - Flow measurement - 1

Lecture 28 - Flow measurement - 2

Lecture 29 - Temperature measurement - 1

Lecture 30 - Temperature measurement - 2

Lecture 31 - Strain gauges

[Lecture 32 - Piezoelectric transducers](#)

[Lecture 33 - Pressure measurement](#)

[Lecture 34 - Force and torque measurement](#)

[Lecture 35 - Displacement and acceleration measurement](#)

[Lecture 36 - Sound measurement](#)

[Lecture 37 - Thermophysical properties measurement](#)

[Lecture 38 - Flow visualization](#)

[Lecture 39 - Air pollution sampling and measurement](#)

[Lecture 40 - Problem solving - 2](#)

- Lecture 1 - Introduction and need of surface engineering
- Lecture 2 - Surface/sub-surface regions and properties of importance for surface engineering
- Lecture 3 - Surface properties and their modification
- Lecture 4 - Classification of surface modification techniques - I
- Lecture 5 - Classification of surface modification techniques - II
- Lecture 6 - Comparison of surface modification techniques and scope of surface engineering
- Lecture 7 - Scope of surface engineering - I
- Lecture 8 - Surface properties for wear and friction resistance - I
- Lecture 9 - Surface properties for wear and friction resistance - II
- Lecture 10 - Surface properties for wear and friction resistance - III
- Lecture 11 - Issues and application of surface modification
- Lecture 12 - Surface damage: type and categories
- Lecture 13 - Surface damage: Adhesive wear - I
- Lecture 14 - Surface damage: Adhesive wear - II
- Lecture 15 - Surface damage: Classical law of adhesive wear and abrasive wear
- Lecture 16 - Surface damage: Abrasive wear - I
- Lecture 17 - Surface damage: Abrasive wear - II
- Lecture 18 - Surface damage: Erosive wear
- Lecture 19 - Surface damage: Melting wear and corrosive wear
- Lecture 20 - Surface damage: Diffusive wear and evaluation of surface damage
- Lecture 21 - Properties and mode of wear
- Lecture 22 - Metal systems
- Lecture 23 - Thermal barrier coatings
- Lecture 24 - Functionally graded materials and other materials
- Lecture 25 - Surface modification techniques: Principle of controlling surface metallurgy
- Lecture 26 - Surface modification techniques: Controlling surface metallurgy - I
- Lecture 27 - Surface modification techniques: Controlling surface metallurgy - II
- Lecture 28 - Surface modification techniques: Controlling surface metallurgy - III
- Lecture 29 - Surface modification techniques: Controlling surface metallurgy - IV
- Lecture 30 - Surface modification techniques: Changing surface composition
- Lecture 31 - Surface modification techniques: Carburizing - I

[Lecture 32 - Surface modification techniques: Carburizing - II](#)

[Lecture 33 - Surface modification techniques: Carburizing and Cyaniding](#)

[Lecture 34 - Surface modification techniques: Nitriding](#)

[Lecture 35 - Surface modification techniques: Plasma carburizing and plasma nitriding](#)

[Lecture 36 - Surface modification techniques: Vacuum based surface modification I](#)

[Lecture 37 - Surface modification techniques: Ion implantation and ion plating](#)

[Lecture 38 - Surface modification techniques: Sputtering and Ion beam assisted deposition](#)

[Lecture 39 - Surface modification techniques: Chemical vapour deposition and boronizing](#)

[Lecture 40 - Surface modification techniques: Laser alloying](#)

[Lecture 41 - Surface modification techniques: Laser nitriding and developing surface layer](#)

[Lecture 42 - Surface modification techniques: Fundamentals of surface modification by weld surfacing and thermal spraying](#)

[Lecture 43 - Surface modification techniques: Fundamentals of surface modification by weld surfacing](#)

[Lecture 44 - Surface modification techniques: Weld surfacing processes](#)

[Lecture 45 - Surface modification techniques: Weld surfacing - I](#)

[Lecture 46 - Surface modification techniques: Weld surfacing - II](#)

[Lecture 47 - Surface modification techniques: Weld surfacing - III](#)

[Lecture 48 - Surface modification techniques: Laser cladding](#)

[Lecture 49 - Surface modification techniques: Principle of thermal spraying](#)

[Lecture 50 - Surface modification techniques: Flame spraying](#)

[Lecture 51 - Surface modification techniques: Improving the performance of flame spray coating](#)

[Lecture 52 - Surface modification techniques: HVOF and Detonation spraying](#)

[Lecture 53 - Surface modification techniques: Cold spraying, arc spraying](#)

[Lecture 54 - Surface modification techniques: Plasma spraying, electroplating, electroless plating](#)

[Lecture 55 - Characterization of modified surfaces: Surface roughness and thickness - I](#)

[Lecture 56 - Characterization of modified surfaces: Surface roughness and thickness - II](#)

[Lecture 57 - Characterization of modified surfaces: Thickness and soundness](#)

[Lecture 58 - Characterization of modified surfaces: Soundness and mechanical properties](#)

[Lecture 59 - Characterization of modified surfaces: Metallography](#)

[Lecture 60 - Characterization of modified surfaces: Wear behavior](#)

Lecture 1 - Work System Design: Introduction

Lecture 2 - Introduction and Concept of Productivity

Lecture 3 - Measurement of Productivity

Lecture 4 - Productivity Measures

Lecture 5 - Productivity Measurement Models

Lecture 6 - Factors Influencing Productivity

Lecture 7 - Causes of Low Productivity

Lecture 8 - Productivity Improvement Technique

Lecture 9 - Numerical Problems on Productivity

Lecture 10 - Case Study on Productivity

Lecture 11 - Work Study: Basic Concept

Lecture 12 - Steps Involved in Work Study

Lecture 13 - Concept of Work Content

Lecture 14 - Techniques of Work Study

Lecture 15 - Human Aspects of Work Study

Lecture 16 - Method Study: Basic Concept

Lecture 17 - Method Study: Steps

Lecture 18 - Method Study: Recording Techniques

Lecture 19 - Operation Process Charts

Lecture 20 - Operation Process Charts: Examples

Lecture 21 - Flow Process Charts

Lecture 22 - Flow Process Charts: Examples

Lecture 23 - Two-Handed-Process Charts

Lecture 24 - Multiple Activity Charts

Lecture 25 - Flow Diagrams

Lecture 26 - String Diagrams

Lecture 27 - Principles of Motion Economy

Lecture 28 - Micro-Motion Study

Lecture 29 - Therbligs

Lecture 30 - SIMO Charts

Lecture 31 - Memo-Motion Study

- Lecture 32 - Cycle Graph and Chronocycle Graph
- Lecture 33 - Critical Examination Techniques
- Lecture 34 - Development and Selection of New Method
- Lecture 35 - Installation and Maintenance of Improved Methods
- Lecture 36 - Work Measurement: Basic Concept
- Lecture 37 - Techniques of Work Measurement
- Lecture 38 - Steps Involved in Time Study
- Lecture 39 - Steps and Equipment of Time Study
- Lecture 40 - Performance Rating
- Lecture 41 - Performance Rating: Examples
- Lecture 42 - Allowances in Time Study
- Lecture 43 - Computation of Standard Time - I
- Lecture 44 - Computation of Standard Time - II
- Lecture 45 - Work Measurement: Applications
- Lecture 46 - Work Sampling: Basic Concept
- Lecture 47 - Procedure of Work Sampling
- Lecture 48 - Work Sampling: Examples
- Lecture 49 - Introduction to Synthetic Data and PMTS
- Lecture 50 - Introduction to MTM and MOST
- Lecture 51 - Ergonomics: Basic Concept
- Lecture 52 - Industrial Ergonomics
- Lecture 53 - Ergonomics: Anthropometry
- Lecture 54 - Man-Machine System - 1
- Lecture 55 - Man-Machine System - 2
- Lecture 56 - Case Study: Office Chair
- Lecture 57 - Case Study: Tower Crane Cabin
- Lecture 58 - Case Study: Car Seat
- Lecture 59 - Case Study: Computer System
- Lecture 60 - Case Study: Assembly Line

Lecture 1 - Introduction to Metal Forming Technology

Lecture 2 - Classification of Metal Working Processes

Lecture 3 - Behavior of Materials

Lecture 4 - Failure of Materials

Lecture 5 - Concept of stress and strain

Lecture 6 - Description of stress

Lecture 7 - State of stress in three dimension

Lecture 8 - Description of strain

Lecture 9 - Hydrostatic and deviator components of stress and strain

Lecture 10 - Elastic stress strain relationships

Lecture 11 - Introduction to theory of plasticity and flow curve

Lecture 12 - True stress and true strain

Lecture 13 - Yield criteria for ductile materials

Lecture 14 - Yield locus, Octahedral shear stress and strain

Lecture 15 - Plastic stress strain relationships

Lecture 16 - Measures of yielding and ductility in tensile testing

Lecture 17 - Instability in tension

Lecture 18 - Strain rate effects on flow properties

Lecture 19 - Temperature effects on flow properties

Lecture 20 - Influence of various parameters on flow properties

Lecture 21 - Classification of metal working processes

Lecture 22 - Mechanics of metalworking and analysis methods

Lecture 23 - Determination of flow stresses in metal working

Lecture 24 - Hot working and cold working

Lecture 25 - Metallurgical considerations in metal forming

Lecture 26 - Introduction and classification of forging processes

Lecture 27 - Equipments used in forging

Lecture 28 - Forging in plane strain

Lecture 29 - Introduction and classification of rolling processes

Lecture 30 - Analysis of rolling load calculations

Lecture 31 - Defects in rolled and forged products

[Lecture 32 - Introduction and classification of extrusion processes](#)

[Lecture 33 - Analysis of extrusion processes](#)

[Lecture 34 - Extrusion of tubes and pipes, extrusion defect](#)

[Lecture 35 - Introduction to rod and wire drawing](#)

[Lecture 36 - Analysis of wire drawing and tube drawing processes](#)

[Lecture 37 - Sheet metal operations - I](#)

[Lecture 38 - Sheet metal operations - II](#)

[Lecture 39 - Powder metallurgy forming - I](#)

[Lecture 40 - Powder metallurgy forming - II](#)



Lecture 1 - Introduction

Lecture 2 - Fundamentals of Radiation

Lecture 3 - Basic Laws of Thermal Radiation

Lecture 4 - Properties of Plane Surfaces

Lecture 5 - Radiative Properties of Materials

Lecture 6 - View Factor

Lecture 7 - Hottel Crossed String Method

Lecture 8 - Inside Sphere and Monte Carlo Method

Lecture 9 - Radiative Heat Exchange Between Black Surfaces

Lecture 10 - Radiative Heat Exchange Between Gray Diffuse Surfaces

Lecture 11 - Network Analogy

Lecture 12 - Solution Methods for Governing Integral Equations

Lecture 13 - Radiative Heat Exchange between Partially Specular Gray Surfaces

Lecture 14 - Non-Gray Surfaces

Lecture 15 - Radiative Heat Transfer in the Presence of Conduction/Convection

Lecture 16 - Radiative Transfer in Participating Media

Lecture 17 - Equation of Radiative Transfer

Lecture 18 - Solution of Radiative Transfer Equation

Lecture 19 - Radiative Heat Transfer in Cylindrical Media

Lecture 20 - Approximate Methods-I

Lecture 21 - Approximate Methods-II

Lecture 22 - The Method of Spherical Harmonics (PN Approximation) - I

Lecture 23 - The Method of Spherical Harmonics (PN Approximation) - II

Lecture 24 - Discrete Ordinate Method (DOM)

Lecture 25 - Zone Method

Lecture 26 - Exchange Areas

Lecture 27 - Monte Carlo Method for Thermal Radiation - I

Lecture 28 - Monte Carlo Method for Thermal Radiation - II

Lecture 29 - Radiative Properties of Gases

Lecture 30 - Atomic and Molecular Spectra

Lecture 31 - Line Radiation

[Lecture 32 - Spectral Modelling](#)

[Lecture 33 - Wide Band Models](#)

[Lecture 34 - WSGG Model](#)

[Lecture 35 - k-Distribution Model](#)

[Lecture 36 - Radiative Properties of Particulate Media](#)

[Lecture 37 - Combustion and Flame](#)

[Lecture 38 - Solar and Atmospheric Radiation](#)

[Lecture 39 - Concentrated Solar Collector](#)

[Lecture 40 - Experimental Methods](#)

Lecture 1 - Understanding Weldability: Introduction - I

Lecture 2 - Understanding Weldability: Introduction - II

Lecture 3 - Metal Properties and Weldability - I

Lecture 4 - Metal Properties and Weldability - II

Lecture 5 - Weldability of Work Hardenable Metals

Lecture 6 - Weldability of Work Hardenable and Precipitation Strengthened Metals

Lecture 7 - Weldability of Precipitation Strengthened Metals

Lecture 8 - Weldability of Metals Strengthened by Grain Refinement, dispersion Hardening and Transformation Hardening

Lecture 9 - Weldability of Transformation Hardening Metals

Lecture 10 - Weldability of Metals: Combination of Strengthening Mechanisms

Lecture 11 - Weldability Consideration

Lecture 12 - Weldability of Carbon and Alloy Steel - I

Lecture 13 - Weldability of Carbon and Alloy Steel - II

Lecture 14 - Weldability of Carbon and Alloy Steel - III

Lecture 15 - Weldability of Low Carbon Steel and Mild Steel

Lecture 16 - Weldability of Medium Carbon Steel and High Carbon Steel

Lecture 17 - Weldability of Carbon and Welding Processes - I

Lecture 18 - Weldability of Carbon and Welding Processes - II

Lecture 19 - Weldability of Carbon Steel and Welding Processes - III

Lecture 20 - Weldability of Carbon Steel and Radiation Welding and Thermal Cutting

Lecture 21 - Weldability of High Strength Low Alloy Steels

Lecture 22 - Weldability of Q&T Steels - I

Lecture 23 - Weldability of Q&T Steels - II

Lecture 24 - Weldability of Q&T Steels - III

Lecture 25 - Weldability of Q&T Steels - IV

Lecture 26 - Weldability of HTLA Steel - I

Lecture 27 - Weldability of HTLA Steel - II

Lecture 28 - Weldability of Cr-Mo Steel - I

Lecture 29 - Weldability of Cr-Mo Steel - II

Lecture 30 - Weldability of Cr-Mo Steel - III

Lecture 31 - Weldability of Pre-Coated Steel - I

[Lecture 32 - Weldability of Pre-Coated Steel - II](#)

[Lecture 33 - Weldability of Stainless Steel - I](#)

[Lecture 34 - Weldability of Stainless Steel - II](#)

[Lecture 35 - Weldability of Martensitic Stainless Steel - I](#)

[Lecture 36 - Weldability of Martensitic Stainless Steel - II](#)

[Lecture 37 - Weldability of Ferritic Stainless Steel - I](#)

[Lecture 38 - Weldability of Austenitic Stainless Steel - I](#)

[Lecture 39 - Weldability of Austenitic Stainless Steel - II](#)

[Lecture 40 - Weldability of PH Stainless Steel](#)

Lecture 1 - Product Design : Basics

Lecture 2 - Introduction of Manufacturing Processes

Lecture 3 - Manufacturing Processes : Advantages and Limitations - I

Lecture 4 - Manufacturing Processes : Advantages and Limitations - II

Lecture 5 - Process Capabilities : Basics

Lecture 6 - Engineering Materials

Lecture 7 - Properties of materials

Lecture 8 - Selection of materials - I

Lecture 9 - Selection of materials - II

Lecture 10 - Applications of Engineering Material

Lecture 11 - Robust design

Lecture 12 - Design for X

Lecture 13 - Product Design for Manual Assembly

Lecture 14 - DFMA Guidelines

Lecture 15 - Ergonomics in Product Design

Lecture 16 - Selection of processes - I

Lecture 17 - Selection of processes - II

Lecture 18 - Process Capabilities.

Lecture 19 - Design Guidelines for Sand Casting

Lecture 20 - Design Guidelines for Die Casting

Lecture 21 - Product Design Guidelines : Compression Molding and Extrusion

Lecture 22 - Design Guidelines for Extrusion and Injection Molding

Lecture 23 - Design Guidelines for Sheet Metal Working

Lecture 24 - Design Guidelines for Machining

Lecture 25 - Design Guidelines for Powder Metal Processing

Lecture 26 - Assembly Processes : Introduction

Lecture 27 - Adhesive Joining : Guidelines

Lecture 28 - Design Guidelines for Mechanical Fasteners

Lecture 29 - Design Guidelines for Welding

Lecture 30 - Design guidelines : Brazing and Soldering

Lecture 31 - Induction Welding : Plastics

[Lecture 32 - Ultrasonic Welding : Plastics](#)

[Lecture 33 - Vibration and Spin Welding : Plastics](#)

[Lecture 34 - Microwave Joining](#)

[Lecture 35 - Hole making : Guidelines](#)

[Lecture 36 - Design for Environment](#)

[Lecture 37 - Design for Environment : Steps](#)

[Lecture 38 - Product Architecture](#)

[Lecture 39 - Rapid Prototyping](#)

[Lecture 40 - Product Design : Manufacturing Perspective](#)

Lecture 1 - Introduction: Fundamental concepts of quality, inspection and their role in manufacturing

Lecture 2 - Need of Inspection: Types and Principles

Lecture 3 - Destructive Inspection - I

Lecture 4 - Destructive Inspection - II

Lecture 5 - Testing of Composite Materials

Lecture 6 - Nondestructive Inspection - Visual Inspection

Lecture 7 - Dye Penetrant Inspection

Lecture 8 - Magnetic Particle Inspection

Lecture 9 - Eddy Current Inspection

Lecture 10 - Ultrasonic Inspection

Lecture 11 - Acoustic Emission Inspection

Lecture 12 - Radiography Inspection

Lecture 13 - Leak Testing

Lecture 14 - Thermographic Nondestructive Testing

Lecture 15 - Advanced Nondestructive Testing Techniques, NDT Standards, Safety in NDT

Lecture 16 - Engineering Metrology - Linear Measurement

Lecture 17 - Angular Measurement and Measurement of Surface Finish

Lecture 18 - Screw Thread Metrology

Lecture 19 - Gear Measurement

Lecture 20 - Miscellaneous Measurements

Lecture 1 - Introduction to Financial Mathematics

Lecture 2 - Important Mathematical Functions and its Characteristics

Lecture 3 - Progressions and Series, Growth and Decay Curves

Lecture 4 - Statistical Measures

Lecture 5 - Problem Solving on Mathematical Functions and Statistical Measures

Lecture 6 - Interest and Interest Rate, Time Value of Money

Lecture 7 - Simple Discount, Focal Date and Equation of Value

Lecture 8 - Introduction to Bank Discount

Lecture 9 - Introduction to Compound Interest

Lecture 10 - Problem Solving on Simple Interest and Bank Discount

Lecture 11 - Introduction to Discrete Compounding and Discrete Payments

Lecture 12 - Equal Payment Series and Gradient Series Factors

Lecture 13 - Geometric Gradient Series Factors

Lecture 14 - Annuities Due and Annuities Deferred

Lecture 15 - Problem Solving on Compounding Factors

Lecture 16 - Compounding Frequency of Interest

Lecture 17 - Interest Factors for Continuous Compounding

Lecture 18 - Introduction to Economic Equivalence

Lecture 19 - Principles of Equivalence

Lecture 20 - Problem Solving on Compounding Frequency and Economic Equivalence

Lecture 21 - Methods of Comparison of Alternatives

Lecture 22 - Payback Period

Lecture 23 - Capitalized Equivalent and Capital Recovery with Return

Lecture 24 - Project Balance

Lecture 25 - Problem Solving on Alternatives Comparison and Project Balance

Lecture 26 - Analysis of Credit and Loans

Lecture 27 - Assessing Interest and Structured Payments in Loans

Lecture 28 - Introduction to Cost of Credit and Amortization

Lecture 29 - Analysis of Amortization Schedule

Lecture 30 - Graduated Payment Mortgage, Sinking Funds

Lecture 31 - Introduction to Depreciation and Depletion



[Lecture 32 - Types of Depreciation: SL Method and Declining Balance Method](#)

[Lecture 33 - Tax Depreciation Methods](#)

[Lecture 34 - SOD and UOP Method of Depreciation, Depletion](#)

[Lecture 35 - Problem Solving on Depreciation and Depletion](#)

[Lecture 36 - Introduction to Break-Even Analysis](#)

[Lecture 37 - Analysis of Break-Even Time and Dual Break-Even Points](#)

[Lecture 38 - Economic Order Quantity](#)

[Lecture 39 - Introduction to Leverage](#)

[Lecture 40 - Financial Leverage and Total Leverage](#)

[Lecture 41 - Introduction to Stocks](#)

[Lecture 42 - Stock Valuation](#)

[Lecture 43 - Two Stage Dividend Growth and Preferred Stocks](#)

[Lecture 44 - Introduction to Bonds](#)

[Lecture 45 - Bond Premium and Discount, Bond Purchase](#)

[Lecture 46 - Introduction to Mutual funds](#)

[Lecture 47 - Performance Measures](#)

[Lecture 48 - Options](#)

[Lecture 49 - Option Valuation](#)

[Lecture 50 - Introduction to Cost of Capital and Ratio Analysis](#)

[Lecture 51 - Introduction to Risk Measurement](#)

[Lecture 52 - Decision-Making Under Risk](#)

[Lecture 53 - Decision Under Uncertainty](#)

[Lecture 54 - Risk Premium, Portfolio Return and Risk](#)

[Lecture 55 - Portfolio Diversification](#)

[Lecture 56 - Introduction to Insurance, Mortality Table](#)

[Lecture 57 - Pure Endowment and Life Annuities](#)

[Lecture 58 - Introduction to Life Insurance](#)

[Lecture 59 - Types of Life Insurance Policies](#)

[Lecture 60 - Reserve Funds, Property and Casualty Insurance](#)

- Lecture 1 - Introduction to Product Design and Development
- Lecture 2 - Product Design Steps and Product Analysis
- Lecture 3 - Profit Consideration
- Lecture 4 - Value Engineering (VE) History, Concept and Definitions
- Lecture 5 - Value Engineering vs Cost Cutting
- Lecture 6 - Creative Thinking
- Lecture 7 - Problem Identification and VEJP
- Lecture 8 - Types of Product Functions
- Lecture 9 - Funtional Analysis
- Lecture 10 - Functional Analysis System Technique
- Lecture 11 - Function-Cost Relationship - I
- Lecture 12 - Function-Cost Relationship - II
- Lecture 13 - VE Applications in Product Design
- Lecture 14 - Value Engineering: Case Study - I
- Lecture 15 - Value Engineering: Case Study - II
- Lecture 16 - VE Tools and Techniques - I
- Lecture 17 - VE Tools and Techniques - II
- Lecture 18 - VE Success Stories - I
- Lecture 19 - VE Success Stories - II
- Lecture 20 - Behavioral Roadblocks

[Lecture 1 - Introduction](#)

[Lecture 2 - Solar Energy Harvesting](#)

[Lecture 3 - Perovskite Solar Cells](#)

[Lecture 4 - Solar Thermal Energy](#)

[Lecture 5 - Heat Transfer Fluids](#)

[Lecture 6 - Hydrogen Energy: Introduction and Hydrogen Production from Fossil Fuels and Biomass](#)

[Lecture 7 - Hydrogen Production from Thermochemical Process](#)

[Lecture 8 - Hydrogen Production from Electrolysis](#)

[Lecture 9 - Photo-electrochemical Production of Hydrogen Using Solar Energy](#)

[Lecture 10 - Hydrogen Production from Biological Process](#)

[Lecture 11 - Nanogenerators: Introduction and Piezoelectric Nanogenerators](#)

[Lecture 12 - Triboelectric Nanogenerators](#)

[Lecture 13 - Pyroelectric Nanogenerators](#)

[Lecture 14 - Thermoelectric Nanogenerators and Electromagnetic generators](#)

[Lecture 15 - Other Energy Resources](#)

[Lecture 16 - Energy Storage](#)

[Lecture 17 - Electrochemical Energy Storage \(Batteries\)](#)

[Lecture 18 - Supercapacitors](#)

[Lecture 19 - Hydrogen Storage](#)

[Lecture 20 - Thermal Energy Storage](#)

Lecture 1 - Introduction

Lecture 2 - Coordinate Frames and Homogeneous Transformations - I

Lecture 3 - Coordinate Frames and Homogeneous Frames - II

Lecture 4 - Differential Transformations

Lecture 5 - Transforming Differential Changes between Coordinate Frames

Lecture 6 - Kinematic Model for Robot Manipulator

Lecture 7 - Direct Kinematics

Lecture 8 - Inverse Kinematics

Lecture 9 - Manipulator Jacobian

Lecture 10 - Manipulator Jacobian Example

Lecture 11 - Trajectory Planning

Lecture 12 - Dynamics of Manipulator

Lecture 13 - Dynamics of Manipulator (Continued...)

Lecture 14 - Manipulator Dynamics Multiple Degree of Freedom

Lecture 15 - Stability of Dynamical System

Lecture 16 - Manipulator Control

Lecture 17 - Biped Robot Basics and Flat Foot Biped Model

Lecture 18 - Biped Robot Flat Foot and Toe Foot Model

Lecture 19 - Artificial Neural Network

Lecture 20 - Neural Network based control for Robot Manipulator

Lecture 21 - Redundancy Resolution of Human Fingers in Cooperative Object Translation - I

Lecture 22 - Redundancy Resolution of Human Fingers in Cooperative Object Translation - II

Lecture 23 - Fundamentals of Robot Manipulability

Lecture 24 - Manipulability Analysis of Human Fingers in Cooperative Rotational Motion

Lecture 25 - Robotic Exoskeletons: An Introduction

Lecture 26 - Introduction to Robotic Hand Exoskeleton

Lecture 27 - Design and Development of a Three Finger Exoskeleton

Lecture 28 - Force Control of an Index Finger Exoskeleton

Lecture 29 - Neural Control of a Hand Exoskeleton

Lecture 30 - Neural Control of a Hand Exoskeleton Based on Human Subject's Intention

Lecture 31 - Robot Assisted Percutaneous Interventions

[Lecture 32 - Experiments on Robot Assisted Percutaneous Interventions](#)

[Lecture 33 - Sliding Mode Control](#)

[Lecture 34 - Higher Order Sliding Mode Control](#)

[Lecture 35 - Smart Needles for Percutaneous Interventions - I](#)

[Lecture 36 - Smart Needles for Percutaneous Interventions - II](#)

[Lecture 37 - Flexible Link Kinematics - I](#)

[Lecture 38 - Flexible Link Kinematics - II](#)

[Lecture 39 - Model Based Control of Robot Manipulators](#)

[Lecture 40 - Simulation of Robot Manipulators](#)

- Lecture 1 - Introduction
- Lecture 2 - Sound Wave Propagation in Fluid - I
- Lecture 3 - Sound Wave Propagation in Fluid - II
- Lecture 4 - Sound Wave Propagation in Fluid - III
- Lecture 5 - Sound Propagation at Medium Boundaries - I
- Lecture 6 - Sound Propagation at Medium Boundaries - II
- Lecture 7 - Standing Waves and Modes
- Lecture 8 - Sound Signal Analysis - I
- Lecture 9 - Sound Signal Analysis - II
- Lecture 10 - Principles of Noise Control
- Lecture 11 - Acoustic Materials
- Lecture 12 - Enclosures
- Lecture 13 - Barriers
- Lecture 14 - Enclosures and Barriers - Tutorial
- Lecture 15 - Sound Absorbing Materials
- Lecture 16 - Porous-Fibrous Sound Absorbers
- Lecture 17 - Panel Sound Absorbers
- Lecture 18 - Helmholtz Resonators
- Lecture 19 - Tutorial on Sound Absorbers
- Lecture 20 - Perforated Panel Absorbers
- Lecture 21 - Microperforated Panel Absorbers - 1
- Lecture 22 - Microperforated Panel Absorbers - 2
- Lecture 23 - Microperforated Panel Absorbers - 3
- Lecture 24 - Introduction to Acoustic Metamaterials - 1
- Lecture 25 - Introduction to Acoustic Metamaterials - 2
- Lecture 26 - History of Acoustic Metamaterials
- Lecture 27 - Applications of Acoustic Metamaterials
- Lecture 28 - Membrane Type Acoustic Metamaterials - 1
- Lecture 29 - Membrane Type Acoustic Metamaterials - 2
- Lecture 30 - Membrane Type Acoustic Metamaterials - 3
- Lecture 31 - Membrane Type Acoustic Metamaterials - 4

[Lecture 32 - Advantages and Applications of Membrane Type AMM](#)

[Lecture 33 - Tutorial on Membrane Type AMM](#)

[Lecture 34 - Introduction to Sonic Crystals](#)

[Lecture 35 - Fundamentals of Crystals](#)

[Lecture 36 - Principle of Working of Sonic Crystals - 1](#)

[Lecture 37 - Principle of Working of Sonic Crystals - 2](#)

[Lecture 38 - Tutorial on Sonic Crystals](#)

[Lecture 39 - More on Sonic Crystals and Conclusions](#)

Lecture 1 - Energy Scenario and Basic Concepts

Lecture 2 - Steam Power Plant Cycle

Lecture 3 - Fossil Fuel Steam Generator - I

Lecture 4 - Fossil Fuel Steam Generator - II

Lecture 5 - Mountings and Accessories - I

Lecture 6 - Mountings and Accessories - II

Lecture 7 - Boiler Performance

Lecture 8 - Coal Properties

Lecture 9 - Coal Handling

Lecture 10 - Problem Solving - I

Lecture 11 - Burning of Fuel

Lecture 12 - Ash Handling

Lecture 13 - Feed Water Treatment

Lecture 14 - Steam Turbines

Lecture 15 - Impulse Steam Turbines

Lecture 16 - Impulse-Reaction Steam Turbines

Lecture 17 - Energy Losses in Steam Turbines

Lecture 18 - Steam Condensers

Lecture 19 - Gas Turbines

Lecture 20 - Problem Solving - II

Lecture 21 - Hydroelectric power plant

Lecture 22 - Hydro plants and forces on plates

Lecture 23 - Hydro Turbines - I

Lecture 24 - Hydro Turbines - II

Lecture 25 - Problem solving - III

Lecture 26 - Principles of nuclear energy

Lecture 27 - Nuclear power plants - I

Lecture 28 - Nuclear power plants - II

Lecture 29 - Combined operations

Lecture 30 - Solar radiations

Lecture 31 - Solar thermal power



[Lecture 32 - Wind energy](#)

[Lecture 33 - Wave and geothermal energy](#)

[Lecture 34 - Photo-voltaic conversion](#)

[Lecture 35 - Problem solving - IV](#)

[Lecture 36 - Direct energy conversion](#)

[Lecture 37 - Instrumentation in power plant](#)

[Lecture 38 - Economic of power generation](#)

[Lecture 39 - Environmental aspects of power generation](#)

[Lecture 40 - Problem solving - V](#)

Lecture 1 - Introduction

Lecture 2 - Introduction: Developments, Objectives, and Functions

Lecture 3 - Introduction: Functions and Tools

Lecture 4 - Tool of IE and Organizational Structure

Lecture 5 - Organisational Structure

Lecture 6 - Organizational Structure: Roles

Lecture 7 - Organizational Structure: Types

Lecture 8 - Organizational Structure: Product Strategies

Lecture 9 - Organizational Structure: Process and Product Organization

Lecture 10 - Organizational Structure and Culture

Lecture 11 - Organizational Structure: Principles

Lecture 12 - Plant Location and Layout: Selection of Site

Lecture 13 - Plant Location and Layout: Factor Affecting Selection of Site

Lecture 14 - Plant Location and Layout: Methods for Selection of Site - I

Lecture 15 - Plant Location and Layout: Methods for Selection of Site - II

Lecture 16 - Plant Location and Layout: Methods for Selection of Site - III

Lecture 17 - Plant Location and Layout: Methods for Selection of Site - IV

Lecture 18 - Plant Layout: Purpose and Types of Layout

Lecture 19 - Plant Layout: Types of Layout

Lecture 20 - Plant Layout: Cellular and Process Layout

Lecture 21 - Plant Layout: Process Layout Design - I

Lecture 22 - Plant Layout: Process Layout Design - II

Lecture 23 - Plant Layout: Product Layout Design

Lecture 24 - Organization of Facility

Lecture 25 - Organization of Facility and Material Handling

Lecture 26 - Material Handling

Lecture 27 - Production Planning and Control: Scope - I

Lecture 28 - Production Planning and Control: Scope - II

Lecture 29 - Production Planning and Control: Capacity Planning

Lecture 30 - Production Planning and Control: Capacity Planning and Scheduling

Lecture 31 - Production Planning and Control: MRP, Routing, Scheduling

- Lecture 32 - Production Planning and Control: Scheduling
- Lecture 33 - Production Planning and Control: Priority Sequencing - I
- Lecture 34 - Production Planning and Control: Priority Sequencing - II
- Lecture 35 - Production Planning and Control: Relative Performance of Priority Sequencing Rules
- Lecture 36 - Inventory: Fundamentals
- Lecture 37 - Inventory: Models - I
- Lecture 38 - Inventory: Models - II
- Lecture 39 - Inventory: Wilson Model
- Lecture 40 - Inventory: Gradual Replenishment Model
- Lecture 41 - Project Management and Network Modelling: Introduction
- Lecture 42 - Network Modelling: PERT
- Lecture 43 - Network Analysis: PERT - I
- Lecture 44 - Network Analysis: PERT - II
- Lecture 45 - Network Analysis: Crashing Network and CPM
- Lecture 46 - Network Analysis: Critical Path Method
- Lecture 47 - Forecasting: Introduction
- Lecture 48 - Forecasting: Methods - I
- Lecture 49 - Forecasting: Methods - II
- Lecture 50 - Forecasting: Methods - III
- Lecture 51 - Forecasting: Methods - IV
- Lecture 52 - Forecasting: Methods - V
- Lecture 53 - Quality Control: Introduction
- Lecture 54 - Quality Control: Fundamentals
- Lecture 55 - Quality Control: SPC - I
- Lecture 56 - Quality Control: SPC - II
- Lecture 57 - Quality Control: Control Charts - I
- Lecture 58 - Quality Control: Control Charts - II
- Lecture 59 - Quality Control: Control Charts for Attributes
- Lecture 60 - Productivity and Work Study

Lecture 1 - Introduction

Lecture 2 - Mechatronics System Examples

Lecture 3 - Electric Circuits and Components

Lecture 4 - Semiconductor Electronics

Lecture 5 - Application of Transistors

Lecture 6 - Sensors Performance Terminology

Lecture 7 - Displacement, Position and Proximity Sensors - I

Lecture 8 - Displacement, Position and Proximity Sensors - II

Lecture 9 - Force, Fluid Flow Sensors

Lecture 10 - Acceleration and Vibration Measurement Sensors

Lecture 11 - Mechanical Actuation Systems

Lecture 12 - Hydraulic and Pneumatic Actuators

Lecture 13 - Electrical Actuation Systems - I

Lecture 14 - Electrical Actuation Systems - II

Lecture 15 - Data Presentation Systems

Lecture 16 - Introduction to Signal Conditioning and Op-Amp

Lecture 17 - OP-AMP As Signal Conditioner

Lecture 18 - Analogue To Digital Converters

Lecture 19 - Digital To Analogue Converters

Lecture 20 - Artificial Intelligence

Lecture 21 - Digital Circuits - I

Lecture 22 - Digital Circuits - II

Lecture 23 - Microprocessor

Lecture 24 - Microcontroller

Lecture 25 - Microcontroller Programming Example

Lecture 26 - Mechanical System Model

Lecture 27 - Electrical System Model

Lecture 28 - Fluid System Model

Lecture 29 - Dynamic Response of Systems

Lecture 30 - Transfer Function and Frequency Response

Lecture 31 - Controllers

[Lecture 32 - Digital Controllers](#)

[Lecture 33 - Program Logic Controllers](#)

[Lecture 34 - Input, output and Communication systems](#)

[Lecture 35 - Fault Finding](#)

[Lecture 36 - Project using Microcontroller - ATMEGA16](#)

[Lecture 37 - Myoelectrically Controlled Robotic Arm](#)

[Lecture 38 - ABU Robocon 2019 - Part I](#)

[Lecture 39 - ABU Robocon 2019 - Part II](#)

[Lecture 40 - Design of a Legged Robot](#)

# DIGIMAT - The No.1 Autonomous Learning Platform for Creative Learning

## NPTEL : Micro and Smart Systems (Mechanical Engineering)

**Co-ordinators : Dr. K.J. Vinoy, Prof. S. Gopalakrishnan, Prof. K.N. Bhat, Prof. G.K. Anathasuresh**

Lecture 1 - Glimpses of Microsystems: Scaling Effects

Lecture 2 - Smart Materials and Systems

Lecture 3 - Microsensors

Lecture 4 - Microactuators

Lecture 5 - Microsystems: some Examples

Lecture 6 - Smart systems Application and Structural Health Monitoring

Lecture 7 - Microfabrication Technologies

Lecture 8 - Thin-film Materials and their Deposition

Lecture 9 - Approaches for Pattern Transfer

Lecture 10 - Surface Micromachining of Microstructures

Lecture 11 - Bulk Micromachining of Microsystems

Lecture 12 - Extended Approaches for Working Microsystems

Lecture 13 - Non-conventional Approaches for Microsystems

Lecture 14 - Packaging of Microsystems

Lecture 15 - Deformation Strains and Stresses

Lecture 16 - Microdevice Suspensions: Lumped Modeling

Lecture 17 - Residual Stress and Stress Gradients

Lecture 18 - Torsion and Twist

Lecture 19 - Vibrations of Microsystems Devices: Part-1

Lecture 20 - Vibrations of Microsystems Devices: Part-2 Micromachined Gyroscopes: Part-1

Lecture 21 - Micromachined Gyroscopes: Part-2 Modelling of Coupled Electrostatic Microsystems: Part-1

Lecture 22 - Modelling of Coupled Electrostatic Microsystems: Part-2

Lecture 23 - Coupled Electrothermal-elastic Modelling

Lecture 24 - Modelling of Microsystems: Scaling Effects

Lecture 25 - Finite Element Method and Microsystems

Lecture 26 - Theoretical Basis for the Finite Element Method

Lecture 27 - Energy Theorems and Weak Form of the Governing Equation

Lecture 28 - Finite Element Equation Development and Shape Functions

Lecture 29 - Isoparametric FE Formulation and some Examples

Lecture 30 - Finite Element for Structures with Piezoelectric Materials

Lecture 31 - Semiconductor Device Physics

[Lecture 32 - BJT and MOSFET Characteristics and Op-Amps](#)

[Lecture 33 - Op-Amp Circuits and Signal conditioning for Microsystems Devices](#)

[Lecture 34 - Control and Microsystems](#)

[Lecture 35 - Vibration Control of a Beam](#)

[Lecture 36 - Signal Conditioning Circuits and Integration of Microsystems and Microelectronics](#)

[Lecture 37 - Pressure Sensor Design Concepts, Processing, and Packaging: Part-1](#)

[Lecture 38 - Pressure Sensor Design Concepts, Processing, and Packaging: Part-2](#)

[Lecture 39 - Pressure Sensor Design Concepts, Processing, and Packaging: Part-3 Capacitive Micro-accelerometer: Part-1](#)

[Lecture 40 - Capacitive Micro-accelerometer: Part-2](#)

Lecture 1 - Classification of optimization problems and the place of Calculus of Variations in it - Part I

Lecture 2 - Classification of optimization problems and the place of Calculus of Variations in it - Part II

Lecture 3 - Genesis of Calculus of Variations - Part I

Lecture 4 - Genesis of Calculus of Variations - Part II

Lecture 5 - Formulation of Calculus of Variations problems in geometry and mechanics and design - Part I

Lecture 6 - Formulation of Calculus of Variations problems in geometry and mechanics and design - Part II

Lecture 7 - Unconstrained minimization in one and many variables - Part I

Lecture 8 - Unconstrained minimization in one and many variables - Part II

Lecture 9 - Constrained minimization KKT conditions - Part I

Lecture 10 - Constrained minimization KKT conditions - Part II

Lecture 11 - Sufficient conditions for constrained minimization - Part I

Lecture 12 - Sufficient conditions for constrained minimization - Part II

Lecture 13 - Mathematical preliminaries function, functional, metrics and metric space, norm and vector spaces - Part I

Lecture 14 - Mathematical preliminaries function, functional, metrics and metric space, norm and vector spaces - Part II

Lecture 15 - Function spaces and Gateaux variation

Lecture 16 - First variation of a functional Frechet differential and variational derivative

Lecture 17 - Fundamental lemma of calculus of variations and Euler Lagrange equations - Part I

Lecture 18 - Fundamental lemma of calculus of variations and Euler Lagrange equations - Part II

Lecture 19 - Extension of Euler-Lagrange equations to multiple derivatives

Lecture 20 - Extension of Euler-Lagrange equations to multiple functions in a functional

Lecture 21 - Global Constraints in calculus of variations - Part I

Lecture 22 - Global Constraints in calculus of variations - Part II

Lecture 23 - Local (finite subsidiary) constraints in calculus of variations - Part I

Lecture 24 - Local (finite subsidiary) constraints in calculus of variations - Part II

Lecture 25 - Size optimization of a bar for maximum stiffness for given volume - Part I

Lecture 26 - Size optimization of a bar for maximum stiffness for given volume - Part II

Lecture 27 - Size optimization of a bar for maximum stiffness for given volume - Part III

Lecture 28 - Calculus of variations in functionals involving two and three independent variables - Part I

Lecture 29 - Calculus of variations in functionals involving two and three independent variables - Part II

Lecture 30 - General variation of a functional, transversality conditions. Broken extremals, Weierstrass-Erdmann corner conditions - Part I



# DIGIMAT - The No.1 Autonomous Learning Platform for Creative Learning

Lecture 31 - General variation of a functional, transversality conditions. Broken extremals, Wierstrass-Erdmann corner conditions - Part II

Lecture 32 - Variational (energy) methods in statics; principles of minimum potential energy and virtual work

Lecture 33 - General framework of optimal structural designs - Part I

Lecture 34 - General framework of optimal structural designs - Part II

Lecture 35 - Optimal structural design of bars and beams using the optimality criteria method

Lecture 36 - Invariants of Euler-Lagrange equations and canonical forms

Lecture 37 - Noether's theorem

Lecture 38 - Minimum characterization of Sturm-Liouville problems

Lecture 39 - Rayleigh quotient for natural frequencies and mode shapes of elastic systems

Lecture 40 - Stability analysis and buckling using calculus of variations

Lecture 41 - Strongest (most stable) column

Lecture 42 - Dynamic compliance optimization

Lecture 43 - Electro-thermal-elastic structural optimization

Lecture 44 - Formulating the extremization problem starting from the differential equation, self-adjointness of the differential operator, and methods to deal with conservative and dissipative system

Lecture 1 - Overview

Lecture 2 - Spirit of compliant design

Lecture 3 - A glimpse of applications

Lecture 4 - Mobility and degrees of freedom in compliant mechanisms

Lecture 5 - Maxwell's rule and Grubler's formula

Lecture 6 - Using compatibility and force equilibrium matrices to identify degrees of freedom and states of self-stress in trusses

Lecture 7 - Empirical formula for flexure joints

Lecture 8 - Types of elastic pairs (flexures)

Lecture 9 - Linear finite element analysis of compliant mechanisms with beam elements

Lecture 10 - A compliant mechanism kit

Lecture 11 - Linear and nonlinear finite element analyses using continuum elements

Lecture 12 - Subtleties in finite element analysis: geometric nonlinearity and contact

Lecture 13 - Deformation of a cantilever under a tip-load, using elliptic integrals

Lecture 14 - Elliptic integrals and their use in elastica analysis

Lecture 15 - Frisch-Fay's approach to large deformation of beam

Lecture 16 - Burns-Crossley's kinematic model

Lecture 17 - Howell-Midha's elastic model

Lecture 18 - Putting together the pseudo rigid-body model

Lecture 19 - Modeling a partially compliant mechanism

Lecture 20 - Kinematic coefficients of a four-bar linkage with and without springs

Lecture 21 - Solving equations of PRB modeling and comparing with finite element analysis

Lecture 22 - Loop-closure equations for PRB models of compliant mechanisms

Lecture 23 - Burmester theory for compliant mechanisms

Lecture 24 - PRB-based Synthesis Examples

Lecture 25 - Structural optimization approach

Lecture 26 - Early works on design for compliance

Lecture 27 - Design for deflection of trusses

Lecture 28 - Design for deflection of beams and frames

Lecture 29 - Design of elastic continua for desired deflection

Lecture 30 - Continuum element-based topology optimization of compliant mechanisms

Lecture 31 - YinSyn; synthesis of nonlinear responses with compliant mechanisms

[Lecture 32 - Five different formulations for compliant mechanism design and some benchmark problems](#)

[Lecture 33 - Distributed compliance](#)

[Lecture 34 - How to achieve distributed compliance](#)

[Lecture 35 - Shape optimization](#)

[Lecture 36 - Cam-flexure clamp-case-study](#)

[Lecture 37 - SL model for compliant mechanisms](#)

[Lecture 38 - Feasibility maps for compliant mechanisms](#)

[Lecture 39 - Selection of compliant mechanisms for given user-specifications](#)

[Lecture 40 - Two case-studies using feasibility maps technique](#)

[Lecture 41 - SML model for compliant mechanisms for dynamic response](#)

[Lecture 42 - Re-design of compliant mechanisms; Matlab and Java codes](#)

[Lecture 43 - Non-dimensional analysis of beams](#)

[Lecture 44 - Deformation index and slenderness ratio of compliant mechanisms](#)

[Lecture 45 - Kinetoelastostatic maps](#)

[Lecture 46 - Designing with kinetoelastic maps](#)

[Lecture 47 - Non-dimensinalization of stress, frequency, and other measures](#)

[Lecture 48 - Designing compliant suspensions using kinetoelastic maps](#)

[Lecture 49 - Instant centre method for designing compliant mechanisms](#)

[Lecture 50 - Stiffness and compliance ellipsoids](#)

[Lecture 51 - Building block method of designing compliant mechanisms](#)

[Lecture 52 - Comparative analysis of different methods for designing compliant mechanisms](#)

[Lecture 53 - Aspects of Mechanical advantage of compliant mechanisms](#)

[Lecture 54 - Mechanical advantage of rigid-body and compliant mechanisms](#)

[Lecture 55 - Bistability in elastic systems](#)

[Lecture 56 - Analysis of bistable arches](#)

[Lecture 57 - Compliant mechanisms with bistable arches](#)

[Lecture 58 - Static balancing and zero-free-length springs](#)

[Lecture 59 - Static balance of a compliant mechanism using a linkage](#)

[Lecture 60 - Static balancing method for compliant mechanisms](#)

[Lecture 61 - A catalogue of compliant mechanisms](#)

[Lecture 62 - Compliant suspension mechanism in microsystems \(MEMS\)](#)

[Lecture 63 - Micromechanical signal processors using compliant mechanisms](#)

[Lecture 64 - A few special concepts of compliant mechanisms](#)

[Lecture 65 - Materials and prototyping of compliant mechanisms](#)

[Lecture 66 - Summary of the course](#)

[Lecture 67 - Micromachined accelerometers with Displacement-amplifying Compliant Mechanisms \(DaCMs\)](#)

[Lecture 68 - Miniature compliant mechanisms as cell-manipulation tools](#)

[Lecture 69 - Micro-newton force sensor](#)

[Lecture 70 - Compliant tissue cutting mechanism](#)

[Lecture 71 - A compliant pipe-crawling robots](#)

[Lecture 72 - A compliant easy-chair for the elderly](#)

Lecture 1 - Introduction to Multiphase

Lecture 2 - Thermodynamics of Multiphase systems

Lecture 3 - Thermodynamics of Interface - I

Lecture 4 - Thermodynamics of Interface - II

Lecture 5 - Interfacial phenomena key concepts - I

Lecture 6 - Interfacial phenomena key concepts - II

Lecture 7 - Interfacial heat and mass transfer - I - Interfacial mass, momentum and energy balance, Surface tension, WettingL07

Lecture 8 - Interfacial heat and mass transfer - II - Interfacial dynamics, Instabilities of the interface

Lecture 9 - Interfacial heat and mass transfer - III - Evaporation from thin films

Lecture 10 - Governing equations and interfacial conditions

Lecture 11 - Governing equations : Averaging techniques - I

Lecture 12 - Governing equations : Averaging techniques - II

Lecture 13 - Governing equations : Averaging techniques - III

Lecture 14 - Interface shapes

Lecture 15 - Transport processes at interface with key concepts - I

Lecture 16 - Transport processes at interface with key concepts - II

Lecture 17 - Interfacial transport

Lecture 18 - Interfacial transport including dynamic behavior

Lecture 19 - Interface behavior

Lecture 20 - Heat transfer and evaporation in droplets

Lecture 21 - Droplet vaporization models - I

Lecture 22 - Droplet vaporization models - II

Lecture 23 - Droplet vaporization dynamics - I

Lecture 24 - Droplet vaporization dynamics - II

Lecture 25 - Droplet liquid phase transport

Lecture 26 - Comprehensive droplet vaporization model and correlations - I

Lecture 27 - Comprehensive droplet vaporization model and correlations - II

Lecture 28 - Comparison of droplet vaporization models

Lecture 29 - Species transport in droplet

Lecture 30 - Heat transfer and transport processes in sessile droplets

Lecture 31 - Introduction to atomization

[Lecture 32 - Atomization principles and governing parameters](#)

[Lecture 33 - Spray / droplet breakup models  \$\hat{A}\$ - I \(TAB model\)](#)

[Lecture 34 - Spray / droplet breakup models  \$\hat{A}\$ - II \(WAVE model\)](#)

[Lecture 35 - Droplet combustion - I](#)

[Lecture 36 - Droplet combustion - II](#)

[Lecture 37 - Regimes in spray combustion](#)

[Lecture 38 - Boiling - I](#)

[Lecture 39 - Boiling - II \(Bubble dynamics\)](#)

[Lecture 40 - Boiling - II \(Bubble dynamics and critical heat flux\)](#)

- Lecture 1 - Introduction to convective heat transfer
- Lecture 2 - Governing equations I - Momentum Conservation
- Lecture 3 - Governing equations II - Energy Conservation
- Lecture 4 - Introduction to external forced convection
- Lecture 5 - Scaling Analysis - Momentum
- Lecture 6 - Scaling Analysis - Energy I
- Lecture 7 - Scaling Analysis - Energy II
- Lecture 8 - Similarity solution - Momentum
- Lecture 9 - Similarity solution - Energy
- Lecture 10 - Integral solutions - Momentum
- Lecture 11 - Integral solutions - Energy
- Lecture 12 - Suction and Blowing
- Lecture 13 - Falkner-Skan solution
- Lecture 14 - Arbitrary Wall temperature
- Lecture 15 - Internal forced convection - Developing flow
- Lecture 16 - Hydrodynamic fully developed flow
- Lecture 17 - Mean temperature in fully developed flow
- Lecture 18 - Uniform heat flux
- Lecture 19 - Uniform wall temperature
- Lecture 20 - Tube surrounded by isothermal flow
- Lecture 21 - Heat transfer to fully developed flow - I
- Lecture 22 - Heat transfer to fully developed flow - II
- Lecture 23 - Laminar slug flow
- Lecture 24 - Power law fluids
- Lecture 25 - Forced convection - Tutorial I
- Lecture 26 - Forced convection - Tutorial II
- Lecture 27 - Forced convection - Tutorial III
- Lecture 28 - Introduction to external natural convection
- Lecture 29 - Scaling analysis - I
- Lecture 30 - Scaling analysis - II
- Lecture 31 - Integral solution

- Lecture 32 - Similarity solution
- Lecture 33 - Uniform wall heat flux
- Lecture 34 - Thermal stratification
- Lecture 35 - Mixed convection
- Lecture 36 - Internal natural convection - Scaling analysis
- Lecture 37 - Heat transfer regimes
- Lecture 38 - Regime III
- Lecture 39 - Regime IV - Shallow enclosure limit - I
- Lecture 40 - Regime IV - Shallow enclosure limit - II
- Lecture 41 - Partially divided enclosures
- Lecture 42 - Inclined enclosures
- Lecture 43 - Natural convection - Tutorial I
- Lecture 44 - Natural convection - Tutorial II
- Lecture 45 - Introduction to Turbulence
- Lecture 46 - Reynolds-Averaged Navier Stokes equation - I
- Lecture 47 - Reynolds-Averaged Navier Stokes equation - II
- Lecture 48 - Turbulent boundary layer - Viscous sub layer
- Lecture 49 - Turbulent boundary layer - Fully turbulent sub layer
- Lecture 50 - Heat transfer in turbulent boundary layer
- Lecture 51 - Turbulent internal flow - I
- Lecture 52 - Turbulent internal flow - II
- Lecture 53 - Turbulent internal flow - III
- Lecture 54 -  $k - \epsilon$  model
- Lecture 55 - Turbulence - Tutorial
- Lecture 56 - Experimental techniques - Thermochromic liquid crystals
- Lecture 57 - Experimental techniques - IR thermography
- Lecture 58 - Droplet evaporation - Sessile I
- Lecture 59 - Droplet evaporation - Sessile II
- Lecture 60 - Droplet evaporation - Contact free



- Lecture 1 - Introduction to complex variables
- Lecture 2 - Cauchy Riemann Equations
- Lecture 3 - Analytic Functions
- Lecture 4 - Simple definitions
- Lecture 5 - Definition of sets, domains, theorem on antiderivative
- Lecture 6 - Cauchy Goursat Theorem
- Lecture 7 - Implications of Cauchy Goursat Theorem, Cauchy Integral Formula
- Lecture 8 - Implications of CIF, converse of CG theorem
- Lecture 9 - Examples in contour integrals, ratios of polynomials
- Lecture 10 - Contour integration of sinc function
- Lecture 11 - Method of path deformation
- Lecture 12 - Method of path deformation (Continued...)
- Lecture 13 - Infinite and finite branch cuts
- Lecture 14 - Finite Branch Cut
- Lecture 15 - Infinite branch cut example
- Lecture 16 - Contour integration: rectangular contour
- Lecture 17 - Finite square root branch cut
- Lecture 18 - Example on finite branch cut
- Lecture 19 - Pole on a branch cut
- Lecture 20 - L shaped branch cut
- Lecture 21 - L shaped branch cut continued
- Lecture 22 - Inverse Laplace Transform
- Lecture 23 - Inverse Laplace Transform (Continued...)
- Lecture 24 - Additional material or corrections to lectures
- Lecture 25 - Summary of the total course

Lecture 1 - Introduction

Lecture 2 - Deborah number

Lecture 3 - Response of Elastic solid

Lecture 4 - Response of Viscous fluid

Lecture 5 - Viscoelastic material

Lecture 6 - Creep and stress relaxation

Lecture 7 - Creep and stress relaxation functions

Lecture 8 - Linearity

Lecture 9 - Mechanical Analogues

Lecture 10 - Tutorial

Lecture 11 - Atoms and bonds

Lecture 12 - Interatomic bonds

Lecture 13 - Polymers

Lecture 14 - Polymers (Continued...)

Lecture 15 - Polymers (Continued...)

Lecture 16 - Freely jointed model

Lecture 17 - Constitutive equations

Lecture 18 - Constitutive equations (Continued...)

Lecture 19 - Constitutive equations (Continued...)

Lecture 20 - Viscoelastic effects

Lecture 21 - Lab Session

Lecture 22 - Polymer concentrations

Lecture 23 - Lagrangian and Eulerian perspectives

Lecture 24 - Maxwell model

Lecture 25 - Maxwell model (Continued...)

Lecture 26 - Kelvin-Meyer-Voigt model

Lecture 27 - Three parameter model

Lecture 28 - Three parameter model (Continued...)

Lecture 29 - Three parameter model (Continued...)

Lecture 30 - Jefferey's model

Lecture 31 - Two Maxwell model

[Lecture 32 - N-Maxwell model](#)

[Lecture 33 - N-Maxwell model \(Continued...\)](#)

[Lecture 34 - N-Kelvin Meyer Voigt model](#)

[Lecture 35 - Constitutive modelling](#)

[Lecture 36 - Objectivity](#)

[Lecture 37 - Objectivity](#)

[Lecture 38 - Sinusoidal oscillations](#)

[Lecture 39 - Sinusoidal oscillations \(Continued...\)](#)

[Lecture 40 - Sinusoidal oscillations \(Continued...\)](#)

[Lecture 41 - Summary](#)

[Lecture 42 - Tutorial](#)

[Lecture 43 - Tutorial \(Continued...\)](#)

Lecture 1 - Introduction, Types and Classification of Robots

Lecture 2 - Main Elements of a Robot

Lecture 3 - Modelling and Analysis of Robots

Lecture 4 - Mathematical Preliminaries, Homogeneous Transformations

Lecture 5 - Elements of robot - Joints, Elements of robots - Links

Lecture 6 - Examples of D-H parameters and Link transformation matrices

Lecture 7 - Introduction, Direct Kinematics of Serial Robots

Lecture 8 - Inverse Kinematics of Serial Robots

Lecture 9 - Inverse Kinematics of Serial Robots with  $n < 6$ , Inverse Kinematics of Serial Robots with  $n > 6$

Lecture 10 - Elimination Theory and Solution of Non-linear Equations, Inverse Kinematics of a General 6R Robot

Lecture 11 - Introduction, Loop-closure Equations

Lecture 12 - Direct Kinematics of Parallel Manipulators

Lecture 13 - Mobility of Parallel Manipulators

Lecture 14 - Inverse Kinematics of Parallel Manipulators

Lecture 15 - Direct Kinematics of Stewart Platform Manipulators

Lecture 16 - Sun tracking using 3-DOF parallel manipulator

Lecture 17 - Stewart-Gough platform-based force-torque sensor

Lecture 18 - Vibration isolation using a Stewart-Gough platform

Lecture 19 - Introduction, Linear and Angular Velocity of Links

Lecture 20 - Serial Manipulator Jacobian Matrix

Lecture 21 - Parallel Manipulator Jacobian Matrix

Lecture 22 - Singularities in Serial and Parallel Manipulators

Lecture 23 - Statics of Serial and Parallel Manipulators

Lecture 24 - Hyper-redundant robots

Lecture 25 - Redundancy resolution in human arm

Lecture 26 - Flexible robots

Lecture 27 - Introduction, Lagrangian formulation

Lecture 28 - Examples of Equations of Motion

Lecture 29 - Inverse Dynamics and Simulation of Equations of Motion

Lecture 30 - Recursive Formulations of Dynamics of Manipulators

Lecture 31 - Motion planning

[Lecture 32 - Control of a single link](#)

[Lecture 33 - Control of a multi-link serial manipulator](#)

[Lecture 34 - Control of a multi-link manipulator](#)

[Lecture 35 - Control of constrained and parallel manipulator, Cartesian control of serial manipulators](#)

[Lecture 36 - Force control of manipulators, Hybrid position/force control of manipulators](#)

[Lecture 37 - Advanced topics in non-linear control of manipulators](#)

[Lecture 38 - Wheeled Mobile Robots \(WMR\) on Flat Terrain](#)

[Lecture 39 - Wheeled Mobile Robots \(WMR\) on Uneven Terrain](#)

[Lecture 40 - Kinematics and Dynamics of WMR on Uneven Terrain](#)

[Lecture 41 - Over-Constrained Mechanism and Deployable Structures](#)

[Lecture 42 - Kinematic and Static Analysis](#)

Lecture 1 - The longitudinal wave in vibrating spring

Lecture 2 - Harmonically excited systems

Lecture 3 - The concept of coincidence frequency

Lecture 4 - A classical problem in sound-structure interaction

Lecture 5 - Classical problem (Continued...)

Lecture 6 - Uncoupled solution to the classical problem

Lecture 7 - Uncoupled solution (Continued...).

Lecture 8 - Introduction to the coupled problem.

Lecture 9 - The coupled roots

Lecture 10 - Physical meaning of terms

Lecture 11 - Derivation of coupled roots using asymptotic method

Lecture 12 - Coupled roots derivation (Continued...)

Lecture 13 - Regions of heavy and light fluid loading

Lecture 14 - Light and heavy fluid loading (Continued...)

Lecture 15 - The coupled vibration field

Lecture 16 - The coupled acoustic field and stationary phase

Lecture 17 - The 2-D structural-acoustic waveguide

Lecture 18 - The coupled partial differential equations

Lecture 19 - Derivation of the coupled dispersion equation

Lecture 20 - A schematic of coupled waves

Lecture 21 - Derivation of coupled waves using asymptotic method

Lecture 22 - Asymptotic method (Continued...) and Maple demo

Lecture 23 - Physics of the coupled waves

Lecture 24 - Critical points

Lecture 25 - Heavy fluid loading

Lecture 26 - Summary of the rectangular waveguide

Lecture 27 - Impedance and mobility

Lecture 28 - Derivation of acoustic and vibration response

Lecture 29 - Derivation of vibro-acoustic response (Continued...)

Lecture 30 - Derivation of vibro-acoustic response (Continued...)

Lecture 31 - Numerical example

- Lecture 32 - Coupled resonance analysis using matrices
- Lecture 33 - Coupled resonance analysis (Continued...)
- Lecture 34 - Sound radiation from a baffled panel
- Lecture 35 - Derivation of pressure response.
- Lecture 36 - Radiation efficiency
- Lecture 37 - Physics of volume velocity cancellation
- Lecture 38 - Derivations in the frequency domain: 1-D
- Lecture 39 - Physics of the vibration spectrum in 2-D
- Lecture 40 - Modal character across the frequency range
- Lecture 41 - Simultaneous radiation from several modes
- Lecture 42 - Panel radiation model using monopoles
- Lecture 43 - Physics of panel radiation using monopole model
- Lecture 44 - Physics of panel radiation using monopole model (Cointinued...)
- Lecture 45 - Radiation resistance derivation from Maidanikâ€™s work (Continued...)
- Lecture 46 - Radiation resistance derivation from Maidanikâ€™s work (Continued...)
- Lecture 47 - Radiation resistance derivation from Maidanikâ€™s work (Continued...)
- Lecture 48 - Modal average radiation efficiency
- Lecture 49 - Modal average radiation efficiency (Cointinued...)
- Lecture 50 - Transmission of sound through a rigid panel with flexible mounts
- Lecture 51 - Frequency dependence of sound transmission
- Lecture 52 - Sound transmission through a flexible partition
- Lecture 53 - Transmission loss in different situations
- Lecture 54 - Cylindrical shell vibration
- Lecture 55 - Behavior of uncoupled shell waves
- Lecture 56 - Fluid waves in rigid-walled cylindrical shells
- Lecture 57 - Wave propagation characteristics in flexible cylindrical shells carrying fluid: Fullers paper
- Lecture 58 - Wave impedance of an infinite plate: fluid loading
- Lecture 59 - Fluid loading in a finite plate
- Lecture 60 - Summary of the entire course

- Lecture 1 - Introduction to differential geometry
- Lecture 2 - Properties of surfaces: First fundamental form
- Lecture 3 - Properties of surfaces: Second fundamental form
- Lecture 4 - Surfaces of revolution
- Lecture 5 - Gauss Codazzi relations
- Lecture 6 - Gauss Codazzi (Continued...)
- Lecture 7 - Differential element length in a thin shell
- Lecture 8 - Strain of a differential element
- Lecture 9 - Explicit strain expressions
- Lecture 10 - Love simplifications and inconsistencies Of the theory
- Lecture 11 - Euler Bernoulli Beam equation using the Hamilton's Law
- Lecture 12 - Euler Bernoulli Beam and Hamilton's Law (Continued...)
- Lecture 13 - Beta definition, force and moment resultants
- Lecture 14 - Hamilton's Law for a general shell
- Lecture 15 - The Hamilton's law (Continued...)
- Lecture 16 - Final Dynamical Equations and boundary conditions
- Lecture 17 - Physics of each term in the dynamic equations
- Lecture 18 - Physics of each term (Continued...)
- Lecture 19 - The sixth equation of motion
- Lecture 20 - The sixth equation of motion (Continued...)
- Lecture 21 - Equations of motion for a rectangular plate using Hamilton's law
- Lecture 22 - Equations of motion for a rectangular Plate (Continued...)
- Lecture 23 - Rectangular plate boundary conditions
- Lecture 24 - Rectangular plate equation using force balance
- Lecture 25 - Modeshapes and resonances of a vibrating beam
- Lecture 26 - Modeshapes and resonances of a vibrating Rectangular plate
- Lecture 27 - Modeshapes and resonances of a vibrating Circular plate
- Lecture 28 - Vibrating circular plate (Continued...)
- Lecture 29 - Modeshapes and resonances of a vibrating Circular ring
- Lecture 30 - Details of vibrating rings
- Lecture 31 - Insights into vibrations of ring



- Lecture 32 - Cylindrical shell equations of motion using Force balance
- Lecture 33 - Cylindrical shell: Transverse equation of motion
- Lecture 34 - Orthogonality of modeshapes
- Lecture 35 - Orthogonality of Modes (Continued...)
- Lecture 36 - The Rayleigh Quotient
- Lecture 37 - Rayleigh Quotient Example: Simply-supported beam
- Lecture 38 - The Rayleigh Ritz method
- Lecture 39 - The Rayleigh Ritz method applied to a Complicated system
- Lecture 40 - The Lagrange Multiplier method
- Lecture 41 - The penalty method
- Lecture 42 - Orthogonal polynomials of RB Bhat
- Lecture 43 - Rayleigh Ritz paper by RB Bhat
- Lecture 44 - Numerical examples of the Rayleigh Ritz method
- Lecture 45 - Numerical examples of Rayleigh Ritz method And animations
- Lecture 46 - Rayleigh Ritz applied to curved structures
- Lecture 47 - Forced response of plates and shells
- Lecture 48 - Forced response (Continued...)
- Lecture 49 - Simply-supported plate response to various forces
- Lecture 50 - Simply-supported plate response to various Forces (Continued...)
- Lecture 51 - Simply-supported cylindrical shell response to a Point harmonic force
- Lecture 52 - Cylindrical shell response (Continued...)
- Lecture 53 - Cylindrical shell response (Continued...)
- Lecture 54 - Cylindrical shell response to a traveling load using Only transverse modes
- Lecture 55 - The Receptance method
- Lecture 56 - The receptance method (Continued...)
- Lecture 57 - Stiffening a cylindrical shell using rings
- Lecture 58 - Stiffening of a cylindrical shell (Continued...)
- Lecture 59 - Damping in structures
- Lecture 60 - Loss factor and Complex Young modulus

Lecture 1 - Introduction to Course

Lecture 2 - Position and Orientation of a Rigid Body

Lecture 3 - Homogenous Transformation

Lecture 4 - Linear and angular velocity of rigid body

Lecture 5 - Motion of Rigid Body and Particles

Lecture 6 - Introduction to multi-body systems

Lecture 7 - Joints, Degrees of Freedom and Constraints

Lecture 8 - Position, Velocity and Acceleration in Multi-body Systems

Lecture 9 - Mass and Inertia of a Rigid Body

Lecture 10 - External forces and moments

Lecture 11 - Angular momentum, Spinning tops and Gyroscopes

Lecture 12 - Free-body diagram and Equations of motion

Lecture 13 - Newton-Euler Formulation for Serial Chains

Lecture 14 - Lagrangian Formulation

Lecture 15 - Examples of Equations of Motion

Lecture 16 - Equations of Motion Using Computer Tools

Lecture 17 - Introduction and Examples of equations of motion

Lecture 18 - Inverse dynamics and Simulations of equations Of motion

Lecture 19 - Simulation using Computer Tools

Lecture 20 - Introduction and Goal of control

Lecture 21 - State Space Formulation

Lecture 22 - Solution of State Equations

Lecture 23 - Stability of Dynamical Systems

Lecture 24 - Controllability and Observability of Linear Systems

Lecture 25 - Examples of Controllability and Observability

Lecture 26 - Introduction to Classical Control

Lecture 27 - Root Locus

Lecture 28 - Frequency Domain Approach

Lecture 29 - PID Control

Lecture 30 - Root Locus based Controller Design

Lecture 31 - State Space Design



- Lecture 1 - Introduction
- Lecture 2 - Mathematical Preliminaries - I
- Lecture 3 - Tensors and Deformations
- Lecture 4 - Lagrangian and Eulerian Perspectives
- Lecture 5 - Mathematical Preliminaries - II
- Lecture 6 - Image Processing Preliminaries
- Lecture 7 - Image Processing Operations
- Lecture 8 - Light Matter Interaction - I
- Lecture 9 - Lab Demo I: Optical Microscope
- Lecture 10 - Optical System: Lenses
- Lecture 11 - Lab Demo II: Lenses and Camera
- Lecture 12 - Light Matter Interaction - II (Lab Demonstration)
- Lecture 13 - Light Matter Interaction - II (Lab Demonstration)
- Lecture 14 - Tracer Particles for Flow Visualisation
- Lecture 15 - Particle Tracking Velocimetry
- Lecture 16 - Particle Image Velocimetry - I
- Lecture 17 - Particle Image Velocimetry - II
- Lecture 18 - Particle Image Velocimetry - III
- Lecture 19 - Particle Image Velocimetry - IV
- Lecture 20 - Particle Image Velocimetry - V
- Lecture 21 - Particle Image Velocimetry - VI
- Lecture 22 - Schlieren and Shadowgraphy
- Lecture 23 - Lab Demo III: PIV and Schlieren
- Lecture 24 - Introduction to optical methods for solids
- Lecture 25 - Basics of Digital Image Correlation
- Lecture 26 - Iterative implementation of DIC
- Lecture 27 - Example implementations
- Lecture 28 - How is a DIC experiment set up ?
- Lecture 29 - DIY(C)!
- Lecture 30 - Introduction to Photoelasticity
- Lecture 31 - Why do we see fringes ?

[Lecture 32 - How does light interact with matter ?](#)

[Lecture 33 - Origin of Birefringence](#)

[Lecture 34 - Loaded sample in a polarizer](#)

[Lecture 35 - Stress-induced birefringence](#)

[Lecture 36 - Analyses of optical paths using matrix methods](#)

[Lecture 37 - Putting it all together](#)

[Lecture 38 - What is tomography ?](#)

[Lecture 39 - Signal processing and Fourier methods](#)

[Lecture 40 - Rays and the Radon transforms](#)

[Lecture 41 - Geometric interpretations](#)

[Lecture 42 - The inverse problem: From Radon transform to 2D cross-section](#)

[Lecture 43 - Cone beams, parallel beams and the Feldkamp algorithm](#)

- Lecture 1 - Introduction to Statistical Thermodynamics
- Lecture 2 - Basic Probability Theory and Statistics
- Lecture 3 - Important Probability Distributions
- Lecture 4 - Combinatorial Analysis for Statistical Thermodynamics
- Lecture 5 - Basic Concepts
- Lecture 6 - Macrostates and Microstates
- Lecture 7 - Bose Einstein and Fermi Dirac Statistics
- Lecture 8 - Entropy and the equilibrium particle distribution
- Lecture 9 - Operator Theory - 1
- Lecture 10 - Stirling Approximation and Lagrange Multipliers
- Lecture 11 - Equilibrium particle distribution
- Lecture 12 - The Dilute Limit and Concept of Molecular Partition Function
- Lecture 13 - The Molecular Partition Function and its relationship with Classical Thermodynamics
- Lecture 14 - Historical Survey of Quantum Mechanics
- Lecture 15 - Operator Theory - 2
- Lecture 16 - Operator Theory - 3
- Lecture 17 - Bohr Model for the Spectrum of Atomic Hydrogen
- Lecture 18 - Heuristic Introduction to the Schrodinger Equation
- Lecture 19 - The postulates of Quantum Mechanics
- Lecture 20 - The Steady State Schrodinger Equation: Single Particle Analysis
- Lecture 21 - Coordinate System - 1
- Lecture 22 - Coordinate System - 2
- Lecture 23 - Coordinate System - 3
- Lecture 24 - The Steady State Schrodinger Equation: Multiparticle analysis
- Lecture 25 - The Particle in a Box
- Lecture 26 - The Uncertainty Principle
- Lecture 27 - The Pauli Exclusion and the Correspondence Principle
- Lecture 28 - Problem Solving - 1
- Lecture 29 - Problem Solving - 2
- Lecture 30 - The Internal Motion for a two particle system
- Lecture 31 - The rotational and vibrational energy mode for a diatomic molecule

- Lecture 32 - Hermite polynomials as vibrational energy mode solution
- Lecture 33 - Equivalent two body model of atomic hydrogen
- Lecture 34 - The Electronic Energy Mode for Atomic Hydrogen
- Lecture 35 - Problem Solving - 3
- Lecture 36 - The four quantum numbers and multielectron systems
- Lecture 37 - Spectroscopic term symbols for multielectron atoms
- Lecture 38 - Electron energies for multielectron systems
- Lecture 39 - Combined energy modes for atoms and diatomic molecules
- Lecture 40 - Perturbation analysis of the Schrodinger Wave equation
- Lecture 41 - Selection rules
- Lecture 42 - The Rotational and vibrational spectroscopy
- Lecture 43 - Ro-vibrational spectroscopy (Simplex model)
- Lecture 44 - Rotation vibration coupling (Complex model)
- Lecture 45 - Ro-vibrational spectroscopy (Complex model)
- Lecture 46 - Ro-vibronic spectroscopy
- Lecture 47 - Working with Spectroscopic Schemes, Notations and Term Symbols
- Lecture 48 - From Particles to assembly - I
- Lecture 49 - From Particles to assembly - II
- Lecture 50 - Connecting Quantum Mechanics to Classical Mechanics
- Lecture 51 - The Equipartition principle and ideal gas
- Lecture 52 - Thermodynamic properties of ideal monoatomic and diatomic gas
- Lecture 53 - The zero of energy (rotational and vibrational)
- Lecture 54 - Specific heats, Internal energy through Vibrational and Ro-vibrational energy modes
- Lecture 55 - The Ro-vibrational partition function and Introduction to intersction of Radiationand Matter
- Lecture 56 - Absorption and Emission of Radiation
- Lecture 57 - The Rabi frequency and Beer's Law
- Lecture 58 - Insights into radiative spectral transitions
- Lecture 59 - Theory of Absorption Spectroscopy