

Department of Mechanical Engineering

Courses under Minor Degree List

MOOCS Platform: NPTEL/SWAYAM

Sr.No.	Sem.	Name of Course	Teaching Scheme	Duration	Instructor	Organizing Institute	Credits
1	V	Industrial Safety Engineering	4Hrs/week	12 Weeks	Prof. Jhareswar Maiti	IIT Kharagpur	4
2	V	Basics of Materials Engineering	4Hrs/week	12 Weeks	Prof. Ratna Kumar Annabattula	IIT Madras	4
3	VI	Concepts of Thermodynamics	4Hrs/week	12 Weeks	Prof.Suman Chakraborty	IIT Kharagpur	4
4	VI	Mechanical Measurement Systems	4Hrs/week	8 Weeks	Prof. Ravi Kumar	IIT Roorkee	4
5	VII	Welding Processes	4Hrs/week	12 Weeks	Prof. Murugaiyan Amirthalangam	IIT Madras	4

Syllabus

Industrial Safety Engineering

Module 1:

Introduction to Industrial Safety Engineering, Key concepts and terminologies, Key concepts and terminologies-Safety domain ontology, Key concepts and terminologies-Risk Assessment & Control, Safety Engineering & Accident causing mechanisms

Module 2:

Preliminary Hazard List, Preliminary Hazard Analysis, Hazard and operability study (HAZOP), Failure Modes and Effects Analysis (FMEA) - Identification of Failure Modes, Application of Hazard Identification Techniques

Module 3:

FAULT TREE ANALYSIS (FTA) - Construction, FAULT TREE ANALYSIS (FTA) - Gate by Gate method, FAULT TREE ANALYSIS (FTA) - Cut-set method, FAULT TREE ANALYSIS (FTA): Importance measures, EVENT TREE ANALYSIS (ETA)

Module 4:

BOW-TIE TOOL, Bow-tie: Common Cause Cut Sets, Bow-tie: Cut-sets for Accident Scenarios, Bow-tie: Identification of Safety Barriers

Module 5:

Risk Assessment, Consequence Assessment, Energy Control Model and Hazard Control Hierarchy, Safety Function Deployment, Ranking of Design Solutions: AHP approach

Module 6:

Quantification of Basic Events for Non-repairable Components, Quantification of Basic Events - Hazard Rate, Quantification of Basic Events - Exponential Distribution, Quantification of Basic Events - Weibull Distribution

Module 7:

Quantification of Basic Events: Failure to Repair Process, Quantification of Basic Events: Combined Process, Quantification of Basic Events: Failure & Repair Intensities, Computation of combined process parameters: Laplace transform analysis, Computation of combined process parameters: Markov Analysis

Module 8:

Quantification of Systems Safety and Reliability Block Diagram, Systems Safety Quantification: Truth Table Approach, Systems Safety Quantification: Structure Function, Systems Safety Quantification: Minimal Cut and Minimal Path Representation Using Structure Function, Systems Safety Quantification: Tutorial

Module 9:

Human Error, Classification and Causes, Human Error Identification, Human Reliability Assessment, Human Error Quantification from Expert opinions by Fuzzy Set

Module 10:

Accident Investigation, Accident Investigation & Analysis: Descriptive Analytics, Control Chart Analysis, Accident Data Analysis: Regression, Accident Data Analysis: Classification Tree

Module 11:

Occupational Health & Safety Management Systems (OH&SMS) and OHSAS 18001-Part I, Part II, Part III, Safety Performance Indicators Part-I, Part-II, Energy Isolations

Module 12:

Virtual Reality- Introduction, Geometry of virtual world, VR roadmap-A case study, Summary

Basics of Materials Engineering

Module 1:

Introduction, Crystal Structure

Module 2:

Imperfections in solids

Module 3:

Imperfections in solids contd.

Module 4:

Mechanical properties of materials

Module 5:

Failure of Materials

Module 6:

Failure of Materials contd.

Module 7:

Basics of Fracture Mechanics

Module 8:

Fatigue failure theories

Module 9:

Fatigue failure theories

Module 10:

Phase diagrams

Module 11:

Phase diagrams contd.

Module 12:

Thermal Processing and Heat Treatment of Steels

Concepts of Thermodynamics

Module 1:

Fundamental definitions and concepts of Thermodynamics

Module 2:

Properties of pure substances

Module 3:

Work and heat

Module 4:

First law of thermodynamics for closed systems

Module 5:

First law of thermodynamics for closed systems-I

Module 6:

First law of thermodynamics for closed systems-II

Module 7:

Second law of thermodynamics

Module 8:

Entropy transfer for closed systems

Module 9:

Entropy transfer for open systems

Module 10:

Irreversibility and exergy

Module 11:

Thermodynamic Cycles : Air Standard Cycles, Vapour Power Cycles

Module 12:

Thermodynamics Cycles : Vapour Power Cycles (contd.), Refrigeration Cycles

Mechanical Measurement Systems

Module 1:

Basic concepts of measurement, Functional elements of instruments, Classification of measuring instruments, Methods of correction for interfering and modifying inputs, Static characteristics of measuring instruments-1

Module 2:

Static characteristics of measuring instruments-2, Loading effect and Impedance matching, Statistical analysis, Chi-square test, Least square method

Module 3:

Uncertainty analysis, Problem solving-1, Generalized model of a measuring system, Zero and first order system, First order system- step response

Module 4:

First order system- ramp response, First order system- impulse response, First order system- frequency response, Second order system- step response (1), Second order system- step response (2)

Module 5:

Second order system- ramp response, Second order system- impulse and frequency response, Higher order systems, Compensation, Transducers (1)

Module 6:

Transducers (2), Flow measurement (1), Flow measurement (2), Temperature measurement (1), Temperature measurement (2)

Module 7:

Strain gauges, Piezoelectric transducers, Pressure measurement, Force and torque measurement, Displacement and acceleration measurement

Module 8:

Sound measurement, Thermophysical properties measurement, Flow visualization, Air pollution sampling and measurement, Problem solving-2

Welding Processes

Module 1:

Introduction to the course, Classification of welding processes and definition of welding arc, Physics of welding arc - Part 01, Part 02, Part 03

Module 2:

Physics of welding arc -Part 04, Fundamentals of ionization in welding arc, Electrical conductivity of welding arc, Electrical resistivity of welding arc, Heat transfer inside the arc

Module 3:

Arc ignition mechanisms Part – I, Part – II, Principles of Gas Tungsten Arc Welding, Shielding gases for arc welding, Selection of shielding gases for engineering alloys

Module 4:

Arc welding power sources Part 01, Part 02, Part 03, Variations in GTAW process

Module 5:

Square wave, variable polarity, GTAW with filler, hot wire GTAW, Dual gas GTAW and Plasma Welding processes, Multi cathode GTAW and Activated GTAW, Buried GTAW and Rate controlling parameters of GTAW, Introduction to consumable welding processes

Module 6:

Melting rate of consumable wires, Physics of droplet transfer in consumable welding, Modes of droplet transfer - Part 1, Part 2, Part 3, Shielded Metal Arc Welding, Flux cored arc welding - Introduction

Module 7:

Electrode fluxes and process characteristics of flux cored arc welding, Flux cored arc welding - Process characteristics, Advances in gas metal arc welding - Pulsed GMAW, Advances in gas metal arc welding - Controlled dip short circuiting processes

Module 8:

Submerged arc welding, Resistance welding – Fundamentals, Resistance spot welding - Part 01, Part 02

Module 9:

Resistance spot welding - Part 03, Part 04, Variants in resistance welding - Part 1, Part 2

Module 10:

Laser welding process - Part 01, Part 02, Part 03, Part 04

Module 11:

Electron beam welding process, Other welding processes - Electroslag welding, Magnetically Impelled Arc Butt (MIAB) welding, Aluminothermic (thermit) welding, Introduction to solid state welding processes - Friction welding, Friction stir welding - Part 1

Module 12:

Friction stir welding - Part 2, Other solid state welding processes, Joining processes for Plastics - Part 1, Part 2, Adhesive bonding of plastics, Welding nomenclatures.