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

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[Lecture 38 - Solid Modeling](#)

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

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

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

[Lecture 45 - Parametric Cubic Curve](#)

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[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

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

[Lecture 34 - Forecasting](#)

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

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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](#)

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[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

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- 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



- Lecture 1 - Introduction to Tribology
- Lecture 2 - Tribological Interfaces
- Lecture 3 - Fundamentals of Friction and Wear
- Lecture 4 - Adhesion, Abrasion, and Surface Fatigue Mechanisms
- Lecture 5 - Wear Measurement Techniques
- Lecture 6 - Principles of Lubrication, types of Lubricants and their properties
- Lecture 7 - Lubrication regimes and film thickness calculations
- Lecture 8 - Mixed Lubrication
- Lecture 9 - Hydrodynamic Lubrication Theory
- Lecture 10 - Design Considerations for Hydrodynamic Lubrication Systems
- Lecture 11 - Elastohydrodynamic Lubrication
- Lecture 12 - Solid Lubrication
- Lecture 13 - Surface modification techniques for tribological applications
- Lecture 14 - Thin film coatings and their tribological properties
- Lecture 15 - Nanotribology
- Lecture 16 - Tribocorrosion
- Lecture 17 - Wear testing techniques and standards
- Lecture 18 - Measurement and analysis of wear debris
- Lecture 19 - Experimental Design and Statistical Analysis
- Lecture 20 - Introduction to Data-Enabled Engineering
- Lecture 21 - Data Collection and Preprocessing
- Lecture 22 - Feature Extraction and Selection
- Lecture 23 - Introduction to Machine Learning Algorithms
- Lecture 24 - Regression and Classification Algorithms for Tribological Modeling
- Lecture 25 - Deep Learning for Tribological Engineering
- Lecture 26 - Data-Driven Models for Friction Prediction
- Lecture 27 - Data-Driven Models for Wear Prediction
- Lecture 28 - Data-Driven Models for Lubricant Optimization
- Lecture 29 - Data-Driven Models for Tribofilm Formation
- Lecture 30 - Data-Driven Models for Tribocorrosion Prediction
- Lecture 31 - Prediction of Coating and Surface Treatment Performance

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[Lecture 33 - Uncertainty Quantification and Sensitivity Analysis](#)

[Lecture 34 - Data Management and Ethics in Data-Enabled Engineering](#)

[Lecture 35 - Case Studies in Data-Enabled Tribological Engineering](#)

[Lecture 36 - Future Directions in Data-Enabled Tribological Engineering](#)

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](#)

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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](#)

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[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](#)

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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

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Lecture 8 - Cables

Lecture 9 - Friction

Lecture 10 - Application of Friction - Part 1

Lecture 11 - Application of Friction - Part 2

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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](#)

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

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- 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](#)

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

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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

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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](#)

Lecture 1 - Introduction to sheet forming and tensile test of sheets

Lecture 2 - Tensile test, effect of properties, exercise problem

Lecture 3 - Sheet deformation processes

Lecture 4 - Sheet deformation processes (Continued...)

Lecture 5 - Sheet deformation processes (Continued...)

Lecture 6 - Sheet deformation in plane stress

Lecture 7 - Sheet deformation in plane stress (Continued...)

Lecture 8 - Stamping analyses

Lecture 9 - Load instability and tearing

Lecture 10 - Load instability and tearing

Lecture 11 - Formability testing of sheet metals

Lecture 12 - Sheet formability

Lecture 13 - Sheet formability (Continued...)

Lecture 14 - Bending of sheets

Lecture 15 - Bending of sheets (Continued...)

Lecture 16 - Cup deep drawing

Lecture 17 - Deep drawing, redrawing, ironing of cup

Lecture 18 - Stretching of sheet

Lecture 19 - Hydroforming

Lecture 20 - Yield functions with sheet anisotropy

Lecture 21 - Demonstration of sheet forming experiments

Lecture 1 - Thermodynamics Concepts - Part I

Lecture 2 - Thermodynamics Concepts - Part II

Lecture 3 - Thermodynamic Analysis of Vapor Power Cycle

Lecture 4 - Rankine Cycle

Lecture 5 - Modified Rankine Cycle

Lecture 6 - Exergy Analysis of Vapor Power Cycles

Lecture 7 - Rotodynamic Machines

Lecture 8 - Impulse Turbine

Lecture 9 - Reaction Turbine

Lecture 10 - Performance Analysis of Steam Turbines

Lecture 11 - Steam Nozzles - Part I

Lecture 12 - Steam Nozzles - Part II

Lecture 13 - Steam Generator

Lecture 14 - Water Tube Boiler - Part I

Lecture 15 - Water Tube Boiler - Part II

Lecture 16 - Fuels and Combustion - Part I

Lecture 17 - Fuels and Combustion - Part II

Lecture 18 - Steam Condenser

Lecture 19 - Feed Water Heaters

Lecture 20 - Cooling Towers

Lecture 21 - Fundamentals of Gas turbine systems

Lecture 22 - Modifications of Brayton cycle

Lecture 23 - Combined Power cycle

Lecture 24 - Gas Turbines for Aircraft Propulsion

Lecture 25 - Hydro-Power System - Part I

Lecture 26 - Hydro-Power System - Part II

Lecture 27 - Wind Energy - Part I

Lecture 28 - Wind Energy - Part II

Lecture 29 - Energy From Oceans - Part I

Lecture 30 - Energy From Oceans - Part II

Lecture 31 - Geothermal Energy

[Lecture 32 - Energy Storage - I](#)

[Lecture 33 - Energy Storage - II](#)

[Lecture 34 - Energy Storage - III](#)



- Lecture 1 - Introduction to phase diagrams
- Lecture 2 - Thermodynamic relations
- Lecture 3 - Single component system and binary solutions
- Lecture 4 - Regular solutions
- Lecture 5 - Real solutions
- Lecture 6 - Phase transformations
- Lecture 7 - Practice problems (Module 1)
- Lecture 8 - Introduction to homogenous nucleation process
- Lecture 9 - Fundamental to heterogeneous nucleation
- Lecture 10 - Growth of pure metal
- Lecture 11 - Alloy solidification
- Lecture 12 - Formation of different S/L interface
- Lecture 13 - Solidification structures and segregation
- Lecture 14 - Weld Metal Solidification and Microstructure - I
- Lecture 15 - Weld Metal Solidification and Microstructure - II
- Lecture 16 - Solidification of additive manufacturing - I
- Lecture 17 - Solidification of additive manufacturing - II
- Lecture 18 - Rate of solidification-sand casting
- Lecture 19 - Rate of solidification-die casting
- Lecture 20 - Riser design and solidification of pure metal
- Lecture 21 - Zone melting and rapid solidification
- Lecture 22 - Semisolid processing and other solidification techniques
- Lecture 23 - Demonstration of the solidification process and numerical problems

**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](#)

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[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](#)

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[Lecture 15](#)

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[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

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

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

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- Lecture 3 - Strategies, Active control, Detuning and Decoupling
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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)

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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

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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...)

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Lecture 28 - Atomic mechanism of growth

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- [Lecture 33 - Eutectic: Solidification](#)
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- [Lecture 35 - Solidification of casting / ingot](#)
- [Lecture 36 - Precipitation hardenable alloy](#)
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- [Lecture 46 - Recovery, Recrystallization and Grain growth](#)
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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...)

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[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)

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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](#)

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

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**NPTEL : Micro fluidics (Mechanical Engineering)**

**Co-ordinators : Prof. S. Chakraborty**

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[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](#)

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[Lecture 62](#)

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[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 \(Continued...\)](#)
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- [Lecture 39 - Components of machine tool \(Continued...\)](#)
- [Lecture 40 - Components of machine tool \(Continued...\)](#)
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- [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](#)

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# 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**

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Lecture 17 - Milling machine - indexing

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Lecture 19 - CNC and non-traditional machining methods

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**NPTEL : Rocket Propulsion (Mechanical Engineering)**

**Co-ordinators : Prof. K. Ramamurthi**

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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

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Lecture 12 - Blast Waves: Damage from Blast Waves, Examples, Multiple Spikes in an Impulse, Iso-damage Curve on an Overpressure-Impulse Diagram, Complex Structures

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Lecture 10 - Terminologies of limits fits and tolerances

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- Lecture 10 - Analysis of the truss system
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- Lecture 5 - Concepts of BL thickness (?)
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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](#)

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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](#)

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[Lecture 37 - Two phase Heat transfer in Microchannels - Part 1](#)

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[Lecture 39 - Nano fluid Heat transfer - Part 1](#)

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[Lecture 41 - Measurement techniques in Micro and Nanoscale Heat transfer - Part 1](#)

[Lecture 42 - Measurement techniques in Micro and Nanoscale Heat transfer - Part 2](#)

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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](#)

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[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](#)

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[Lecture 34 - Module 29 - Spherical Waves](#)

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[Lecture 36 - Module 31 - Inhomogeneous Wave Equation](#)

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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

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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](#)

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[Lecture 36 - Role of Chemistry on Bulging or Depression Tendency - Part I](#)

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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](#)

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[Lecture 37 - Determination of Single Crystal Orientation by X-Rays](#)

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[Lecture 39 - Factors Contributing to Peak Broadening](#)

[Lecture 40 - Residual Stress Measurement by X-Rays](#)

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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](#)

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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](#)

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[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](#)

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[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

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[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

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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](#)

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**NPTEL : Metal Casting (Mechanical Engineering)**

**Co-ordinators : Dr. D. B. Karunakar**

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Lecture 2 - Flow Regimes

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Lecture 6 - Dispersed Flow

Lecture 7 - Slug Flow

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Lecture 9 - Droplet Annular and Stratified Flow

Lecture 10 - Measurement of Void Fraction

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Lecture 19 - Vpour Absorption Systems - 2

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- 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

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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

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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

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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

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Lecture 26 - Lesson 1 - Undamped free vibration

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Lecture 29 - Lesson 4 - Damped free vibration

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- 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
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- Lecture 11 - Newer variants of Gas tungsten arc welding
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- Lecture 18 - Fundamentals of resistance welding
- Lecture 19 - Resistance welding processes: spot and seam welding
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- Lecture 23 - Solid state joining technologies: Fundamentals
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- Lecture 27 - Magnetic pulse welding
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- Lecture 30 - Heat affected zone and weld thermal cycle - II
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- Lecture 32 - Metallurgical transformations in weld and heat affected zone of steels
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- Lecture 34 - Solidification cracking and their control
- Lecture 35 - Cracking of Welded Joints II - Cold Cracks
- Lecture 36 - Understanding Weldability Introduction - I
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- 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
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- Lecture 46 - Weldability Consideration
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- Lecture 53 - Weldability of HTLA Steel - I
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- 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

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- 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
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- Lecture 11 - Basic System Models - Mechanical Systems
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- Lecture 24 - System Transfer functions
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Lecture 3 - Solidification of Pure Metals and Alloys

Lecture 4 - Freeze Wave Mechanism and Solidification Time

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Lecture 7 - Allowances in pattern making

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Lecture 9 - Testing of molding sands

Lecture 10 - Sand preparation for casting

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Lecture 14 - Organic binders

Lecture 15 - Special moulding process

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Lecture 18 - Pouring time calculation

Lecture 19 - Aspiration effects in gating system

Lecture 20 - Problem solving on gating design

Lecture 21 - Solidification analysis

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Lecture 28 - Special casting process - 3

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Lecture 30 - Melting practices

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Lecture 24 - Impulse Steam Turbine Performance

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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

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Lecture 7 - Problem Identification and VEJP

Lecture 8 - Function analysis

Lecture 9 - Functional analysis system technique

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Lecture 11 - Quality function deployment

Lecture 12 - Computer aided design

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Lecture 14 - Design for X

Lecture 15 - Ergonomics in product design

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Lecture 19 - Rapid prototyping: concept, advantages

Lecture 20 - Rapid prototyping processes

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- 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
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- 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
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- 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
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- 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
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- Lecture 41 - Material Removal Processes: Tool materials
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- Lecture 43 - Material removal processes: Grinding - I
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- Lecture 57 - Improving surface properties: Introduction
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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

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Lecture 7 - Input probability distribution functions for discrete systems

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Lecture 9 - Continuous distribution functions and empirical distribution functions

Lecture 10 - Problem solving on statistical models in simulation

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Lecture 14 - Simulation of a single server queueing system

Lecture 15 - Computer representation of simulation of single server queuing system

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Lecture 17 - Issues and Challenges in Congruential Generators

Lecture 18 - Testing of random numbers

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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

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Lecture 29 - Confidence Intervals for comparing more than two systems

Lecture 30 - Problem Solving on output analysis of single and alternative systems

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# 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**

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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

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Lecture 12 - Extended Approaches for Working Microsystems

Lecture 13 - Non-conventional Approaches for Microsystems

Lecture 14 - Packaging of Microsystems

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Lecture 17 - Residual Stress and Stress Gradients

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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

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Lecture 26 - Theoretical Basis for the Finite Element Method

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Lecture 5 - Formulation of Calculus of Variations problems in geometry and mechanics and design - Part I

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Lecture 11 - Sufficient conditions for constrained minimization - Part I

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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

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Lecture 30 - General variation of a functional, transversality conditions. Broken extremals, Weierstrass-Erdmann corner conditions - Part I



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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

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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

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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

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Lecture 14 - Interface shapes

Lecture 15 - Transport processes at interface with key concepts - I

Lecture 16 - Transport processes at interface with key concepts - II

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Lecture 18 - Interfacial transport including dynamic behavior

Lecture 19 - Interface behavior

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Lecture 27 - Comprehensive droplet vaporization model and correlations - II

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[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